Design and Implementation Automated Egg Incubator

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ABSTRACT Artificial egg incubators are devices used for incubating and hatching eggs through preservation the required conditions for fetus development inside the egg. Generally, this paper aims to design and implement an egg incubator system in order to provide adequate conditions for egg hatching and to meet the growing market needs for locally grown white meat at reasonable prices, this system uses software program for controlling the temperature and humidity using the proteus program and Arduino ide. This incubator system is based on two Arduino boards one of which is Arduino nano reads the temperature and humidity values inside the incubator chamber and it is displayed 16x2 display screen when this value is more than the maximum or less, then the bell gives sound to indicate of the exceeded permissible values and the controller processes. It controls the motor that turns the eggs to change their position in order to prevent the embryo from sticking to the shell. the electronic lock that makes the incubator door limited to the person responsible. The research would be a user-friendly product as it is manufactured in a limited and small size and can be transported to other locations with minimal user handling.

Keywords: Arduino board, egg incubator, humidity and temperature sensor.

1. INTRODUCTION

Hatching of chicken eggs is done in one of two ways: natural or artificial. In the natural way, a hen is kept sitting on a limited number of eggs ranging from 10 to 12 for 21 days. This long period is needed for the hen to hatch eggs and then incubate chicks. All of this results in reduced productivity [1]. On the other hand, the world's growing population and their consumption cannot rely on this type of incubation [2].

In order to avoid the disadvantages of the natural type of hatching, the artificial type comes into use. In this way, one can simulate the broody of the hen for increasing the number of eggs and offering the required conditions for the hatching. The Chinese and Egyptians are pioneers of artificial incubation procedures [3]. There are two types of artificial incubators: forced-air incubators

and still-air incubators.

Forced-air incubators have fans to circulate the air inside the incubator Chamber, but still-air incubators have not. Therefore, the forced-air incubators maintain the temperature, humidity and oxygen level better than still-air incubators. That is why all modern artificial incubators are of the forced-air type [4]. The four most important required factors in an artificial incubator for the embryo inside the fertilized egg to develop into a chick are temperature, humidity, ventilation and turning the eggs overtime [5][6]. Thus, the designer of an artificial incubator must take these major factors into consideration.

2. LITERATURE REVIEW

In this paper will discuss four papers that have tried to design artificial incubators using an Arduino. The paper states that the system will be

controlled and operated by the Arduino. In fact, it is found that the Arduino is used just for reading the temperature and humidity values from the sensor to show these values on the Liquid Crystal Display (LCD), since the authors use two digital temperature controllers (W1209) [7]. The first W1209 is for controlling the heating elements, i.e., a bulb. This W1209 will turn on the bulb until the temperature reaches the specified temperature (more than 38.5 °C or less than 39 °C). And when the temperature is lower than the Arduino via the relay to distribute the heat coming from the lamps inside the incubator. The DC motor is used for turning the eggs every three hours. The motor is also controlled by the Arduino through a relay.

Although this paper tries to overcome some drawbacks found in the previous papers, it still has its weaknesses. For the humidity the author puts two bowls of water but there is no control to keep the humidity, constant for it is well-known that water will decrease during the incubation period because of the evaporation process. The LCD in the three research's above is used just to show one or both values of the temperature and the humidity while it could be 38.5 °C, this W1209 will turn on the bulb again. This process will be repeated until the end of the incubation period. The second W1209 is used for controlling the cooling element, which is a 12V DC fan.

The scenario that when the temperature rises above the optimum value which is 39 °C, the second W1209 will run the fan and keep it on until the temperature becomes under this optimum value. During the running period of this fan the air circulates inside the incubator. The DHT11 sensor is used for reading the temperature and humidity values inside the incubator and it is also used for sending the information to the Arduino which displays the values on the LCD connected to it. This shows the purpose of using Arduino in the system.

This paper has several drawbacks. First, there is no automatic turning of the eggs. Instead of that, the turning is performed every three days and this is not scientific. According to science, eggs must be turned more than once a day [6][8][9].

Second, the authors also mentioned that humidity needs to be regulated by controlling the

fan and water, but as mentioned, a fan was used to lower the temperature if it was higher in value and had nothing to do with humidity another weakness. That is, there is no humidity control. Third, further weakness is the use of two W1209 controllers to control the bulb and the fan while the Arduino is used just to read the information and display it on the LCD. In fact, this is a major drawback in this paper because the Arduino can do all these jobs easily through relays. Another drawback of each research's is that they use a sensor that can give only an integer number for the temperature and as it is known that the best temperature for the embryo to develop and hatch is the real number like 37.5 °C [10] therefore, these types of sensors will not be a good choice to be used in the artificial incubator.

The paper [11] uses the DHT22 sensor to monitor the temperature and humidity inside the incubator and send the data to the Arduino to control the heaters, the turning of eggs and the fans. This data will be shown on an LCD screen. If the temperature sensed by the sensor less than the reference temperature, which is 37.5 °C, then the Arduino will turn the lamps ON to make the temperature increase until it is equal to or greater than 37.8 °C. Then the Arduino switches off the lamps through relays. The fans are also controlled by the Arduino via the relay to distribute the heat coming from the lamps inside the incubator.

The DC motor is used for turning the eggs every three hours. The motor is also controlled by the Arduino through the relay. Although this paper tries to overcome some drawbacks found in the previous papers, it still has its weaknesses. For the humidity, the author puts two bowls of water but there is no control to keep the humidity constant for it is well-known that water will decrease during the incubation period because of the evaporation process.

The LCD in the three research's above is used just to show one or both values of the temperature and the humidity while it could be used to show other useful things such as seen in our paper later. Our work, has overcome all the defects of the three papers referred to above as illustrated in the following sections. Thus, an artificial incubator, which can automatically control the above four

major required factors for hatching is designed and implemented. The proposed incubator has been tested. It has given excellent results.

The paper [12], Sumardi Sadi, deliberate scope heat rule System Prototype Engineering Based Programmable judgment Controller Zelio SR2 B121 BD, in this forecast audition mechanisms based on the chamber temperature increases firm automatic by encoding the PLC, a rise in boil of the chamber and the tariff of the roast upwelling knows how to be practical via the LCD. The system tin drudgery from heat of 0 ° C to 90 ° C degrees. Chamber reheats stuff manufacturing customs three devices: key controller, Zelio Logic SR 121BD, second, Integrated trail (IC) LM35 and third, a 24 VDC state source.

The paper [13] Okpagu, P. E. & Nwosu, A. W. using the futuristic strategy and high temperature suppression of the smart egg incubator system for an a variety of picking up the egg based PID controller in this work, the exciting lamps were old to set the correct fever of the egg but filled with tears and the calculation of the cliques was out of date to make sure the hardness and drying was in good condition, where the incubator heat is maintained at the conventional heat via PID, models were validated through simulation and the Zeigler-Nichol adjustment method and obtained at the conclusion of the third test shown commendable progression in bypass, peak time but growth time and settling time not fun in the test completely third.

The paper [14] S Shafiudin, N Kholis. designed Monitoring System and heat calculating on PID based in this work, the second-hand in PID calculating is considered to detect stand via ARX (Auto Regressive exogenous) MATLAB, which is dynamic/non-linear to find geometric classical and PID constants price that is apt to system. The

hardware draft for PID-based egg incubator uses Arduino Uno R3, as the core controller that includes PID source, and PWM, to continue set hotness stability, which is integrated with glowing untroubled actuators and sensors everywhere DHTI 1 sensor as the booklover as hotness rider and fix humidity. The effect of the cram showed that PID constants evaluate of all deposit is different. For similar 15-Watt plant, $K_p = 3.9956$, $K_i = 0.361$, $K_d = 0$, although for analogous 25-Watt plant, the merit of $K_p = 5.714$, $K_i = 0.351$, $K_d = 0$. The PID constants consequence were clever to produce steady system comeback which is based on set-point with steady splendor error's use is around 5%, that is 2.7%. With a hatching percentage of 70-80%, the hatching development is doing well in the air-conditioned environment (changeable).

1. METHODOLOGY

Paper development has been divided into major parts. There are electronic design and software design. So, when combined all parts will be performing the incubator eggs. In electronic design is focus on building the system circuit. Besides that, in software is focused on program the system using Arduino UNO and Arduino nano.

A. Electronic Design

Figure 1: shows the block diagram for artificial egg incubators. The inputs to the artificial egg incubators are keypad and dht11 sensor. Besides that, artificial egg incubators have four outputs. The outputs are LCD, buzzer, heat source, Electronic lock, led green, led red, fan and servo motor used to stir eggs.

Figure 1: block diagram for artificial egg incubators

Figure 2: shows the circuit diagram of artificial egg incubators. What's interesting about two Arduino used in artificial egg incubators system. Arduino nano the processing input from the dht11 sensors and determines what to do with the

system (if turned on the heat source, fan, or alarm). Arduino Uno controls the motor that turns, keypad and electric lock [15].

Figure 2: The circuit diagram of artificial incubator egg

A. Software Design

The Software design shown in figure 3 describes a program that is used to operate the incubator egg in this section consists of a flowchart and explains how the incubator works.

In the incubator when the temperature rises above the maximum, the dht11 sensor reads this value and sends it to the Arduino nano controller via pin 2 and the controller gives the buzzer a

signal through pin 1 to make a sound and at the same time the controller send a signal to relay 1 through pin A4 to turn on the fan that works to expel excess heat to exterior the fan continues cooling until the temperature drops to the permissible range, after which the fan stops. As for when the temperature drops below the minimum, the dht11 sensor reads the value and sends a signal to the Arduino nano controller via pin 2, which in turn sends a signal to the buzzer and relay 2 through the A5 terminal to turn on the

boiler to raise the temperature until it reaches the required range, then disconnect relay 2 (boiler) and buzzer. As for humidity, the minimum required humidity for the incubator is 56% in the first days and the highest humidity is 85% in the last days of the incubation. The boiler works to increase the value temperature, an amount of

moisture enters into the incubator in the form of steam, and when the fan is operating to reduce the amount of heat, the incubator gets dry air and the humidity decreases. The servo motor use to turn on egg at degree 180 every 8, and the door incubator open when Password true.

Figure 3: The flow chart of incubator eggs temperature and humidity.

1. EXPERIMENTAL AND ANALYSIS

In automated incubator egg several factors have to be considered for the successful process of incubation and hatch of the system. There are two major factors in automated incubating of eggs:

A. Results related to temperature and humidity

When the temperature rises above the higher value such as figure 4, the Arduino nano controller works by giving a signal to the alarm through pin1 to make a sound and also sends a signal to the switch relay 1 through pin A4 to

switch from non- conduction to conduction mode , so the fan rotates to expel the excess heat to outside the incubator and the temperature gradually decreases until you arrive to 38 degree

Celsius and then sends a signal to relay 1 to switch to non-conduction mode ,so the fan and alarm stop.

Figure 4: display value of temperature high

When the temperature drops below the minimum value as in figure 5 the controller nano sends a signal to relay 2 through the pin A5 to

operate the boiler continues to supply heat to the incubator until the incubator temperature reaches 37 degree Celsius after that it sends controller indicating relay 2 to turn the boiler off.

Figure 5: display value of temperature low

Also, when the humidity level falls below the minimum of 56%, the controller sends a signal to relay 2 and switches to the conduction states, so the heater works and pushes an amount of heat and moisture in the form of steam into the incubator and continues until the humidity level reaches the minimum permissible level then disconnects relay 2 and the heater stops and is done get rid of the heat entering with moisture by

fan. When temperature is the range of incubator temperature the boiler stops. As in figure 6.

Figure 6: incubator temperature

A. Using Data and Calculation

Table 1 shows the data of temperature and humidity changing in automated incubator eggs for whole 24 hours.

TABLE 1: THE DATA COLLECTION FOR EVERY HOUR

Time(hour)	Temperature(c)	Humidity (%)	State of fan	State of boiler
1	37	59	0	0
2	36	58	0	0
3	36	57	0	0
4	35	57	0	1
5	37	57	0	0
6	36	56	0	0
7	37	56	0	0
8	37	56	0	0
9	36	55	1	0
10	35	55	1	1
11	37	55	1	0
12	36	58	0	0
13	35	53	1	1
14	37	56	0	0
15	36	57	0	0
16	37	57	0	0
17	37	53	1	0
18	37	54	1	0
19	35	59	0	0
20	36	59	0	0
21	35	56	0	1
22	36	56	0	0
23	35	56	0	1
24	37	57	0	0

Refer to Figure 6; it shows the graph of temperature and humidity in one day. From the calculation, the mean value (the average of the all the values, then divided by 24) for temperature is 36.2 °C. Besides that, mean value for humidity is 56.25 %. For actual temperature in automated

incubator egg should be constant between (36°C - 39°C). If the temperature is drops below 36°C or increase above 39°C, the eggs may not hatch and broken. If the automated Incubator Egg running at 40°C only for 15 minutes, will be affect the embryos [11].

Figure 7: Graph of temperature and humidity

1. CONCLUSION

In this paper an automatic hatching machine was designed to provide adequate conditions for incubation and hatching of eggs. A fan was used to distribute air and a heater to provide heat and humidity, and a motor was used to turn the eggs in order to ensure that the yolk was moved and not attached to the egg wall. The basic factors of the incubator environment were controlled by the proteus and Arduino ide program, where the Arduino nano controller receives reading of the dht11 sensor to give signal for the switch (relay1) to operate the fan in order to reduce the temperature or relay 2 to operate the heater to provide the incubator with heat and humidity in the form of steam and to increase the guarantee of stability the temperature and humidity in the required range.

The incubator is equipped with a bell to alert the incubator if the condition for incubator eggs changes from the require range and electric lock in order not to open the door for anyone. And therefore, having result for the testing. An automatic hatching machine also can hatch of different poultry eggs are within a similar range, such as guinea fowl, turkeys, ducks, goose, quail and ostrich. For recommended is the solar energy should be used as backup power supply. It is because of the untimely failure of electricity to enhance the efficiency of the system, adding Field Programmable Gate Array (FPGA) which is an integrated circuit designed to be configured by a

customer or a designer after manufacturing to the devices to detect the condition of egg inside the incubator and sending that to the administrator person and control the system used.

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