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Design of a Temperature and Humidity Monitoring System in Broiler Farms Using Internet of Things-Based Thingspeak

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ABSTRACT

Broiler chickens or also called broiler chickens are a type of chicken specifically designed for meat production in a relatively short time. They have fast growth and have high meat quality. Optimal temperature is very influential to achieve high productivity of broiler chickens. Broiler chicken coops require proper temperature regulation to create an optimal environment for the growth and health of the chickens. In this study, I propose the use of automatic light activation as a method for efficiently controlling broiler coop temperature. The method used involves installing a temperature sensor in the cage connected to a control system. When the temperature inside the cage exceeds or falls below a set limit, the control system will automatically turn on or off the light to maintain the desired temperature. The temperature settings tested in this study included the minimum and maximum temperatures set to achieve thermal comfort for broiler chickens. In addition, I also observed the effect of the duration of the light on the temperature in the cage.

KEYWORDS *IoT, Temperature control, Broiler chicken coop, Automatic lamp activation*

1. INTRODUCTION

Chicken meat is an abundant source of animal protein and can be found easily by the public at an affordable price (Aji Susanto, 2023). According to data from the Central Statistics Agency (BPS), broiler meat production in 2022 in West Java will reach 733 981.72 tons. The high production rate indicates that the chicken farming business is a business that is of interest to the majority of the public because of the promising profits. However, the process of caring for chickens also needs to be developed in order to improve the quality of livestock.

Broiler chickens are livestock that have fast growth and require optimal temperatures to achieve high productivity. Ambient temperature affects the growth of chickens. In principle, maximum growth and efficient use of feed cannot be achieved if the birds are kept below or above unsuitable ambient temperatures.

Currently, the majority of small to medium scale chicken farms still use conventional methods in terms of daily chicken care, such as temperature regulation in the cage. This is felt to be less effective in increasing the productivity of breeders. This obstacle is rarely overcome by small to medium scale breeders. In fact, livestock factors and livestock facilities will be able to provide maximum livestock yields if farmers have knowledge and skills in various technological mastery.

With these problems, researchers are trying to create a technological innovation, namely controlling the temperature of broiler chicken coops by activating automatic lights. With this automatic control system, it is expected that the broiler coop temperature can be maintained at the optimal range for maximum growth and productivity.

2. METHODE

The stages of research conducted by researchers in this activity are as follows

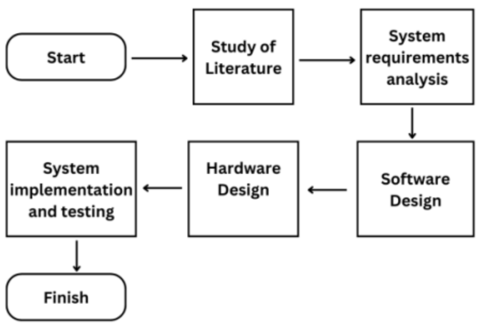


Figure 1. Framework Research

A. Study of Literature

Literature study was conducted to obtain an in-depth understanding of the factors that influence the growth of broiler chickens and optimal temperature requirements. Relevant literature on broiler temperature management and automatic control were also reviewed to support system design

B. System Requirements Analysis

Based on the study of literature and knowledge about broiler chickens, a system requirements analysis was carried out which included selecting the right temperature sensor, designing the necessary hardware, and designing software to control the activation of the lights.

Details of the equipment required :

1) Arduino ESP32S / node MCU 32s
2) DHT11 Sensors
3) Relay 2 channel (optional 1 channel for spare fan as humidity regulator)
4) Enough cable
5) Micro USB data cable
6) 5 watt bulb
7) Lamp fittings
8) Male contact

C. Software design

The software is developed to connect the temperature sensor with the microcontroller and control the activation of the lights. The software program is designed with an algorithm that is able to read temperature data, compare it with a specified threshold, and make a decision to turn on or turn off the light.

C.1. Simulated pinning on the ESP32S

1) Connect DHT sensor to arduino (+ to 3.3v, out to pin 26, - to GND)
2) Connect relay terminal to arduino (vcc to 5v, inp1 to pin 19, GND to GND)
3) Connect a 5 watt bulb to the relay with the normally open initial condition

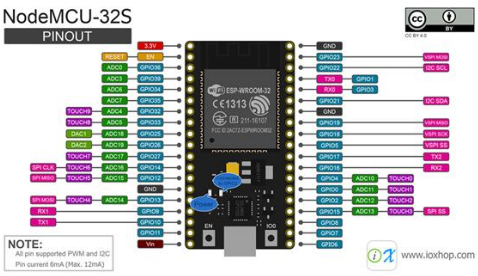


Figure 2. NodeMCU-325

C.2. Writing code using the Arduino IDE

The details of the program are written as follows, complete with a description of each function block.

```
#include <DHT.h>
#include <WiFi.h>
#include <HTTPClient.h>

#define DHT_PIN 26
#define RELAY_PIN 19
#define TEMPERATURE_THRESHOLD_ON_MIN 28
#define TEMPERATURE_THRESHOLD_ON_MAX 31

DHT dht(DHT_PIN, DHT11);

const char* ssid = "Ardi";
const char* password = "9919001zjy";
const char* server = "api.thingspeak.com";
const char* apiKey = "HI226TU41URUH0OR";

void setup() {
  // Setup DHT sensor
  dht.begin();

  // Setup relay pin as output
  pinMode(RELAY_PIN, OUTPUT);

  Serial.begin(115200);

  // Connect to WiFi
  connectToWiFi();
}

void loop() {
  // Read temperature and humidity
  float temp = dht.readTemperature();
  float humidity = dht.readHumidity();

  // Print temperature and humidity
  Serial.print("Temp: ");
  Serial.print(temp);
  Serial.print(" °C ");
  Serial.print("Humidity: ");
  Serial.print(humidity);
  Serial.println(" % ");

  // Control relay based on temperature
  if (temp >= TEMPERATURE_THRESHOLD_ON_MIN && temp <=
TEMPERATURE_THRESHOLD_ON_MAX) {
```

```
    digitalWrite(RELAY_PIN, HIGH);  // Turn on the relay
  } else {
    digitalWrite(RELAY_PIN, LOW);   // Turn off the relay
  }

// Send data to Thingspeak
  if (WiFi.status() == WL_CONNECTED) {
    HTTPClient http;
    String url = "http://";
    url += server;
    url += "/update?api_key=";
    url += apiKey;
    url += "&field1=";
    url += String(temp);
    url += "&field2=";
    url += String(humidity);
    http.begin(url);

    int httpCode = http.GET();
    if (httpCode > 0) {
      Serial.println("Data dikirim ke Thingspeak");
    } else {
      Serial.println("Gagal mengirim data ke Thingspeak");
    }

 http.end();
  } else {
    Serial.println("Tidak terhubung ke WiFi, mencoba tersambung
kembali...");
    connectToWiFi();
  }

  delay(5000);
}

void connectToWiFi() {
  Serial.println("Connecting to WiFi...");

  WiFi.begin(ssid, password);
  int retryCount = 0;
  while (WiFi.status() != WL_CONNECTED) {
    delay(1000);
    Serial.print(".");
    retryCount++;
    if (retryCount > 10) {
      Serial.println();
      Serial.println("Gagal menyambungkan ke WiFi");
      return;
```

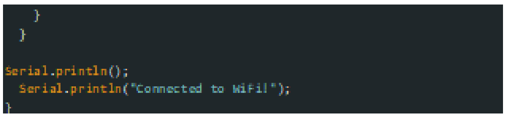


Figure 3. Coding Programs

C.3. The process of compiling and uploading the program uses the Arduino IDE

The process of compiling the program that has been made using the Arduino IDE and then executing it on the hardware that has been prepared.

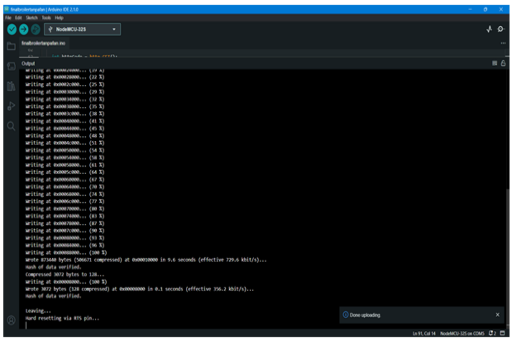


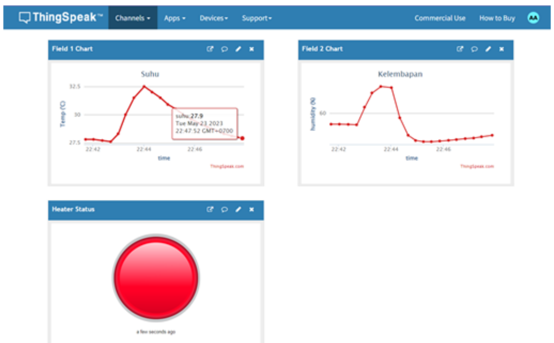
Figure 4. The Process of Compiling

D. System implementation and testing

After the hardware and software design is complete, the system is implemented in the field by installing a temperature sensor in the boiler chicken coop. The system is then tested to ensure that the running temperature measurement is accurate and the running light control matches the detected temperature.

D.1. Heater on if the temperature is less than 28C

It can be seen in the simulation shown on the ThingSpeak application when the temperature conditions start to drop below 28 C the system immediately responds to turn on the light bulb as expected, and can be seen in the following figure.



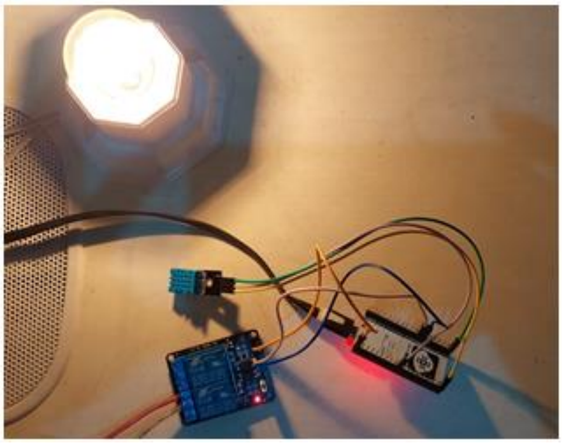
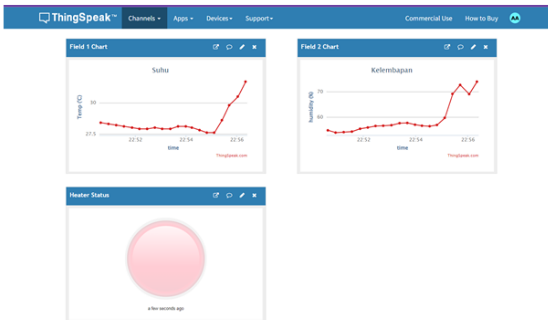


Figure 5. Testing System 1

D.2. Heater off at temperatures over 31 C

The system that has been created will automatically turn off the light bulb at temperatures above 31 C to avoid overheating of the boiler chickens which can result in death of the boiler chickens. The simulation can be seen in the following figure.



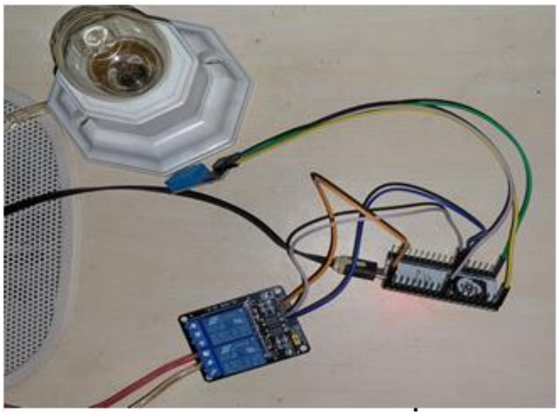


Figure 6. Testing Programs 2

3. *RESULTS AND DISCUSSION*

The results showed that the broiler coop temperature control system with automatic light activation functioned well. The temperature sensor is capable of accurately measuring temperature, and based on the detected temperature data, the system automatically controls the turning on or off of the light.

In conditions of temperature below the specified threshold, the lights are activated to increase the temperature in the cage. This helps prevent cold stress in broiler chickens. Conversely, if the temperature exceeds a set upper limit, the lights are turned off to cool down the house temperature and avoid heat stress.

In the discussion, the research results are compared with relevant literature studies. The use of a broiler coop temperature control system with automatic light activation can help maintain a suitable temperature for broiler chicken growth, optimize productivity, and reduce the risk of death due to inappropriate temperatures.

4. CONCLUSION

The Internet of Things-based chicken coop temperature control system is designed by utilizing Arduino ESP32S / MCU 32s nodes as a microcontroller, DHT11 sensors as temperature and humidity sensing elements in the chicken coop, and the ThinkSpeak application as an interface system.

This entire system can be used to regulate the temperature of the cage in real time which can be controlled and monitored remotely via a smartphone by utilizing the internet network. The implementation of this tool for chicken farmers in the future is expected to solve the problems of chicken farmers so that it can increase productivity in fulfilling market demand for chicken meat.

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