TECHNOLOGICAL INSTITUTE OF THE PHILIPPINES

938 Aurora Blvd., Cubao, Quezon City

COLLEGE OF ENGINEERING AND ARCHITECTURE

COMPUTER ENGINEERING DEPARTMENT

2nd SEMESTER SY 2023 - 2024

FINAL PERIOD

AUTOMATION AND ROBOTICS

CPE 103

CPE32S1

Chick's Mist: Automated Water Mist System for Poultry Houses

Submitted to:

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Submitted on:

May 16, 2024

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Chick's Mist:
Automated Water Mist System for Poultry Houses

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Abstract – The Chick's Mist (CM) project addresses the major issue of heat stress in chicken farms in tropical countries such as the Philippines. Heat stress reduces poultry productivity and welfare, resulting in financial losses. Existing solutions lack comprehensive monitoring of environmental factors. Chick's Mist introduces an automated water mist system (WMS), integrating cloud connectivity for real-time monitoring and control via the Blynk IoT app. Utilizing ESP8266 microcontrollers and DHT11 sensors, the system maintains optimal humidity by activating a water pump when necessary. Testing demonstrated 100% accuracy in both humidity detection and system responsiveness. This innovation offers a reliable, efficient solution to mitigate heat stress, improving poultry health, productivity, and farm sustainability. This system represents a vital advancement in sustainable poultry farming, safeguarding animal health while optimizing production outcomes in the face of challenging climatic conditions.

Keywords - CM, WMS, ESP8266, Blynk IoT, DHT11.

I. Introduction

This chapter presents the Problem Statement, Project Overview, and the Objectives of the Chik's Mist..

a. Problem Statement

The hot weather in the Philippines induces significant challenges, especially on poultry farms. Heat stress on poultry animals can lead to reduced food intake, retarded growth, intestinal disequilibrium, lower reproductive performance, immunity, and endocrine disorders in livestock and poultry[1].

The harmful impact of heat stress can decrease growth rates, appetites, feed utilization, laying, impaired meat, and egg qualities. Affecting poultry farm productivity and causing significant losses to poultry farmers that threaten its long-term sustainability[2].

With the advancement of technology, there are various applications trying to solve these challenges in poultry houses. However, developed systems are lacking in monitoring critical environmental factors in harmful gas, microclimatic, and air quality categories[3].

Many problems arise in poultry farms due to rising cage temperatures that are often faced by broil breeders. Lack of adequate facilities for dealing with stress in broilers is often a problem that is often faced by farmers to stabilize the humidity of the open cage room air. They stabilize the humidity by using a water pump and splashing it on the chickens that are struggling with the heat[4].

Hot conditions present significant challenges for poultry farms, primarily due to heat stress, which results in reduced productivity and significant financial losses for farmers, threatening the sustainability of their operations. Although technological advancements have introduced various solutions, many systems lack comprehensive monitoring of critical environmental factors like harmful gasses, microclimatic conditions, and air quality. Broil breeders often face high cage temperatures and inadequate facilities to manage heat stress, resorting to manual methods such as using water pumps to splash water on the chickens. This highlights the need for more sophisticated, automated systems to effectively monitor and control the poultry house environment, improving animal welfare and farm productivity.

b. Project Overview

This project aims to create a Chik's Mist, an automated water mist system for poultry farms, integrating cloud connectivity for remote monitoring. The system will accurately measure temperature and humidity within the farm, thus utilizing the connection between the prototype and the Blynk app to provide real-time data and control. Through a closed-loop design, the prototype will efficiently manage watering based on environmental conditions, offering a practical solution for poultry farm management. Many poultry farms now rely on humidity sensors to help monitor the moisture of the litter. Between 50% and 70% of the time, ventilation for moisture removal will move enough moisture out of the house to keep the litter from getting too wet[5].

c. Objectives

The primary goal of Chik's Mist is to produce and establish an automation system that addresses a real-world issue, particularly the heating problems in farms in tropical countries. This design requires the prototype to be an unrestricted-circle system able to communicate between two or further stage-alone biases, as well as seeing and executing an electromechanical function. Specifically, this design focuses on creating an automated water mist system connected to the cloud.

The following are the specific objectives for the Chik's Mist:

1. Develop a closed-loop water mist system prototype using ESP8266 microcontrollers.
1. To establish a reliable WiFi connection between the microcontroller and a computer or mobile device
2. Test and validate the system's accuracy based on the sensor readings to ensure effectiveness.

II. Methodology

This chapter presents the Hardware Design, Software Design, and Data Engineering of the Chik's Mist.

a. Hardware Design

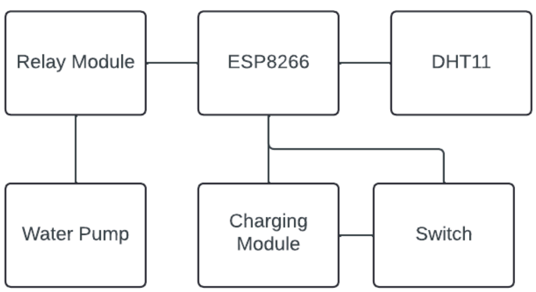

Figure 1. Chik's Mist Framework

Figure 1 shows the framework of the Chik's Mist consisting of an ESP8266 in the center as a microcontroller, which is connected to the following components:

- **DHT11 Sensor**, for measuring the temperature and humidity for feedback mechanism.
- **Relay Module**, for controlling the high voltage water pump, which is 12V.
- **Charging Module,** for managing power supply, since it is step-up using a boost converter.
- **Switch,** for turning on the ESP8266 and stand alone operation.

This setup allows for the monitoring of environmental conditions and remote control of the water pump via Wi-Fi using the Blynk IoT platform.

i. Electronics Systems

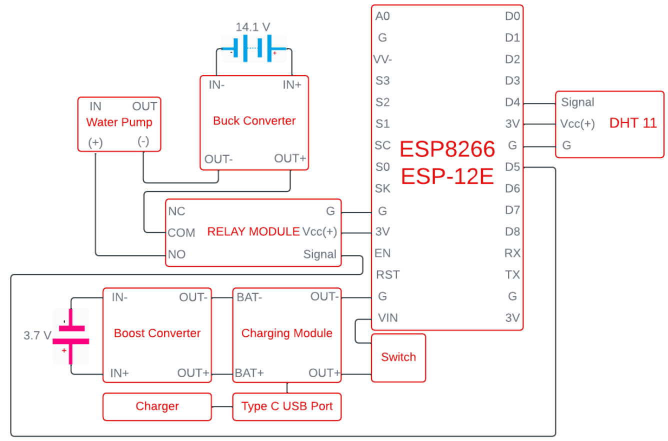

Figure 2. Chik's Mist Schematic Diagram

Figure 2 shows the schematic diagram of the Chik's Mist, detailing the functionality and connectivity between the ESP8266 ESP-12E and various components: DHT11 sensor, Relay Module, Switch, and Charging Module.

Table 1. Functionality and Connectivity of Components

Components	Functionality and Connectivity
DHT11 Sensor	This is directly connected to the pins of ESP8266, specifically the Signal, Vcc(+), and G of DHT11 to the D4, 3V and G of the ESP12E respectively.
Relay Module	It is directly connected to the ESP8266, where it uses a buck converter to reduce the DC battery voltage from 14.1V to 12V to match the water pump's voltage requirement. This is mainly used to control a high-voltage water pump, which is 12V.
Charging Module	It is directly connected to the ESP8266 for standalone operation. The charging module is used to charge the 3.7-lithium-ion battery connected to the boost converter.
Boost Converter	Steps up the 3.7V lithium ion battery to 5V to meet the operational requirements of both the ESP8266 and the relay module.
Switch	It is directly connected to the VIN of the ESP8266 and the output port of the charging module. The switch allows for standalone operation by toggling the microcontroller's power.

Table 1 shows the functionality and connectivity of the components seen in Figure 2.

ii. Physical Systems

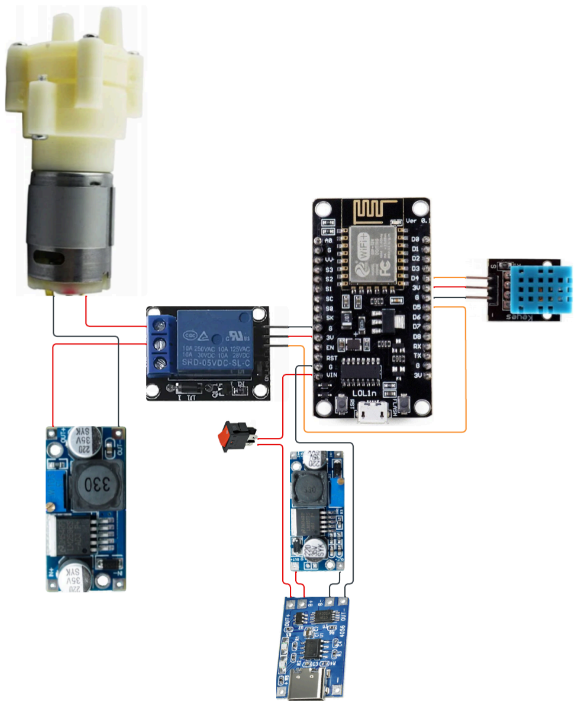

Figure 3.Chik's Mist Physical System

Figure 3 shows the Chik's Mist's physical representation of the connections between each component. In the connection of the ESP8266, there are multiple connections: first is the DHT11 sensor, which reads temperature and humidity and passes them to the ESP8266; next is the buck converter, which reduces the voltage coming from the charging module; and the switch controls the state of the ESP8266; it is used to turn on and off. Next is the relay module to control the on and off state of the water pump; this is used with a boost converter to boost the voltage of the water pump.

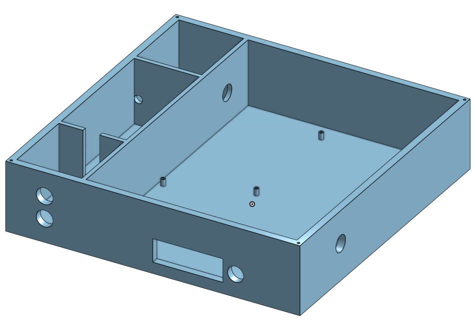

Figure 4. Components Protective Case

Figure 4 shows the component protective case designed to protect hardware that is susceptible to water damage. Accurate measurements are needed for easy assembly of the parts, and screw holes are needed to secure the components when moving. The water pump is isolated, and it is essential to ensure that other hardware is safe in case of water leaks. Holes are designed for specific functions, specifically charging ports, pump intake/outtake, water drain, and wires for easy tube and wire management.

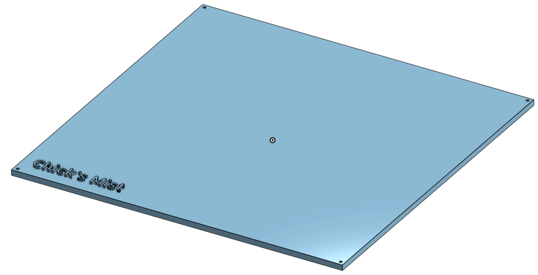

Figure 5. Components Protective Case Cover

Figure 5 shows the protective case cover to secure components from water splashes and other factors that can be a possible cause for system malfunction or destruction. These are not limited to water splashes, weather, or other debris when it is set up on the poultry farm.

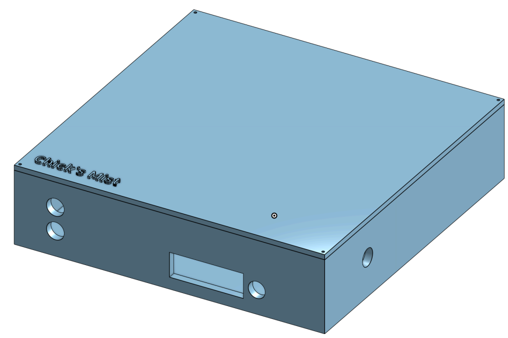

Figure 6. Assembled Protective Case

Figure 6 shows the assembly of the protective case, which is the joint figure of 4 and 5.

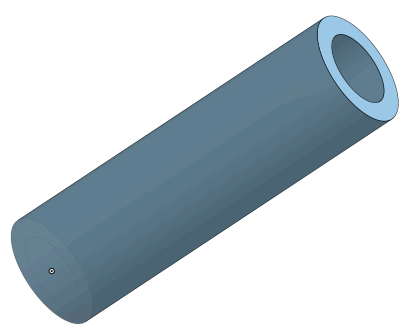

Figure 7. Tube Connectors

This figure shows the tube connectors which are used for the connection of the water sprinkler and the hose.

iii. Power Management

Table 2. Components Used for Power Management

Components	Function
5x 18650 3.7V 2200mAh Lithium Ion	Acts as a power source, supplying the voltage required for the water pump.
Battery Holder 18650 1S and 4S with Wire	Used to shelter the battery and allow easy connection to the circuit.
Type C USB 5v 18650 Charging Module	This is the power source for the ESP8266 and the DHT11. This is also used to easily charge the battery.

Table 2 shows all the components used to power the system. The power used in the system clarifies what power sources are used for the microcontroller and water pump.

b. Software Design

i. Embedded Software

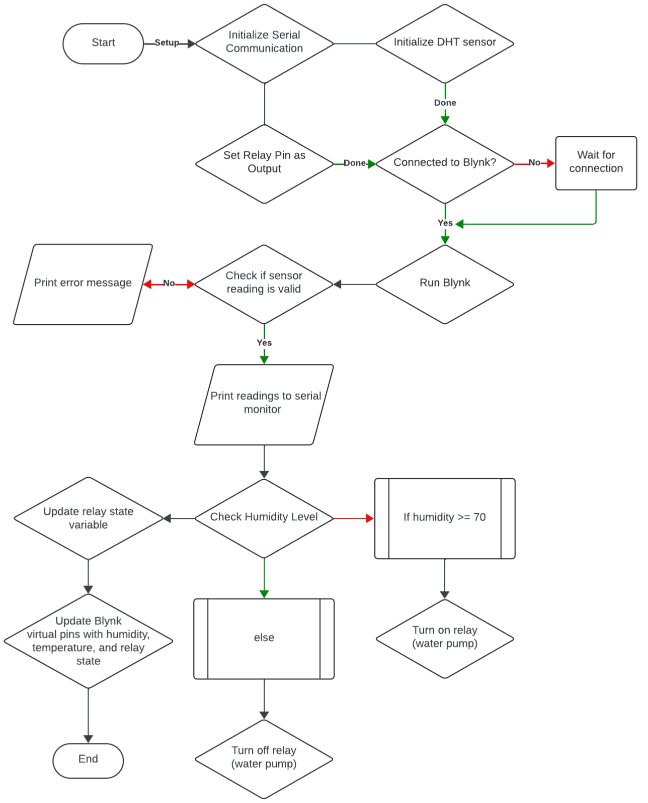

Figure 8. Flowchart for Embedded Logic

Figure 8 shows the flowchart for embedded logic of the system. The setup for the serial communication and initializing the DHT sensor. The system checks if it's connected to the Blynk IoT; if it is not connected, it waits for the connection. Once connected, it checks the sensor reading and updates the Blynk App humidity, temperature, and relay state if it's on or off. The system checks the humidity level; if the humidity is higher than 70, the relay turns on, and if it is below 70, it turns off.

ii. Application Software

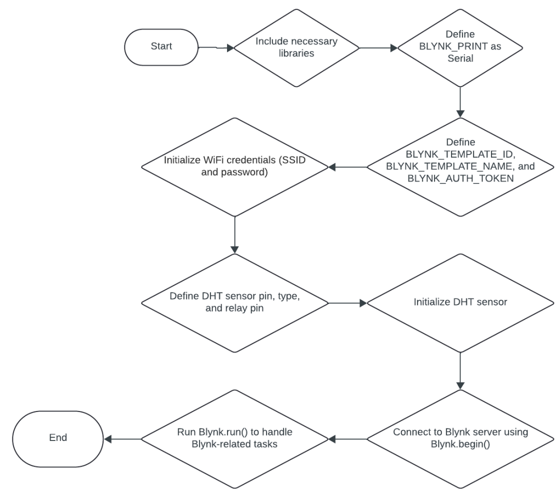

Figure 9. Communication between NodeMCU and the Blynk Server

Figure 9 shows how NodeMCU and the Blynk Server communicate. The process, starts by including libraries and defining Blynk, then moves to initialize the DHT sensor to connect it to the Blynk server, and lastly handle Blynk-related tasks.

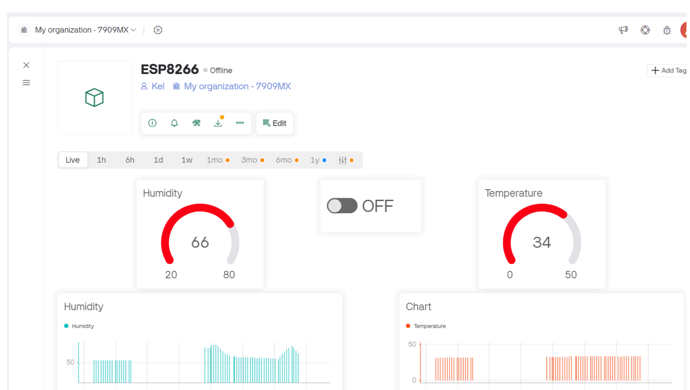

Figure 10. Blynk IoT Dashboard(Computer Device)

Figure 10 shows the dashboard on the Blynk IoT platform displayed on the computer, which monitors temperature and humidity levels. It includes a graph that charts humidity readings over time and the relay state, if it's on or off.

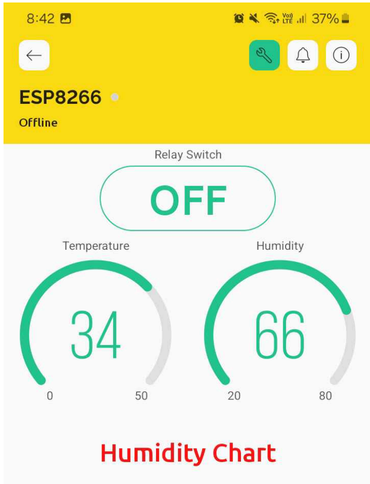

Figure 11. Blynk IoT Dashboard(Mobile Device)

Figure 11 shows the Blynk IoT application on mobile device dashboards, which are used to monitor humidity and temperature. It also shows the humidity chart for better monitoring and the relay's state if it's on or off.

c. Data Engineering

In the Chik's Mist project, the data engineering aspect primarily revolves around the collection and utilization of sensor data to maintain optimal environmental conditions.

i. Data Description

For data description, there is no complex data acquisition or calibration process involved. Since the DHT11 sensor is already a digital sensor, it provides digital outputs for temperature and humidity readings, which are directly used by the microcontroller for further processing and control.

ii. Algorithms Used

Table 3. Code Snippet of the System

```
#define BLYNK_PRINT Serial
#define BLYNK_TEMPLATE_ID "TMPL6Ac1bzWo2"
#define BLYNK_TEMPLATE_NAME "Mist System"
#define BLYNK_AUTH_TOKEN
"_9kRxtFRvqy75xx6uYHlX11kPlYTLa8W"

#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>
#include <DHT.h>

char ssid[] = "Kel";
char pass[] = "12345678";

#define DHTPIN 2
#define DHTTYPE DHT11
#define RELAY_PIN 14

DHT dht(DHTPIN, DHTTYPE);
int relayswitch = LOW;

void setup() {
  Serial.begin(115200);
  pinMode(RELAY_PIN, OUTPUT);
  dht.begin();
  Blynk.begin(BLYNK_AUTH_TOKEN, ssid, pass);
}

void loop() {
  Blynk.run();
  float humidity = dht.readHumidity();
  float temperature = dht.readTemperature();

  if (isnan(humidity) || isnan(temperature)) {
    Serial.println("Failed to read from DHT sensor!");
    return;
  }

  Serial.print("Temperature: ");
  Serial.print(temperature);
  Serial.print("°C, Humidity: ");
  Serial.print(humidity);
  Serial.println("%");

  if (humidity >= 70) {
    digitalWrite(RELAY_PIN, HIGH);
    Serial.println("Turning on relay (water pump)");
  } else {
    digitalWrite(RELAY_PIN, LOW);
    Serial.println("Turning off relay (water pump)");
  }

  Blynk.virtualWrite(V0, humidity);
  Blynk.virtualWrite(V1, temperature);
  Blynk.virtualWrite(V2, relayswitch);

  delay(2000);
}
```

- **Initialization Algorithm**, The setup() function follows a specific sequence of steps to initialize system components, ensuring they are ready for operation.
- **Main Loop Algorithm**, Within the loop() function, various algorithmic processes occur:
- **Sensor Reading Algorithm**: Reading temperature and humidity values from the DHT sensor.
- **Data Validation Algorithm**, Checking if sensor readings are valid.
- **Decision-Making Algorithm**, Determining the state of the relay based on humidity readings.
- **Blynk Update Algorithm**, Updating Blynk virtual pins with sensor data. Delay Algorithm: Introducing a delay to control the update frequency.

Table 3 shows a decision-making algorithm that uses conditional statements to control the water pump depending on the humidity level and the loop “if-else” to determine the operation of the water pump. When the humidity reaches 70%, the water pump will be on state, and if it is below 70%, the water pump is off state. This ensures that the system operates as intended, and the function of the water mist system on the poultry houses prevents over-fogging and maintains the humidity levels to a normal state, which helps the well-being of the poultry and optimizes water usage.

III. Testing Procedures and Results

a. Testing Configuration / Setup

The testing setup for Chick’s Mist: Automated Water Mist System in Poultry House is outlined below:

1. **Accuracy Testing.** The accuracy of the water mist system will be assessed by monitoring the activation of the water pump in response to humidity levels. The system will be configured to turn on the water pump when the humidity sensor reads 70% or higher. Testing will be conducted under various humidity conditions to ensure consistent and accurate operation.

2. **Blynk Connections Testing.** The functionality of Blynk connections will be evaluated by monitoring sensor readings in the Blynk IoT app. Changes in temperature, humidity, and relay status displayed in the Blynk app will be observed to ensure real-time data transmission and control. The reliability and responsiveness of the Blynk interface will be assessed to verify seamless communication between the water mist system and the Blynk platform**.**

b. Testing Results

Table 4. Accuracy Test

Test #	Pinching Sensor	Changes in Humidity
1	✔	✔
2	✔	✔
3	✔	✔
4	✔	✔
5	✔	✔
6	✔	✔
7	✔	✔
8	✔	✔
9	✔	✔
10	✔	✔
Accuracy		100 %

Table 4 shows the testing results for the accuracy of the system. In the testing results, the tested prototype could quickly detect changes in humidity correctly. As seen in the results of the test done above, the program responded well with 100% accuracy.

Table 5. Blynk Connections Test

Test #	Humidity Value	Relay State (Water Pump)
1	>= 70	ON
2	>= 70	ON
3	>= 70	ON
4	>= 70	ON
5	>= 70	ON
6	>= 70	ON
7	>= 70	ON
8	>= 70	ON
9	>= 70	ON
10	>= 70	ON
Accuracy		100 %

Table 5 shows the test for communication between devices and the Blynk App. In the table above, the humidity value is checked and transmitted to the node MCU over the Blynk IoT. Based on the tests that are done, opening at 70% with 10 trials, the system is accurate and correct, reaching 100% accuracy on the tests.

IV. Analysis of Testing Results

The analysis of the testing results gives information on the robustness and use of Chick’s Mist. The first set of tests is focused on evaluating the responsiveness of the DHT11 to changes in humidity, which demonstrated outstanding performance. Pinching the sensor to manipulate its humidity resulted in the system detecting the changes accurately and achieving 100% across all 10 tests. The next test is focused on the accuracy of the system that activates the water pump when the DHT11 sensor records a value of over 70% humidity. In all 10 trials, the system gets a perfect accuracy of 100%.

V. Conclusions

The challenges of heat on poultry farms come from the lack of existing solutions for monitoring and cage temperature that require humidity stabilization. The Chick's Mist project successfully achieves its objectives by introducing an automated misting system that surpasses conventional methods. Through the integration of advanced hardware components and robotics, the system offers a versatile and efficient sprinkler solution for poultry farms.

The reliability of the system in accurately maintaining humidity levels is important to poultry farmers to provide continuous support in managing poultry houses, especially in extreme heat. Achieving 100% accuracy in testing, highlighting the reliability of the system in regulating levels, and addressing heat stress in poultry houses. The system responds consistently to changes in humidity levels, activating the water misting when in need. The use of Blynk IoT ensures that monitoring is easier with the use of computers or smartphones, provides a user-friendly interface, and enables poultry farmers to remotely monitor and manage environmental conditions. Chick's Mist presents a significant advancement in the challenges of heat stress on poultry farms. This system improves poultry health and productivity, contributes to animal welfare, and promotes sustainable farming practices.

VI. References

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