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Design of monitoring system for controlling the Temperature of chicken coops based on Internet of Things by utilizing Thingspeak

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ABSTRACT
Broiler chickens are cattle whose growth is affected by ambient temperature. Inappropriate chicken cage temperatures can affect productivity and cause death in broiler chicken, so setting the cage temperature should be done. The design of this automatic temperature control system used the ESP32 microcontroller as the primary controller, the DHT22 as the enclosure temperature sensor and the ThingSpeak as remote monitoring. The microcontroller shall order if the measured temperature is above the set temperature limit and shall order the LED to light red, if the measured temperature is below the specified temperature limit to light blue, but due to the limitations of the author's LED material uses yellow. The results of the study showed that this automatic chicken coop temperature setting tool can work well to automatically regulate the chicken coop temperature and that the data on the results of this study would be entered into ThingSpeak and printed on the LCD.

KEYWORD Automatic temperature control; chicken cage; ESP32; temperature sensor; ThingSpeak

1. INTRODUCTION

Proper and well-controlled temperatures are essential in maintaining the health and comfort of livestock, including chickens. Chicken cages that are overheated or too cold can negatively affect the health of chickens and their quality of production. Therefore, it is important to have an effective and reliable temperature control system in a chicken cage [1, 2].

In this report, we will discuss the design of a microcontroller-based chicken cage temperature management system, especially using ESP32. ESP32 is one of the popular and powerful microcontrollers that allows easy control of devices and wireless communications [3]. Using ESP32, we can design a real-time intelligent, connected system to monitor and regulate the temperature of the henhouse [4, 5].

The temperature control system we designed will have several major components, including temperature sensors, ESP32 microcontrollers, and temperature control devices. The temperature sensor will be used to measure the temperature inside the henhouse, while the ESP32 will act as the brain of the system, receiving data from the sensor and controlling the temperature control device [6, 7].

The purpose of this report is to provide an in-depth understanding of the design of microcontroller-based chicken cage temperature management systems using ESP32. We will describe the system design and implementation process, including component selection, configuration settings, and integration between sensors [8, 9].

2. METHOD

2.1. Boiler Chicken

A broiler chicken is a chicken that has a high ability to live and efficiently convert food into meat. In general, this chicken is ready to harvest at the age of 28-45 days with a weight of 1.2-2 kg/tail. The environmental temperature affects the growth of chickens. In principle, the maximum growth and efficiency of food use cannot be achieved, if chickens are kept below or above inappropriate environmental temperatures [10]. At 34 °C, chickens have difficulty removing heat, especially when followed by high humidity in such a state that they can no longer remove heat, so body temperature tends to soar. By the time an animal is no longer able to maintain a homoeothermic, it will reduce heat production by using internal physiological mechanisms to work towards better heat balance regulation [11, 12]. The consumption of food and secretion of thermogenic hormones will decrease to reduce basal metabolism which will be followed by a decrease in productivity. If all of these physiological mechanisms fail to correct or restore the body's heat load balance, the animal's body temperature increases and the animal enters an acute phase. If the system is still failing, the next phase will result in death. Table 1 shows comfortable temperatures for broiler chickens at different age levels [13, 14].

Tabel 1. A comfortable temperature for chickens

Age (Day)	Temperature (°C)
1	32-29
3	30-27
6	28-25
9	27-25
>12	26-24

2.2. Microcontroller

The ESP32 microcontroller is an integrated circuit that can receive input signals, process them, and deliver output signals controlled by specifically writeable and erasable programs. ESP32 is a microcontroller consisting of microprocessors, memory, Input/output (I/O) lines, and other complementary devices integrated into a single chip [15]. ESP32 is a type of microcontroller developed by Expressive Systems. These microcontrollers have interesting features and complete facilities, in addition to being easy to obtain and relatively affordable. ESP32 also has low power in its operation and is based on the dual-core Xtensa LX6 architecture [5, 16].

ESP32 has very flexible capabilities. It has a high clock speed, up to 240 MHz, and can achieve performance of around 600 DMIPS. The microcontroller is equipped with many features including many GPIO pins, wireless communications such as Wi-Fi and Bluetooth, ADC (Analog-to-Digital Converter), PWM (Pulse Width Modulation), UART (Universal Asynchronous Receiver-Transmitter), and other Peripheral Interfaces. ESP32 also has programmable capabilities in systems using SPI serial links. It has an on-chip programmable memory (flash) with greater capacity, which allows developers to flexibly perform software updates. With its comprehensive features and high capabilities, ESP32 is ideal for use in a variety of applications, including the Internet of Things (IoT), remote control systems, cloud-based monitoring, internet-connected prototype development, and more. As such, ESP32 is a reliable and flexible microcontroller for use in a variety of electronic projects that require advanced control, communication, and connectivity.

3. RESULT AND DISCUSSION

The Microcontroller-Based Chicken Cage Temperature Management System Design consists of two parts: hardware design and program creation.

3.1. System Diagram Block

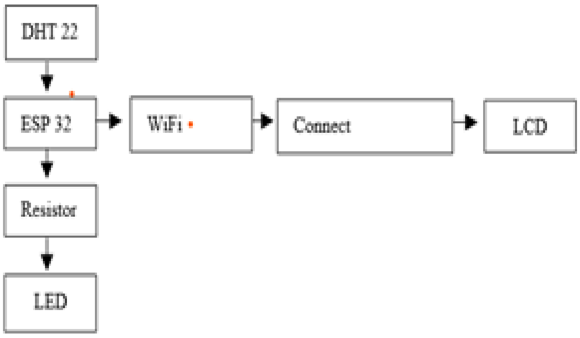

Figure 1. System Diagram Block

In this series there are 4 LEDs that provide high or low input to the microcontroller. The switch serves to determine the temperature limit used to command the microcontroller, so that it can work to maintain stable enclosure temperature according to the predetermined temperature limit value. Determination of temperature limits based on age and comfortable temperature for chickens.

Tabel 2. LEDs and Temperature Limits

LED	Batasan Suhu	Umur Ayam (Hari)
LED 1 Yellow1	Koneksi WiFi	-
LED 2 Yellow2	<21	>30
LED 3 Green	21-29	20
LED 4 Red	>29	1-20

Tabel 3. Temperature Measurement Results With Temperature Limits

Waktu (WIB)	Suhu Lingkungan	Suhu Kandang	Keterangan
00.00	26	25,9	Led hijau
03.00	27	26,7	Led hijau
06.00	28,2	27,9	Led hijau
09.00	29,1	29,1	Led merah
12.00	30	29,8	Led merah
15.00	29,7	29,8	Led merah

Based on the measurements, it was found that LED lights were often green, indicating that the ambient temperature was sufficient for chicken breeding. However, it is recommended to add cooling circulation at 12 o'clock and above as the weather tends to be slightly hot. In conclusion, the adequate environmental temperature for chicken breeding can be known through green LED light indicators, but additional measures such as cooling circulation at 12 o'clock and above to keep the temperature optimal for chicken.

4. CONCLUSION

The design of a microcontroller-based chicken cage temperature management system using ESP32 offers a real-time, effective and connected solution to monitor and regulate the chicken cage temperature. With proper selection of components, good configuration settings, and good integration between sensors, microcontrollers, and temperature control devices, the system can improve chicken efficiency and well-being and support chicken farm operational success.

Through the design and implementation of this system, we were able to achieve some significant results. First, we successfully selected ESP32 as the right microcontroller for this system. ESP32 offers the robust capabilities and flexibility required to control temperature control devices and communicate with temperature sensors. Conduct in-depth research on the components available for the henhouse temperature control system. Be sure to select components that meet specific needs, such as accurate temperature sensors, compatible microcontrollers, and reliable temperature control devices.

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