

# ARDUINO UNO APPLICATION FOR TEMPERATURE CONTROL CHICKEN EGGS INCUBATOR MACHINE

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**Abstract** - Poultry animals such as chickens incubate their eggs in three weeks to hatch their eggs, which sometimes the egg yields are not optimal so that a poultry egg incubator and its system are needed to optimize the results of hatching in which this built-in incubator with a capacity of 300 eggs with a rack system that rotates automatically based on Arduino Uno, using a digital temperature and hygrometer sensor so that the temperature can be set at 38-39 °C and the humidity can be set at 55-70% according to the egg hatching temperature and humidity, and from the test results obtained, the number of eggs that do not hatch and hatch both that hatch normally, defective, and die, the research conducted, for chicken eggs, which originally amounted to 300 eggs to be hatched, 291 eggs that hatched well, 5 defective eggs, and 3 eggs that died and 1 egg that does not have any embryos, and the result that this chicken egg incubator machine is capable of hatching eggs 97%.

**Keywords** - Chicken Eggs Incubator Machine, Rack System Rotating, Digital Temperature and Hygrometer Sensor, Arduino Uno

## I. INTRODUCTION

Chickens farming is a promising business because people desperately need chickens meat and eggs as nutritional intake. To hatch large numbers of eggs with good quality, an egg incubator with a large capacity is needed. In hatching eggs, there are several things that must be considered in the hatchery, namely: temperature, humidity, air ventilation, frequency of egg screening and egg cleanliness [1]. Most of the egg incubators, the average is done manually, one of which is to turn the eggs over within a specified time, and check the temperature levels the eggs must receive each day. This machine is equipped with temperature and hygrometer digital sensor to match the temperature and the humidity required for eggs to hatch which is controlled by Arduino Uno [3].

This machine is expected to increase the amount of production so that it will greatly assist breeders, both as novice breeders and advanced breeders in continuing their livestock business in a more advanced manner because with this eggs incubator machine by using Arduino Uno that hatch well above 95% are able to increase the amount of poultry production that hatches and increase farmer income.

## II. SIGNIFICANCE OF THE STUDY

The eggs incubator machine that can be hatched have a capacity of 300 eggs with a temperature that has been set at 38 - 39 °C by an automatic digital temperature sensor and the humidity can be set at 55-70% by an automatic hygrometer sensor with a rotating rack system based on Arduino Uno to obtain heat and humidity evenly distributed to all eggs so that breeders make their work easier and produce optimal eggs in increasing their income.

## A. Literature Review

Automatic chicken eggs incubator is a tool to create the best environmental conditions so that the eggs can be incubated which in the end the eggs can be hatched. The function of this machine will take over the role of a parent when it incubates its eggs naturally. In hatching eggs, there are several requirements that refer to the rate of increase in the hatching of eggs such as:

### 1. Eggs Selection.

Chicken eggs to be hatched must be selected properly because it will determine the success of hatching. The following are the characteristics of good poultry eggs [4], namely:

- a. Has normal weight and shape (normal weight: 0.04-0.05 kg)
- b. The eggshell should be clean of dirt.
- c. The air cavity is clearly visible at the blunt side and does not move.
- d. The ratio between male and female is not more than 1: 8 [5].
- e. The age of the male and female parent is at least 12 months [6].
- f. No defects such as cracks, too rough surface, soft shell, thickening of the skin in one part, more than one yolk, and others.
- g. The smell isn't bad or has been stored for a long time.

Before hatching eggs, there are several pre-hatch treatments [2], namely:

- a. The eggs to be hatched must be selected according to the characteristics of the eggs the good above.
- b. The eggs to be hatched are cleaned with a disinfectant such as water warm, alcohol 70%, formaldehyde 40%, potassium permanganate (KMNO<sub>4</sub>) or other type of disinfectant slowly with use a sponge or cotton cloth as a cleaner.
- c. The correct way to store eggs is that the air cavity is at the top and should not be stored for more than 5 days after the eggs leave the mother.

### 2. Temperature.

Embryos in poultry eggs will develop rapidly as long as the temperature of the eggs are stable and will stop growing if the temperature is less or more than required. Temperature stability can be achieved by utilizing a temperature control device installed in the incubator chamber. The heat in the hatching machine is produced by heating from an aluminum conductor plate that is connected to an electric current to produce heat energy, where the aluminum conductor plates are on the right, left, back and bottom of the machine. In this research, MH1210W is used as digital temperature sensor with all its spesification [7].

### 3. Humidity.

The surface of the egg shell has pores that make it easier for water to enter / exit the egg. All eggs, whether incubated (incubated) or not, will slowly dry out. The amount of water that comes out of the eggs during the incubation process is very important to note. This amount is determined by the humidity level in the incubator chamber. Low humidity levels will cause the eggs to dry out faster so that the egg embryos stick to the inner surface of the egg shell. This is one of the triggers for poultry to fail to hatch. For this reason, humidity in the incubator space is obtained by inserting a container filled with water into the eggs incubator.

4. Air Circulation.

Air circulation is also very important because it is related to humidity. If the air circulation is too little, the room humidity will be higher, and vice versa.

5. Hatching Period.

The hatching period for poultry eggs can be seen in the following table

Table I. Hatch periode of chicken eggs

Poultry Eggs	Chicken
Hatch Period (Day)	21
Rotating Stop (Day)	18
Temperature ( <sup>0</sup> C)	38 - 39
Humidity (%)	55

Research Method

1. Design System

Design system can be seen in the following block diagram and flow chart figure.

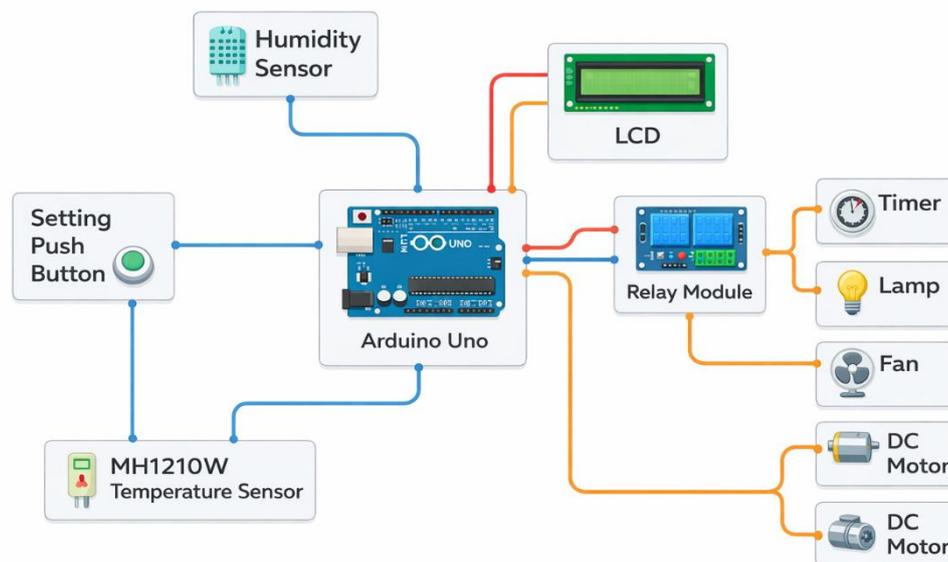


Figure 1. Block Diagram

This system is designed as a small automation controller with Arduino Uno as the central brain. The Arduino continuously receives input from three sources: a humidity sensor that measures air moisture, an MH1210W temperature sensor that reads ambient temperature, and a setting push button used by the user to change modes or adjust threshold values. Every time the button is pressed, the Arduino interprets it as a command (for example, to enter a setup mode, increase/decrease a setpoint, or switch between manual and automatic operation).

After collecting the sensor readings, the Arduino processes them based on the programmed control rules. At the same time, it updates the LCD display so the user can instantly see real-time information such as current temperature, humidity, system mode, and the ON/OFF status of each device. This makes the system easy to monitor without needing a computer.

When the measured conditions meet certain criteria (for example, temperature rising above a set limit or humidity exceeding a threshold), the Arduino sends control signals to the relay module. The relay module acts like an electrically controlled switch, allowing the low-voltage Arduino outputs

to safely control higher-power devices. Through these relays, the system can turn ON/OFF a lamp, a fan, and one or more DC motors. In addition, a timer unit can be integrated so that some devices operate according to a schedule (for example, turning the lamp on at specific hours or limiting motor operation time). Overall, the system works as a complete sensing–decision–actuation loop: sensors provide environmental data, Arduino makes decisions, LCD provides feedback to the user, and the relay module drives the real devices (lamp, fan, and DC motor) in a controlled and automated way.

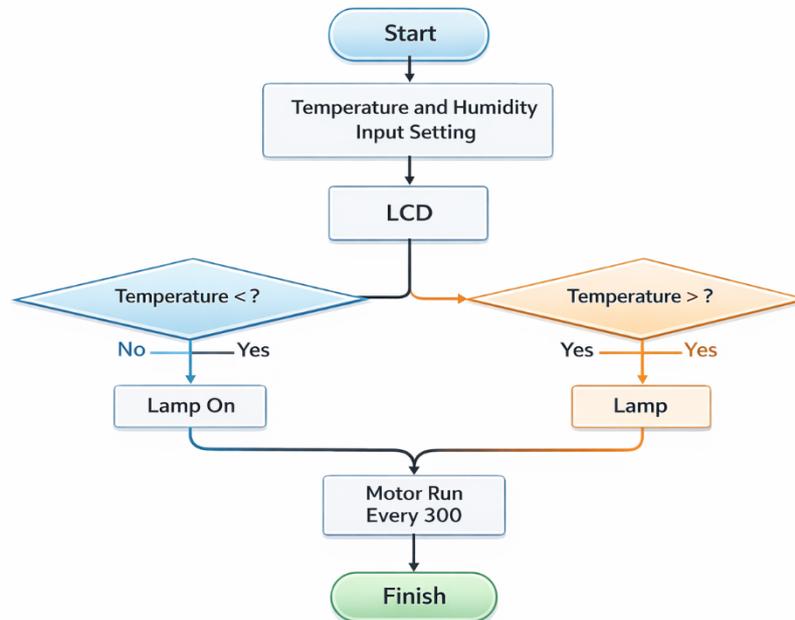


Figure 2. Flow Chart Diagram

The flowchart illustrates the operational process of an automated temperature and humidity control system. The process begins at the Start stage, where the system is initialized. After initialization, the system proceeds to the Temperature and Humidity Input Setting step. In this stage, the controller receives and sets the desired temperature and humidity parameters that will be used as reference values for system operation. Next, the system sends the current environmental data to the LCD display, which provides real-time information to the user. The LCD shows parameters such as temperature and humidity levels so that the user can monitor the condition of the system easily.

After displaying the information, the system performs a decision process based on the temperature value. If the detected temperature is below the predetermined threshold, the system activates the lamp, turning it on to increase the temperature or maintain the required environmental condition. On the other hand, if the temperature is above the threshold, the system triggers another response where the lamp operates differently (for example, turning off or adjusting the heating condition depending on the programmed logic).

Once the appropriate action for the lamp has been executed, the process continues to the motor control stage. In this stage, the motor runs periodically every 300 seconds, which helps regulate airflow or perform a mechanical action such as ventilation or circulation within the system. Finally, after completing the motor operation cycle, the process reaches the Finish stage. This indicates the end of one operational cycle of the system. In practical applications, the system would typically loop back to continuously monitor temperature and humidity, ensuring that the environment remains within the desired conditions.

B. Research Model

Research model of poultry eggs incubator can be seen in the following figure.



Figure 3. Research Model

The diagram illustrates the electronic circuit and internal configuration of an automatic egg incubator system. The system is controlled by an Arduino Uno microcontroller, which acts as the central processing unit. The Arduino receives input from the humidity setting control and push button, allowing the user to configure environmental parameters inside the incubator. Inside the incubator chamber, several components work together to maintain optimal conditions for egg incubation. A lamp functions as the primary heat source to regulate temperature, while a fan helps distribute heat evenly throughout the chamber. The egg rack turning motor (DC motor) automatically rotates the egg trays to ensure uniform embryo development. Another DC motor may support ventilation or mechanical movement within the system. The Arduino processes sensor inputs and user settings, then sends control signals to the actuators, including the lamp, fan, and motors, through a control module. This integrated system allows the incubator to maintain stable temperature and humidity conditions automatically, improving the efficiency and success rate of egg hatching. The overall circuit can be seen in the following figure.

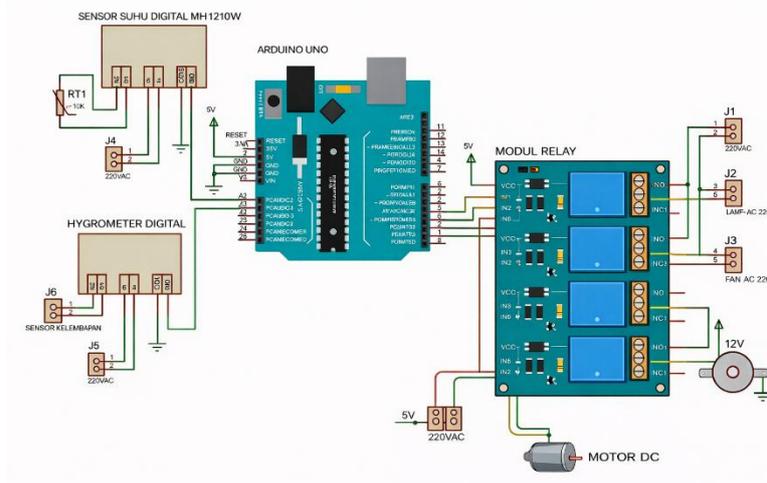


Figure 4. Automatic Control Circuit

The diagram shows the electrical circuit of an automatic egg incubator control system based on Arduino Uno. The MH1210W digital temperature sensor and the digital hygrometer are used to measure temperature and humidity inside the incubator. These sensors send environmental data to the Arduino Uno, which acts as the main controller of the system. After processing the sensor data, the Arduino sends control signals to the relay module. The relay module functions as a switch to control several devices, including an AC lamp (heater), an AC fan for air circulation, and a DC motor used to rotate the egg rack. The system operates using a 5V supply for the controller and relays, while the actuators such as the lamp and fan operate with 220V AC, and the motor uses 12V DC.

C. Research Location

This research was conducted at Dusun II Desa Medan Krio, Kecamatan Medan Sunggal, Kotamadya Medan, Provinsi Sumatera Utara.

III. RESULTS AND DISCUSSION

A. Research Result

The research result can be seen in the following table.

TABLE II. HATCH RESULT OF CHICKEN EGGS

Amount of Chicken Eggs (300 eggs)			
Hatch Chicken Eggs			No Embryo Eggs
Normally	Defektive	Dead	1
291	5	3	

Automatic chicken eggs incubator machine and the hatched poultry eggs can be seen in the following figure.



Figure 5. Automatic Poultry Animals Eggs Incubator Machine

The images show a prototype of an automatic egg incubator designed for poultry egg hatching. The incubator is built in a rectangular cabinet with several egg trays arranged in multiple layers. Each tray holds eggs in an organized position to ensure proper spacing and uniform incubation conditions.

Inside the chamber, a lamp is installed as a heat source, providing the temperature required for embryo development. The incubator is also equipped with a control panel on the top, which contains temperature and humidity controllers as well as indicator switches. The system is designed to maintain optimal incubation conditions automatically. Sensors inside the incubator monitor the temperature and humidity, while a control system regulates heating and air circulation to keep the environment stable. The trays allow a large number of eggs to be incubated simultaneously, improving efficiency for small-scale poultry farming. Overall, this incubator helps increase the success rate of egg hatching by providing a controlled and stable environment.

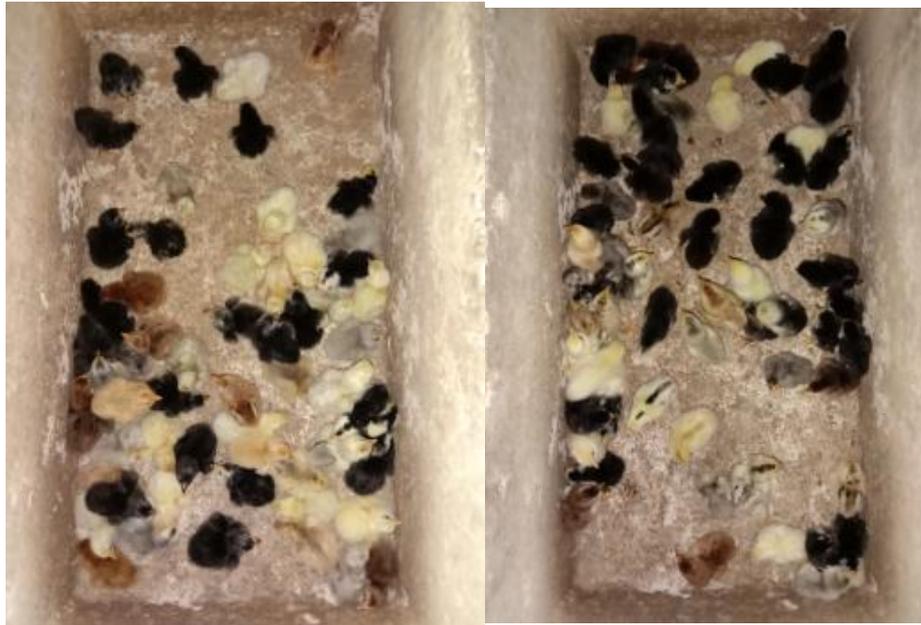


Figure 6. Hatched Chicken Eggs

The image shows newly hatched chicks collected after the incubation process. The chicks display various colors, including black, yellow, brown, and mixed patterns, indicating natural variation in breed or genetic traits. They are placed together in a container shortly after hatching, where they appear active and healthy. This condition demonstrates that the incubation process has been successful. The chicks have hatched properly from the eggs that were previously incubated in the automatic incubator system. The presence of many chicks indicates that the incubator was able to maintain suitable environmental conditions such as temperature, humidity, and ventilation during the hatching period.

## B. Discussion

Chicken eggs have hatched for 21 days, the hatching is as follows:

- Day 1: Put the eggs in the automatic egg incubator
- Day 4 : Look at the eggs to see if they have any embryos. Eggs that do not have an embryo or infertile are immediately removed from the incubator. The motor starts moving the egg rack according to the timer setting.
- Day 5 to 11: The motor moves according to the timer setting. On the 11th day, eggs are monitored again to see the embryo development.
- Day 12 to 17: Motor moves according to the timer setting. On the 17th day, another observation is carried out on the eggs to see the development of the embryo.
- Day 18: The motor stops moving then checks the eggs.

- Day 20: Check the eggs for cracks in the eggshells.
- Day 21: The eggs hatch.

To find the effectiveness of egg incubator is:

% Machine Effectiveness = Eggs hatch normally / Potential for hatching eggs x 100%

% Machine effectiveness on chicken eggs = 291/300 x 100% = 97%

#### IV. CONCLUSION

Based on the observation results, it can be concluded that successful chicken egg incubation depends strongly on maintaining stable environmental conditions. Chicken eggs hatch properly when the incubator provides an appropriate temperature range of **38–39°C**, humidity of **55–70%**, and sufficient air circulation to support embryo development. In addition to these conditions, only **fertile eggs that contain an embryo** are able to hatch. Overall, the developed chicken egg incubator machine demonstrates high performance, with a minimum effectiveness rate of **97%**. This result indicates that the system can maintain a suitable incubation environment consistently. Furthermore, the use of an **Arduino Uno** enables reliable temperature control, helping the incubator operate steadily and improving the hatching success rate.

#### ACKNOWLEDGEMENT

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