Chapter 1

BACKGROUND OF THE PROBLEM

Introduction

The eggs incubator is a device which can control the temperature and humidity for hatching process. By using eggs incubator, the quail does not need to incubate the egg manually. Thus, incubator device can help farmers to hatch an egg to produce the quail on a greater number. Researchers have to build the incubator for various egg, such as for chicken, quail, turtle, partridge, and others, for the incubating system, researchers developed an incubator to automate the adjustment system, such as the temperature, humidity and egg reversal, which was based on the microcontroller and IoT in this paper described as Quail Eggs Smart Incubator Using Arduino and Hatching System based on IOT**.** The incubator could control the temperature, humidity, and egg reversal automatically through Arduino microcontroller. In addition, the incubator was linked to Internet of Things (IoT) system using VNC' s software which could help the farmers in controlling and monitoring the smart incubator from distance. (Kumar, et al., 2021)

Agriculture was the key development in the rise of sedentary human civilization, whereby farming of domesticated species created food surpluses that enables people to live in cities. Poultry farmers were farmers that raise chickens, ducks, turkeys, and other birds of meat or egg production (New world Encyclopedia, 2019). Poultry farming used to involve raising quails in the backyard for daily egg production and family consumption. However, poultry farming was becoming a massive industry divided into several operations such as hatcheries, pullet farms, farms for meat production, and farms for egg production.

(Sanyaja, et al., 2018) developed a Quail Egg Smart Incubator for Eggs Hatching System. The incubator can monitor the temperature, humidity and reversal the quail eggs automatically based on Arduino microcontroller. In addition, the incubator was based on internet of things (IOT) system using VNC's software which helped the farmers to monitor the smart incubator from a distance. The quail egg smart incubator could be applied to hatching the quail egg at CV slamet quail farm, Sukabumi, Indonesia for 17th days incubate.

(Wendylove, 2019) poultry farmers had an incubator that used manual method of egg hatching. According to Felix Baculina, resident of Caridad, Dumingag, Zamboanga del Sur, incubators were pessential in poultry production for it is a current solution to the growing poultry industry. However, incubators used in Dumingag were only thermostat which was an aging device for temperature measurement only. It did not have the capability of detecting the real time measurement of the humidity. The main advantage of incubators were many chicks could be hatched at a time. In contrast, one of its disadvantages is long time absence of electric current may lead to egg spoilage. The manual incubator has 45% to 55% recorded success rate. (F. Baculina personal communication february 2019).

Quail generally takes 18 days to incubate, but they could hatch as early as day 16 or late as day 20. On day 14, we will need to stop turning the eggs. This means not only unplugging the automatic turner, but also removing the egg from the rails and placing them carefully on the hatching tray below the turner until it will hatch in the 18th day of incubation. Add additional water to the incubator, being careful not to spill in the egg or paper towels. You may notice some movement in the eggs at this point, and they should start pipping around day 15 or so. (Bohling., et al, 2020).

The use of Quail Egg Smart Incubator Using Arduino and Hatching System based on IOT could be a crucial aspect of poultry production. By using the desired application, this prototype could manage the time with less effort yet in a productive manner. This application could monitor the humidity and temperature of incubation to reduce the user's effort on visiting the incubator on regular bases. Even when the user was not near from the incubator, the user can utilize this technology to launch the application and modify the temperature and humidity inside the incubator.

Project Context

Quail Egg Smart Incubator using Arduino and Hatching System based on IOT was proposed for poultry farmers as aid for egg hatching. It would boost poultry quail production and to address the absence on temperature monitoring technology in our society. It would also shorten their time on evaluating the egg and the temperature inside the incubator. It would help the poultry farmers to hatch a large number of quail eggs that would not be achieved by the hen. To guarantee a

successful quail hatch, careful monitoring on the temperature and humidity of the incubator and correct turning of eggs as scheduled a must be done.

Purpose and Description

The main purpose of this project was to create a prototype of Quail Eggs Smart Incubator Using Arduino and Hatching System based on IOT that would use various sensors and a microcontroller chip to detect temperature and humidity (Arduino Uno Rev.3). Temperature Monitoring System for Quail Egg Incubator was proposed to monitor and hatch quail eggs. It was constructed with a close square box with exhaust fan, which would allow more consistent temperature and humidity inside as well as faster attainment of desirable and stable temperature, and humidity values when there is a disturbance or shift in ambient conditions. Furthermore, even afar from the incubator, farmers quickly know the changes of the temperature and humidity of an incubator using the application.

Objectives of the Study

The main objective of the project was to design and build a prototype Temperature Monitoring System for Quail Egg Incubator with sensor that could monitor the temperature and humidity using application. The system specifically aimed the following:

- To monitor the Temperature and Humidity of the incubator.
- To create a mobile application and webpage for monitoring of data.
- To send and record data readings to the cloud using via Wi-Fi module.
- To generate report on the temperature and humidity readings and status of other components.

Scope and Limitations

Quail Egg Smart Incubator using Arduino and Hatching System based on IOT was a system that collects data from microcontroller and send to IOT through Wi-Fi module. It only monitored the temperature and humidity through webpage and mobile application. When the eggs were hatched, chicks should be transferred manually out of the incubator and into their cage since that process is beyond the scope of this study.

The egg would be manually placed in the incubator. Candling required manpower to determine whether the egg was fertile or infertile. On the 14th day inside the incubator, the user should transfer the eggs to hatching tray with the same temperature range until they hatch on the 18th day.

Significance of the Study

This project was beneficial to the community especially to the following:

Poultry Farmers. Through this study they would no longer employ several people to look after the incubator since the owner or the handler could automatically monitor through their mobile app.

Personnel Working in Agriculture Sector. With this technology, the personnel working in agriculture sector could boost their production with reduced manpower which would consequently reduce labor cost. Further, it would be useful when they have tight schedule who does not have time to check on their incubator every now and then.

Future Researchers. This study would somehow guide them in doing their own researches related to this project.

Definition of Terms

12V Power Adapter- it is the primary function of power supply to convert electric current from a source to the correct voltage, current, and frequency to power the load. It will give power of current to Arduino to function it.

Arduino Uno- it is the brain of this system and all the sensors and display devices are controlled by it. Arduino is an open-source electronics platform based on easy-to-use hardware and software. You can tell your board what to do by sending a set of instructions on the board. It controlled incubator for quails' eggs during the incubation.

Bulb – it is an incubator act as broody quail which sits on the eggs and provide its body heat for chick hatching, it is also use as heat source and was installed inside the box in such a way that it was connected with the Digital Temperature controller.

Breadboard- it is a platform you can use to build and test electronic circuits, usually without having to do any soldering.

DHT11 Temperature and Humidity Sensor- it is a temperature and humidity sensor that comes with a specialized controller. The temperature is measured by an NTC, and the temperature and humidity measurements are output as serial data by an 8-bit microcontroller.

ESP8266/Wi-Fi module- it is a very user friendly and low-cost device to provide internet connectivity to your projects. The module can work both as an Access point (can create hotspot) and as a station (can connect to Wi-Fi), hence it can easily fetch data and upload it to the internet making Internet of Things as easy as possible. It can also fetch data from internet using API's hence your project could access any information that is available in the internet, thus making it smarter.

Exhaust Fan- it will speed up and slow down to maintain and control the pressure of the incubator. This is a far more energy efficient system than the fixed volume air supply because only the air that is required for the incubations inside the incubator will be condition.

Fan- it circulates the heat inside the incubator.

Jumper Wires- it is typically used with breadboards and other prototyping tools in order to make it easy to change a circuit as needed in the incubator.

LCD- it is enabled to display the temperature and humidity values in the egg incubator. It uses LCD module to minimize the number of cables connected to the Arduino pin.

Relay Module- it is a switch that open and close circuits electronically. Relays control one electrical circuit by opening and closing contacts in another circuit.

Synchronous Motor- it will rotate the eggs gently back and forth to keep the yolk sack from sticking to the shell and providing needed exercise for the developing embryo.

Chapter 2

REVIEW OF RELATED STUDIES AND SYSTEM

Technical Background

The Arduino platform has become increasingly popular among those who were new to electronics. It was an open source in both software and hardware specifications, allowing users to easily put together even the most basic Arduino modules. The goal of Arduino was to make learning how to program microcontrollers simple for software developers. Arduino Programming Language was used for the microcontroller interface based on the Arduino Uno r3, and Arduino IDE is a software based on processing. The Internet of Things (IOT) was used frequently in the technology world to describe everyday objects that are connected to the internet. The Arduino's small form factor allows it to be used in a variety of everyday objects. It would be possible to quickly prototype and experiment with interactive devices using the Arduino platform before generating a production-ready solution.

Hardware Specification

In the development of Quail Egg Smart Incubator using Arduino and Hatching System based on IOT, the following were the required hardware specification:

Arduino Uno

Arduino Uno was the brain of this system and all the sensors and display devices were controlled by it. Arduino was an open-source electronics platform based on easy-to-use hardware and software. You could tell your board what to do by sending a set of instructions on the board. It controlled incubator for quails' eggs during the incubation.

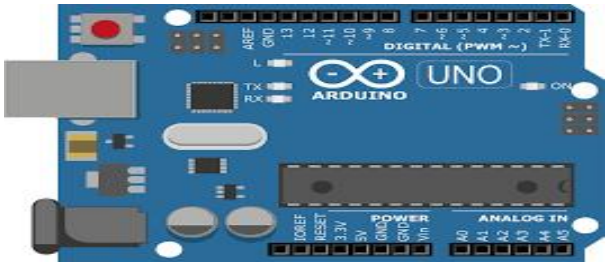

Figure 2.1 Arduino Uno

Bulb

It was the incubator that act as broody quail which sits on the eggs and provide its body heat for chick hatching. It is shown in Figure 2.2 as heat source and was installed inside the box in such a way that it was connected with the Digital Temperature controller.

Figure 2.2 Bulb

Bread Board

It was used to build and test electronic circuits, usually without having to do any soldering. As shown in Figure 2.3, it was also a current passage in order for all the components embedded in the system to function.

Figure 2.3 Breadboard

DHT11 Sensor

It was the temperature and humidity sensor that comes with a specialized controller. The temperature was measured by an NTC, and the temperature and humidity measurements were output as serial data by an 8-bit microcontroller.

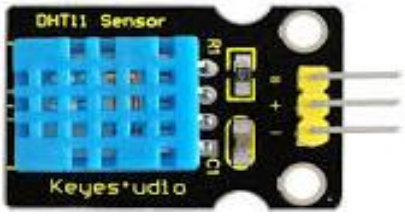

Figure 2.4 DHT11

Wi-Fi Module

The *ESP8266* was a very user friendly and low-cost device to provide internet connectivity to your projects. The module could work both as an Access point (can create hotspot) and as a station (can connect to Wi-Fi), hence it could easily fetch data and upload it to the internet making Internet of Things as easy as possible. It could also fetch data from internet using API's hence your project could access any information that was available in the internet, thus making it smarter. Figure 2.5 shows the Wi-Fi module. It would sent data to the webpage and mobile application via ThingSpeak.com.

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Figure 2.5 ESP8266 Wifi Module

Exhaust Fan

It would speed up and slow down to maintain and control the pressure of the incubator. This was a far more energy efficient system than the fixed volume air supply since only the air required for the incubations would be conditioned.

Figure 2.6 Exhaust Fan

Jumper Wire

These were typically used with breadboards and other prototyping tools in order to make it easy to change a circuit as needed in the incubator.

Figure 2.7 Jumper Wire

LCD

It enabled to display the temperature and humidity values in the egg incubator. It used LCD module to minimize the number of cables connected to the Arduino pin. As shown in Figure 2.8, the LCD display the temperature, humidity and egg turner status inside the incubator.

Figure 2.8 LCD

Relay Module

Relay**s** were switching that open and close circuits electronically. As shown in Figure 2.9 relays control one electrical circuit by opening and closing contacts in another circuit.

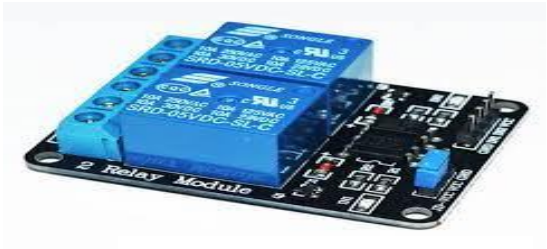

Figure 2.9 Relay Module

Synchronous Motor

It would rotate the eggs gently back and forth to keep the yolk sack from sticking to the shell and providing needed exercise for the developing embryo.

Figure 2.10 Synchronous Motor

12V Power Adapter

The power adapter was the primary power supply to convert electric current from a source to the correct voltage, current, and frequency to power the load. It would give power of current to Arduino for it to function.

Figure 2.11 12V Power Adapter

Fan

It would circulate the heat inside the incubator. As shown in Figure 2.12

Figure 2.12 Fan

Software Specification

Arduino Uno was the brain of the system which could regulate the sensors in the incubator. The Wi-Fi Module would deliver data to the cloud/IOT that could collect data from the microcontroller. The homepage was connected to the Internet of Things, which collected data from Thingspeak and displayed a graph of temperature and humidity. As it was connected to IOT, the mobile application would monitor the status of the incubator and the user will no longer need to visit the webpage. All of this software was linked to the Incubator Monitoring System.

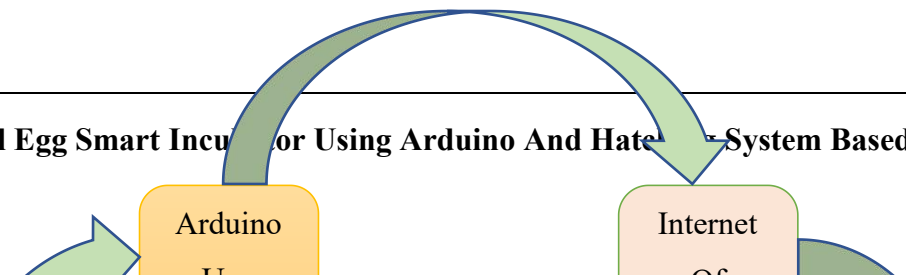

Figure 2.13 Software Specification

Programming Environment

Arduino Integrated Development (IDE) called sketches was used for formatting codes, checking syntax, and uploading programs. The commands that were found in this IDE were verify, upload, new, open, save, serial monitor, file, edit, sketch and tools. The webpage for the proposed project was also developed using Java script, with HTML and Bootstrap used to build and style the page. MIT App Inventor was a web-based platform that teaches computational thinking concepts through mobile app development. Developers create apps by dragging and dropping components into a design view and using a visual blocks language to program the application's behavior**.**

Related Studies

Foreign Studies

In Malaysia, Recent advanced development on IOT technology has driven many low-cost innovative projects within broad fields. Take for example, the recent development on displaying whether pulse rate is normal or not and water level indicator for resident's early warnings. The same things also happen in agriculture and farming fields. Omar et al (2019) designed Smart Egg Incubator System based on Arduino Uno and use water and fan to control the humidity and ventilation. Separately, Sanyaja et al (2018) develop smart incubator based on Arduino for quail eggs. Azahar et al (2020) also developed a system which successfully hatch a quail eggs normally with 87.55% success rate over 490 eggs during 17 days incubation period.

Based on the previous studies, there were several types of incubator designed (Obidiwe et al., 2014; Desha et al., 2015. There were three types of incubators, which are manual, semi-automatic or fully automatic, depending on its application (Omar et al., 2016; Okpagu et al., 2016). Basically, forced-air and still-air incubator were implemented in the incubator. Forced-air incubators included fans that could provide virtuous air circulation, while still-air was the opposite. Therefore, force-air type (Adegbulugbe, Atere, & Fasanmi, 2013) was widely used due to the ability to circulate the air and maintain the heat level, humidity and the internal content of oxygen (Adegbulugbe et al., 2013). The optimum temperature was different between these two types of incubator which were 37.5 – 39.4℃ for still air incubator and 37.5℃ for forced air incubators (Romao et al., 2008). In addition, the humidity was also significant in providing sufficient moisture to certify the warm atmosphere of the incubator machine (Agboola et al., 2013). Incorrect setting of humidity and temperature would lead to the failure of hatching process of the eggs.

Conventionally, most of the incubators were designed in analogue systems. The stability of temperature and humidity was controlled and monitored manually by human or farmers. This analogue system was quite difficult to operate and increases the time of hatching process thus, slowing the production of quail eggs. Furthermore, this analogue system also encountered common problems such as premature hatching, late hatching, and piped egg with no hatching, blood rings and dead embryos that occur at primary stage of embryonic growth (Ogunwande et al., 2015). The

premature hatching was due to high temperature, which was more than 40℃, while late hatching was caused by low temperature. Besides, there were two factors that affect the pipe egg hatching which were; unsuitable ventilation and low humidity due to the inadequate moisture of the incubator. Other than that, the blood ring of the eggs' problem occured due to the instability of temperature control (Lourens, 2005; Ipek, 2015). Lastly, the embryos might die during the primary stage due to the faulty in turning the egg and imprecise ventilation (Romao, Moraes et al., 2010).

The objective of this paper was to design, model and develop quail egg incubation and hatching system that was capable to control the stability of temperature and humidity of the incubator within the temperature range of 37 to 40℃. The focus of this project was to develop a cost-effective incubator machine with good operating systems. To achieve this objective, ArduinoAtMega328p microcontroller has been utilized in this project to control and operate the whole systems automatically.

According to Dyah Anggraeni et al (2018) an egg should be revolved for six minutes in every 4 hours to avoid the developing chick from sticking to the shell. Egg quality was one in all the success factors to hatch. If the egg quality was bad, the chance for the egg to hatch would be low. Thus, before the egg progressing to incubation process, the farmer should check the egg quality first.

In the research work of Ackerman, et al. (2011) a cost- effective embedded model of bird egg incubator was developed that contained a smart sensor for monitoring temperature and humidity. It was incorporated with tilting mechanism for tilting the eggs at an angle of 45^0 alternatively on hourly basis. The advantage of this computer system was it is cheap and consumes less energy.

Local Studies

In Philippines, a relatively large gross domestic product came from the poultry industry to produce eggs, meat, and feathers. This trade relied much on its output quality and the amount produced yearly. In Developed countries, poultry played a vital role. The commodity was relatively cheap and readily available. In the least developing countries, the projected rise in egg intake from 2005 and 2015 was 26%, compared to just 2.4% in the more developed economies. Records from the

Philippine Statistic Authority cited that in the Philippines from October to December 2018, the amount of chicken egg production was 138.54 thousand metric tons. It improved by 8.41 percent relative to the previous year's production of 127.79 thousand metric tons. The production of chicken eggs has recovered from a fall of 0.89 percent in 2016 and 8.41 percent growth in 2018 over the last three years. Increases in chicken egg production were noted in all regions in the fourth quarter of 2018, except Central Luzon, where production levels decreased by 1.19 percent relative to the same period in the previous year. Mariani et al., 2021.

In the automation, monitoring the parameters provided the appropriate conditions equally, and in the management of those parameters, the egg-turning process helped increase the artificial hatching and provided the same treatment as the layer fowl. This locally available technology is expected to contribute much to the development of the poultry industry. The microcontroller-based incubation system's importance is a cost-efficient and relevant improvement in poultry chicks' production capacity. Develop a cost-efficient microcontroller-based egg incubator suitable for small-scale consumption of locally produced poultry, which is low due to materials' insufficiency in developing egg incubator. Farmers use the manual incubator that was developed by the Department of Agricultural Engineering of Kalinga State University and observed that the manual process of incubation results in the following issues: (1) strict monitoring of temperature humidity, which is time-consuming; and (2) manual switching of the egg which is considered laborious. This study is geared towards the design modification of a cost-efficient automated egg incubator. Specifically, it is intended to provide an incubator design that uses modern methods such as the automated controllable device, which maintains humidity & temperature and enables automatic tray switching.

Conceptual Framework

The researchers came up with the idea of using Arduino because of its versatility. Arduino was an open source electronics platform built on user-friendly hardware and software. The prototype was easily put together by watching video tutorials on YouTube and Google. The system components were readily available for purchase on the online stores shopee and lazada.

Figure 2.12 shows the input, process and output diagram of the project Temperature Monitoring System for Quail Egg Incubator using Arduino, where it entails the humidity and temperature threshold values under the input section. For the process, it demonstrated what process was carried out, which corresponds to the input gathered by the sensor and the output visible on the webpage and mobile application.

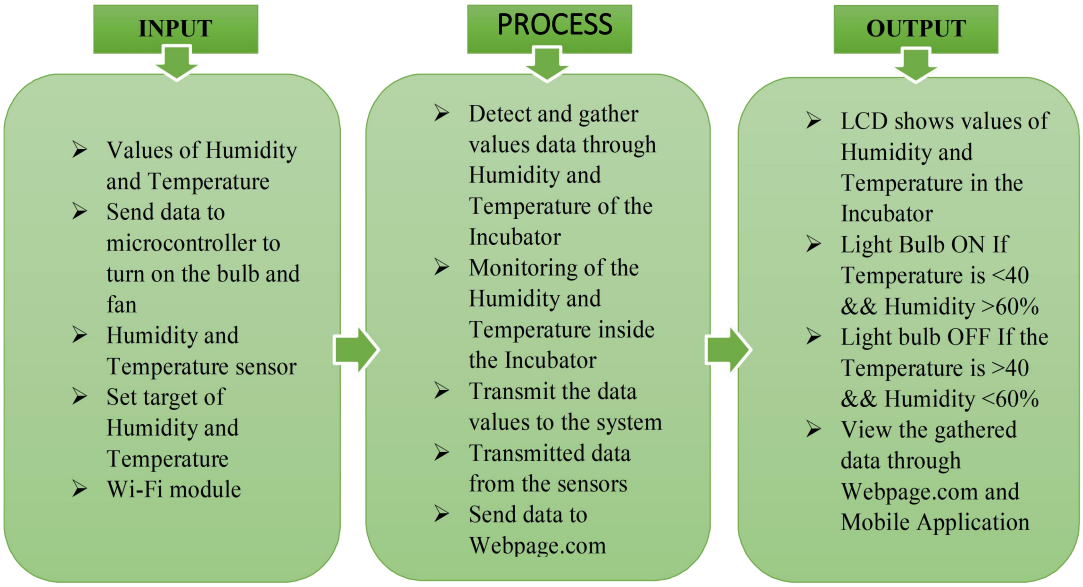

Figure 2.12 Research paradigm of Quail Egg Smart Incubator Using Arduino and Hatching System Based on IOT

Synthesis

The proponents relate and differentiate the studies based on the implications of the concepts presented and the materials used. Based on the studies read, the researcher's prototype was closely similar to **Smart Egg Incubator based on Arduino Uno Sanyaja et.al (2018)**. Arduino Uno plays vital role in developing automated systems, it controlled incubator for quails' eggs. Like the previous study, it's the brain of this system. Its purpose was to keep the temperature and humidity at defined values, so that the eggs can incubate and the chicks can hatch after a few days. DHT11 Temperature and Humidity Sensor was a temperature and humidity sensor that comes with a specialized controller. The temperature was measured by a Negative Temperature Coefficient (NTC), and the temperature and humidity

measurements were output as serial data by an 8-bit microcontroller. Further, the proposed system could also turn egg at least 8 or 6 times a day. The researcher's modern incubators come with built-in egg turners that automatically turn the eggs in 360 degrees within six minutes with the interval of four hours daily. There is no need to turn manually the egg for the machine would do it instead. Using an automatic egg turner was the best way to ensure the eggs were flipped accurately and consistently.

The former studies system is aimed to design, model and develop quail egg incubation and hatching system that was capable to control the stability of temperature and humidity of the incubator within the temperature range of 37 to 40°C. The focus of this project was to develop a cost-effective incubator machine with good operating systems. To achieve this objective, ArduinoAtMega328p microcontroller has been utilized in this project to control and operate the whole systems automatically (Romao, Moraes, Silva, Teixeira, & Cardoso, 2010). In the research work of (Ackerman, et al (2011), a cost- effective embedded model of bird egg incubator was developed that contained a smart sensor for monitoring temperature and humidity. It was incorporated with mechanical if tilting mechanism for tilting the eggs at an angle of 45^0 alternatively on hourly basis. The advantage of this computer system was it was cheap and consumes less energy.

The researcher's prototype was designed that can give the temperature of 37-40 degrees Celsius and humidity of 60% inside the incubator. The synchronous motor that turns the quail eggs was then connected to the Arduino Uno, which has its own process via the relay module. The relay module was the indicator of the synchronous motor that was used to regulate the inside the incubator. Furthermore, the bulb and the fan would execute the process until the temperature and humidity were in normal level.

The researcher's project ensured that all of the incubator's components were operational and that the temperature and humidity levels were appropriate. The egg turner, in conjunction with the synchronous motor, would turn the quail egg 360 degrees in six minutes at a four-hour interval. The researchers examined at the mobile app to see if the microcontroller updated the current temperature and humidity levels. All of the components would be tested to ensure that they were working properly. Using an automatic egg turner was the best way to ensure the eggs

are flipped accurately and consistently - which is always a plus, as the development of embryos is a delicate process. However, it was less involved - again it comes down to personal preference. The researcher's prototype come fitted with an automatic egg turner, so you can go about your daily business knowing that your incubating eggs are being turned on time, every day.

Chapter 3

DESIGN AND METHODOLOGY

The Prototyping Model was utilized on this study. It was a System Development Method (SDM) in which a prototype was produced, tested, and changed as needed until an acceptable prototype was obtained from which the entire system or product could be developed. When not all of the project needs were understood in detail ahead of time, this paradigm worked best. It was an iterative, trial-and-error process that occurs between developers and users. Figure 3.1 depicts the diagram that the researchers used to construct the system.

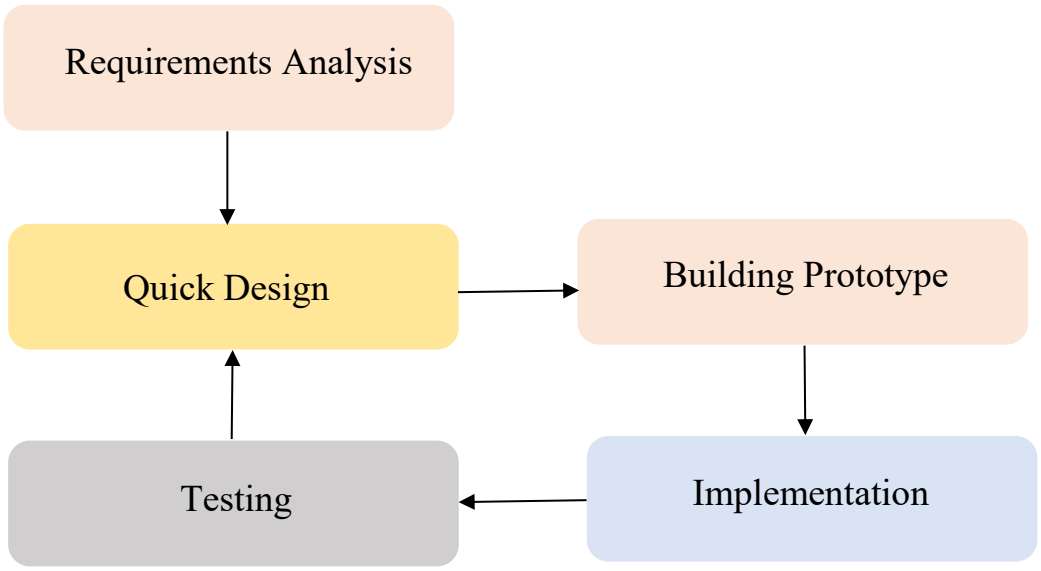

Figure 3.1 Prototyping Phase

Requirement Analysis

The researchers conducted an interview with the poultry farmers specially those who raised quail/s to gather important information about the incubator they were currently using, and the researchers determined how they could upgrade and improve its functionality.

Quick Design

In this phase, researchers made a Quail Egg Smart Incubator Using Arduino and Hatching System based on IOT system. Referring to the Figure 3.2 the sensor is

placed inside the incubator and connected to the main board which is the Arduino Uno. The Arduino Uno was connected to the Wi-Fi Module that send data to the Webpage and Thingspeak.com which was connected to mobile Application to monitor the status of temperature and humidity inside the incubator.

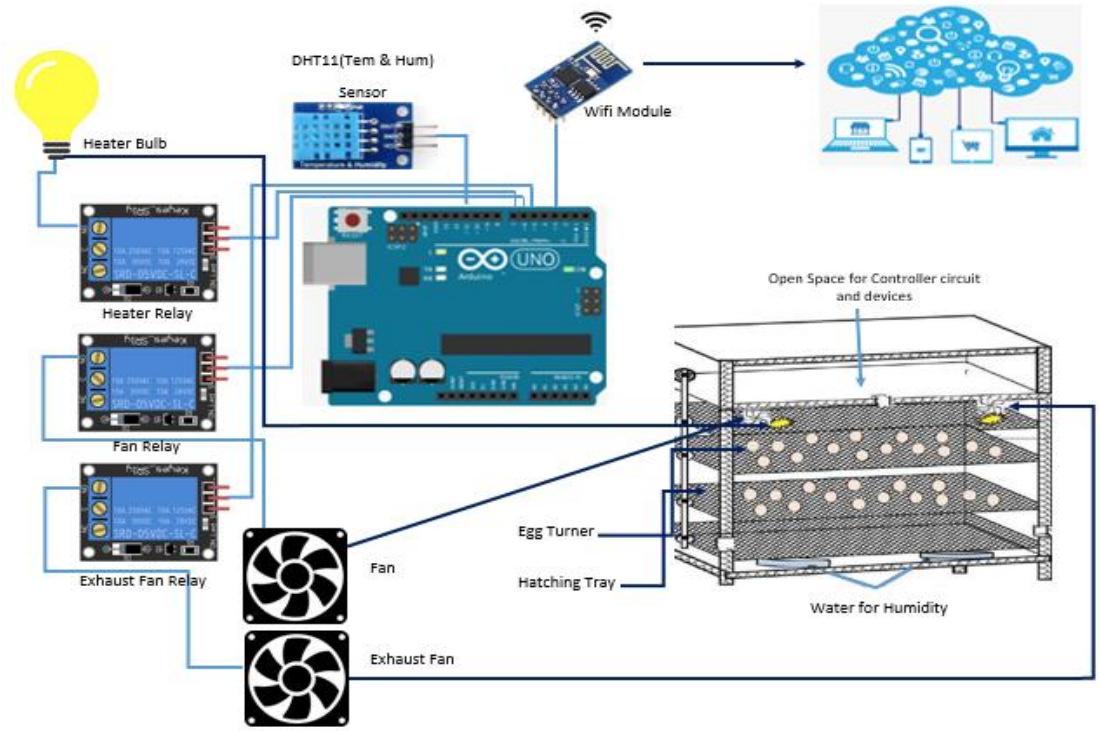

Figure 3.2 Proposed System Diagram

The flow of the system is shown Figure 3.2. The sensor first determines the temperature and humidity of the incubator, after which the system decide what to do based on the parameters set by the researchers. The parameters are as follows: If the temperature is less than or equal to 40ºc with a humidity greater than 60%, the bulb will turn ON as heat source of the incubator; If the temperature is greater than 40ºc with a humidity less than 60%, the bulb will turn OFF to prevent higher temperatures inside the incubator and the exhaust fan will turn ON to allow enough oxygen to come in and to allow the produced carbon dioxide and evaporated water to escape.

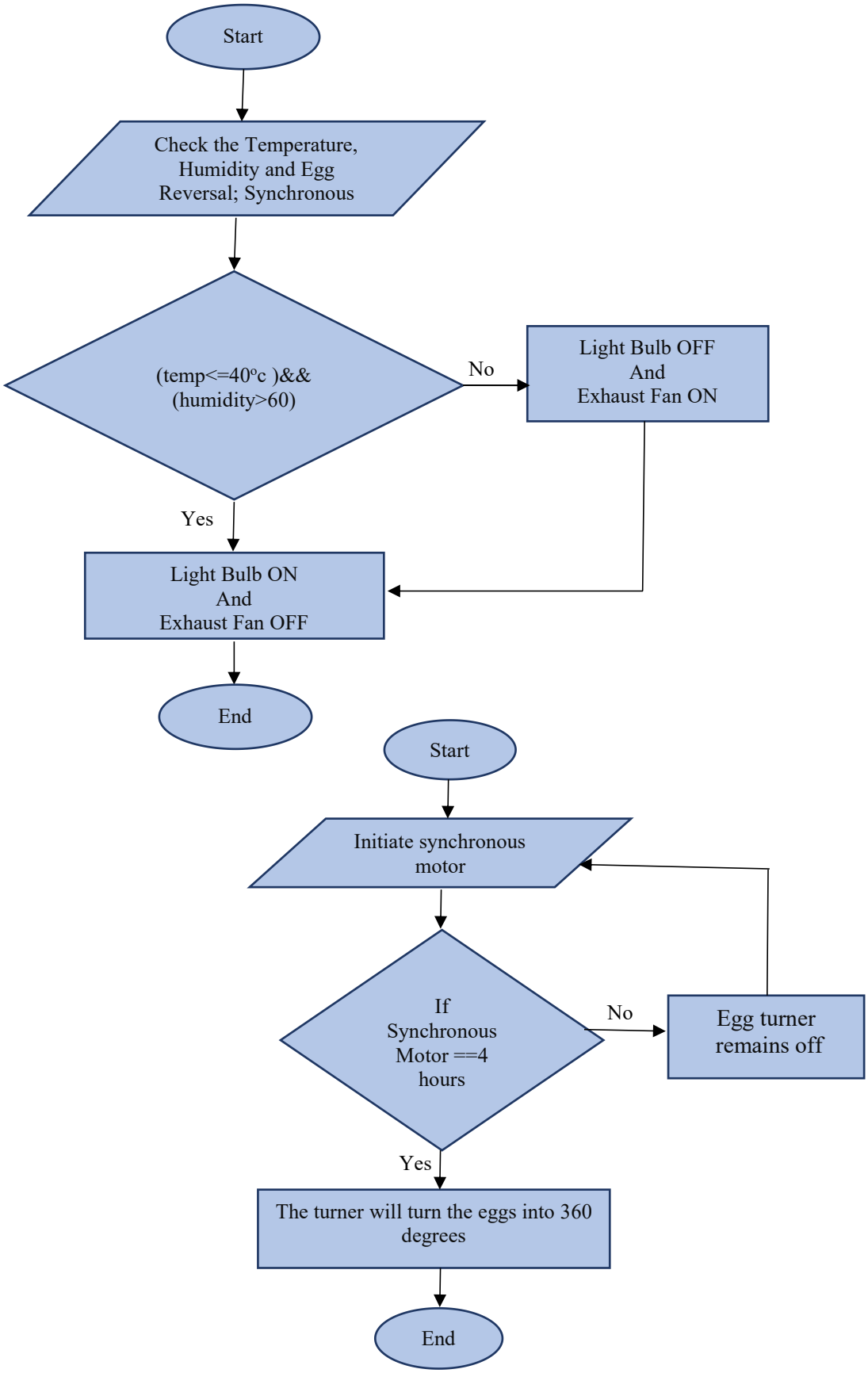

Figure 3.3 Flow Chart of the Propose System

Building Prototype

The user could get an actual feel of the system by interacting with the prototype, which allowed the user to better understand the requirements of the desired system. Prototyping was an appealing idea for complex and large systems where there was no manual process or existing system to assist in determining the requirements. During this phase, an actual prototype was designed based on the data gathered from the quick design. It was a scaled-down working model of the necessary system. Figure 3.4 shows the connection of building prototype.

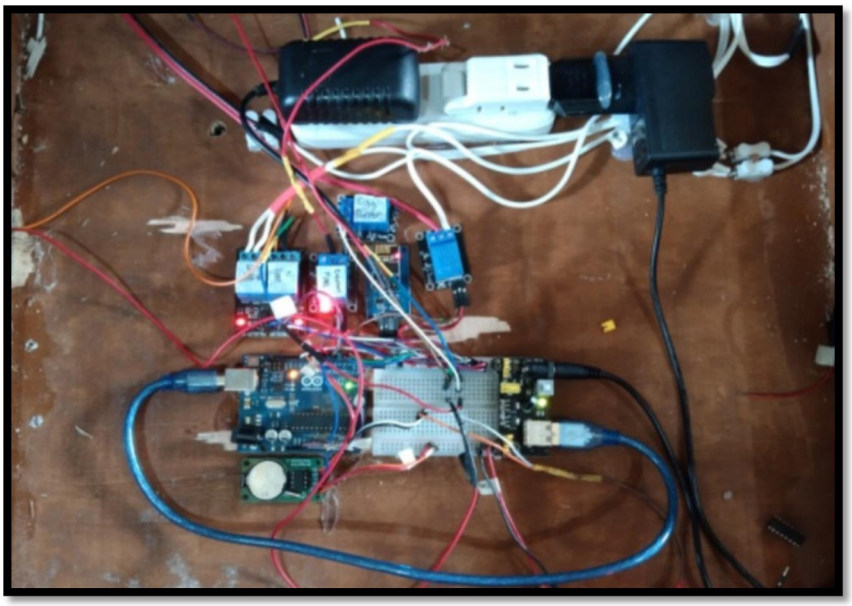

Figure 3.4 Connection of Building Prototype

Implementation

It implies modifying hardware, software, and documentation to improve operational effectiveness. It included making changes to improve a system's performance, solve problems, improve security, or meet user needs. The final system was thoroughly tested and deployed to production after it was developed based on the final prototype. Routine maintenance was performed on the system to reduce downtime and prevent large-scale failures.

Testing

During this phase, the researchers checked that all of the components of the incubator were functional and the temperature and humidity levels were as required.

The egg turner, in conjunction with the synchronous motor, will turn the quail eggs in 360 degrees within six minutes with the interval of four hours daily. The researchers examined the mobile application to see if the microcontroller updates the current temperature and humidity status. All of the component was checked to see if they were performing as planned.

Chapter 4

DEVELOPMENT, TESTING AND IMPLEMENTATION

Description of the Prototype

A Quail Egg Smart Incubator Using Arduino and Hatching System Based on IOT has been designed using Arduino Uno micro-controller and IOT. The incubator was made of plywood and wood be covered by adhesive wallpaper. The DHT11 sensor was placed on the upper side of the incubator which simultaneously measure two environmental parameters, namely temperature and humidity. In the upper right side of the incubator, the LCD was placed in order to display the temperature and humidity of the incubator. The egg turner was placed inside the incubator. Below the egg turner is the hatching tray where eggs would be transferred after fifteen days in the egg turner. In addition, a fan was installed inside the incubator to circulate evenly the heat of the bulb. In the top part of the incubator wires were placed and other components were kept.

Temperature and humidity are two basic parameters that must be regulated during egg incubation. Insufficient temperature and humidity levels throughout the incubation period frequently result in undesirable conditions. As a result of the input functions being utilized here, it is possible to receive stable heat from the temperature level and fan speed in order to control the humidity level of an egg incubator. This project will be able to automatically manage temperature and humidity using a microcontroller. By using the Mobile App, the user may keep an eye on the quail eggs from afar, saving time and effort.

Figure 4.1 Actual Prototype

Development

The following hardware devices were utilized to construct this prototype; an Arduino Uno microcontroller was used to connect all of the hardware devices. A temperature sensor was used to monitor the status of the incubator and sends the information to the microcontroller system, which was in charge of deciding whether or not to work the controllers in order to keep the environment within the incubator at quail egg-friendly levels. The temperature variance was eliminated by the exhaust fan, which adjusts the environment inside the incubator. As a heat source, a bulb was utilized, which was mounted inside and connected to a heater relay. The egg turner would gently rotate the eggs back and forth to prevent the yolk of an egg sack from clinging to the shell and to provide the growing embryo exercise. Simultaneously, the ESP8266 Wi-Fi module sent sensor data to a website called thingspeak.com, which was utilized in this study.

Gantt Chart

A Gantt chart is a graphical representation of a project schedule that is widely utilized. It's a form of bar chart that displays the start and end dates of project elements including resources, planning, and dependencies

Name Tasks	**Jun-Jul 2021**	**Aug, 2021**	**Sept. - Oct. 2021**	**Nov. - Dec. 2021**	**Jan 2022**	**Feb. 2022**	**Mar. 2022**	**Apr. 2022**
Preparation of thesis proposal								
Presentation of thesis proposal								
Preparation and submission of thesis application to effects committee								
Data collection								
Data analysis								
Report writing								

Submission of thesis								
Presentation of thesis								

Figure 4.2 Gantt Chart

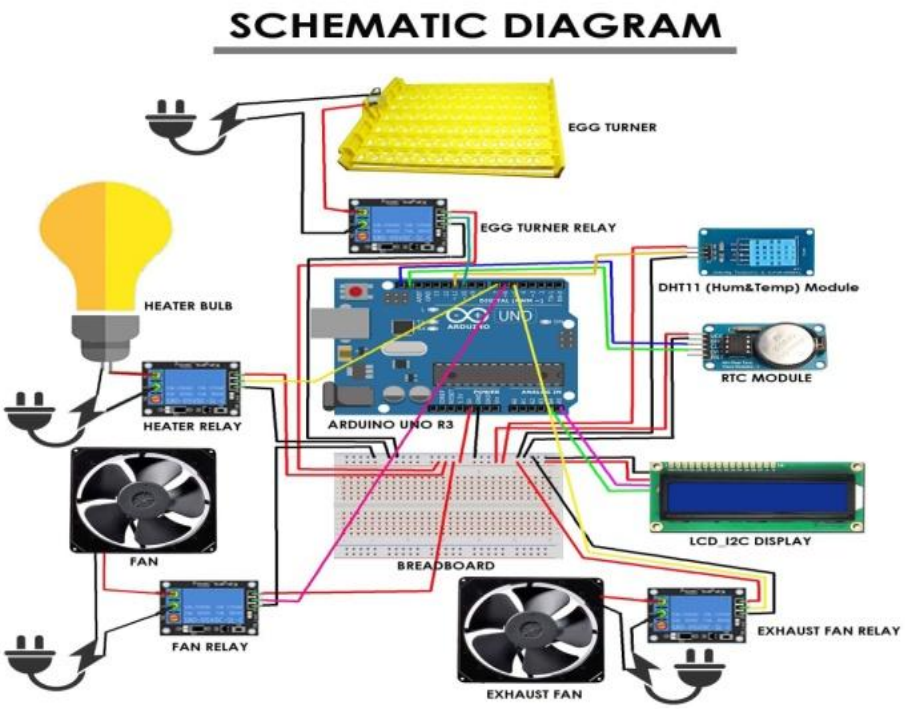

Figure 4.3 Schematic Diagram

Testing

In this phase, the researcher conducted testing at Mango St. San Pablo, Dumingag Zamboanga del Sur, throughout this period. The researcher started with 20 quail eggs, but sadly, the first attempt was failed since the incubator's temperature was insufficient for the quails' needs. For the second time, the researcher increased the temperature from 37 to 40 and started incubating 30 quail eggs at JHCSC-Dumingag Campus. As a result, 22 out of 30 quail eggs successfully hatched, 3 were broken, and 5 were infertile after 18 days. The Quail Eggs Smart Incubator Using Arduino and Hatching System Based on IOT had a 73 percent success rate, indicating that the project is recommended to poultry farmers.

Implementation Plan

Implementation is the action that must follow any preliminary thinking in order for something to actually happen.

In this phase, the researchers presented a plan to be followed.

STRATEGY	ACTIVITIES	PERSON'S INVOLVED	DURATION
Approval of the system project	Sending letter of agreement	Researcher, Poultry farmer	1 day
Distribute user manual	Give manuals	Researcher, Poultry farmer	2 days
Training	Hands on Training	Researcher, Poultry farmer	6 hours

Table 4.1 Implementation Plan

Chapter 5

RESULTS, DISCUSSION, CONCLUSION AND RECOMMENDATION

Monitor the Temperature and Humidity of the Incubator

This system could simply read the incubator's number of days, egg turner status, temperature and humidity content where it could be seen in the LCD which was placed in the upper right side of the incubator. The DHT11 sensor in the system prototype would allow it to read and access the data from the incubator. The sensor was one of the system's basic materials for detecting the incubator's level content. The system could also determine temperature and humidity data using dht11, turned off the bulb or the fan when the temperature and humidity was at the required level of the incubator. The system's operation was generally carried out. As a result, the incubator can run smoothly thanks to the program loaded into the microcontroller. The synchronous motor allowed it to turn the egg automatically. Figure 5.1, 5.2 and 5.3 shows LCD, Mobile Application and Webpage displayed the Egg turner status, temperature and humidity.

Figure 5.1 Status level displays on LCD

Figure 5.2 Status level displays on Mobile Application

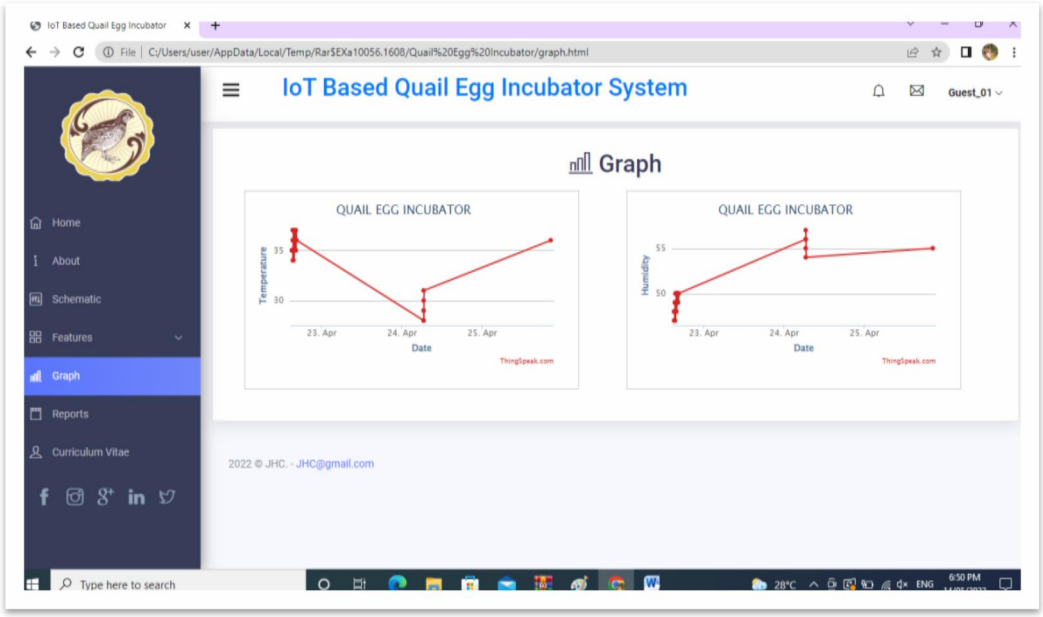

Figure 5.3 Status level displays on Webpage

Table 5.1 shows the readings of DHT11 sensor relative to the condition of the incubator. The sensor was responsible for indicating the condition of the incubator if it was light bulb OFF or Fan ON in order to know its status requirement which was programmed in the microcontroller.

Temperature and Humidity Readings	
Incubator Conditions	Temperature and Humidity Contents
Light Bulb OFF	Greater than 40 °C
Fan ON	Less than 55 %

Table 5.1 Temperature and Humidity Readings

Create a Mobile Application and Webpage for easy Monitoring of Data

The Researchers created mobile application and webpage, which were both able to monitor the data as well as the temperature and humidity status in the incubator.

Figure 5.4 Homepage of the Webpage

Figure 5.4 Mobile Application

Sent Data Readings to the Cloud Using via Wi-Fi module

The system provided all of the incubator's content data, which was acquired by the sensor and was kept in the database. The system used the ESP8266 Wi-Fi module to save data in the cloud. The data read by the DHT11 sensor was recorded in the ThingSpeak, which may also be monitored via mobile application and webpage.

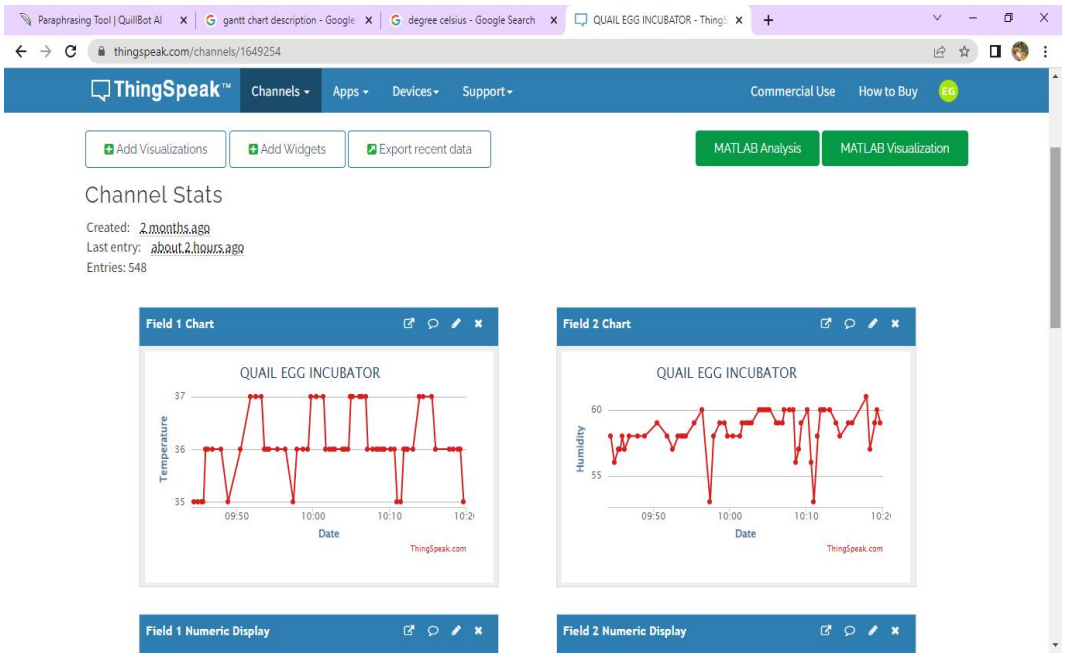

Figure 5.5 ThingSpeak Status

Generate Report on the temperature and Humidity Readings and Status of other components

All data sent by the DHT11sensor was stored to the ThingSpeak with the used of Wi-Fi module. Data stored in the ThingSpeak was also displayed in the webpage and mobile application with the use of Arduino IDE codes provided by the Thingspeak.

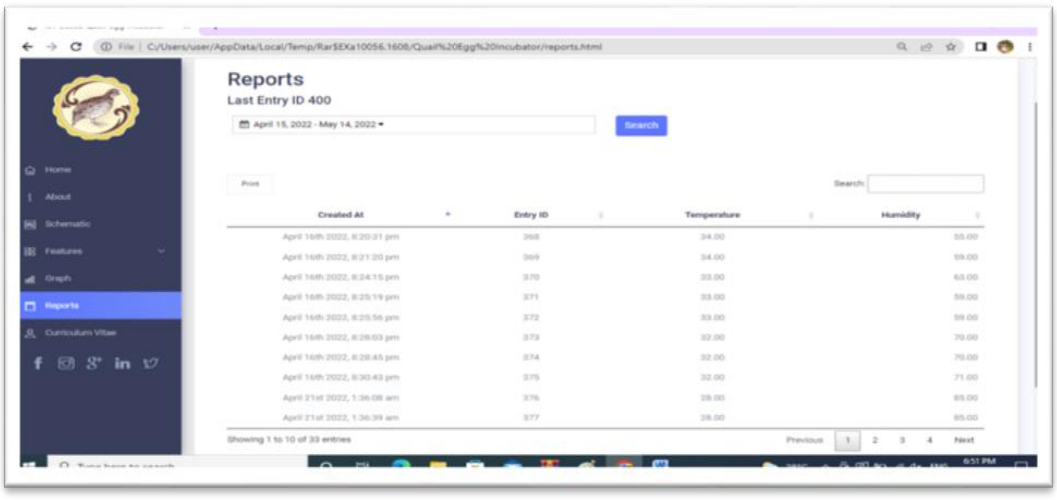

Figure 5.6 Reading Reports of Temperature and Humidity Status

Conclusion

The components functioned properly as a result of the study findings, based from the objectives the temperature and humidity were monitored by using the mobile application and webpage gathered from the Thingspeak with the use of ESP8266 Wi-Fi module. Thus, the functionality of the entire system had been tested thoroughly and it was said to function successfully.

Recommendations

The proponents recommend the following; the system will not only monitor the temperature and humidity of the incubator, but it will also be able to change the temperature and humidity within the incubator using a mobile app. The system requires a backup power source in the event of a power outage or in a location where there is no energy. Poultry producers must adopt the newly designed system which can automatically transfer the eggs to the hatching tray. It also requires an automated candling to determine whether the egg is fertile and infertile. The researcher requires to use a water level detector in order to execute command and let the user notify in any way possible.

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