Monitoring System IoT-Broiler Chicken Cage Effectiveness of Seeing Reactions from Chickens

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Abstract. Broilers are an excellent source of protein and are needed in the productive age population. From the central statistics data in 2019, the number of broiler populations in Indonesia reached 3.15 billion heads. To maximize production and reduce production efficiency, artificial intelligent application innovations are carried out for temperature, humidity, and gas control in broiler chicken coops. Internet of Things helps farmers make efficient use of human resources to adjust the temperature and humidity of the cage. The microcontroller's primary device uses a wifi-embedded ESP32 to be able to transmit data to the server. To read the environmental conditions of the cell, use DHT11 for temperature and MQ2 for gas. The results of the system's application were tested using two models, namely, testing the sensor reading value compared to the weight on the Thermo hygrometer and observation of the reaction of chickens in the cage. The test results were conducted by comparing the sensor's value with Thermo hygrometer difference can be tolerated and normal chicken reaction because the temperature in the enclosure is well maintained.

1. Introduction

Indonesia is the fourth largest country globally, with a population of 275 million people as of March 2021. The average age of the Indonesian population is 29.7 years which is a productive young age [1], [2]. Chicken meat is a good source of quality protein and is needed in the population at a formative age[3]. In developing countries, the diet of people living in cities can use more animal proteins than residents living in villages. In Indonesia, animal protein sources are sourced from broilers that can be commercially mass-produced properly[3]. Supporting the life of broiler chickens good feed patterns, Indonesia's geographical conditions, and suitable climatic conditions [2], [4]. If it is associated with the population, then Indonesia is a very large market, and it is certain that the demand for broilers will be more robust. Based on the data that broiler farming is an excellent prospect to be developed in Indonesia.

Data statistics center in 2019 recorded the number of broiler population in Indonesia reached 3.15 billion heads with the most production centers located on the island of Java, namely West Java (25.37%), Central Java (19.01%), and East Java (14.60%)[5]. So broiler chicken farming business plays an essential role in the Indonesian economy, which in general broiler farming business is carried out by Small and Medium Micro Enterprises (MSMEs)[6].

The climate in Indonesia is suitable for the development of broilers because the temperature, humidity, and wind speed levels are in accordance with the needs of broiler chickens. The temperature requirement at the time of brooding is about 29° C – 35° C, and humidity is 60%-70%, while the period after brooding is completed, the required temperature is 24° C- 29° C, and humidity is 60%-

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The impact of temperature and humidity is a decrease in feed consumption, and chickens tend to drink frequently, stress, growth slows down and is prone to disease [9], [11]. Broilers otherwise will live well if environmental conditions are not well controlled [7].

In monitoring the temperature in the cage, most farmers still rely on Thermo hygrometers installed in enclosures. While the process of setting constant temperature and humidity can be adjusted using a brooder thermos system [12]. The brooder thermos system has curtains inside and outside the drum. Almost all small-scale breeders still use this conventional method to regulate the temperature and humidity of the drums. In traditional systems, surveillance is required because temperature and humidity parameters are easily changed, especially when the weather is erratic as it was is today.

The Internet of Things helps farmers make efficient use of human resources to adjust the temperature and humidity of cages. The parameters used to make the Internet of things equipment are temperature, humidity, and ammonia gas content. Temperature and humidity affect the metabolism process in chickens and can make chickens stressed. Sensors embedded in the Internet of things retrieve ambient data for digital value retrieving. The digital data is sent to the microcontroller for data processing and data transmission to the server. [12] This change in temperature and humidity has a fickle value that affects the setpoint value. To help detect changing temperature values, an intelligent system is needed to use artificial intelligent to assist in the decision-making of chicken coop temperature regulation. By using a fuzzy method, the machine can think like a human. The fuzzy way controls the speed of the blower fan according to the temperature in the cage.

The intelligent broiler chicken breeding method uses the Internet of things proposed by Irving V Paputungan, focusing on temperature and humidity sensor systems to retrieve environmental data inside the cage. Farmers can see sensor retrieval data through the website or android in real-time and know the history[16]. In the study, Lucas also explained how to reduce stress in chickens by controlling the cage's temperature and humidity. The internet of things model is combined with artificial intelligence to analyze standard temperature and humidity in the chicken coop according to the age of the chicken. This paper was prepared to try the effectiveness of the use of internet-based monitoring devices of things. The effectiveness of the use of the device is tested by looking at the reaction of chickens in the coop. The chickens tested were 14 days to 15 days old, numbering 100 heads.

2. Methodology

For a depiction of the Internet of things, hardware settings, refer to figure 1. Sensors used to retrieve temperature and humidity sensor environmental data use DHT11 and detect ammonia gas using MQ2 sensors. Microcontroller to control sensor role and send data to users using ESP32. Esp32 is equipped with a wifi module and 3.3-volt input. Io32 pins are connected to data pins on DHT11 sensors, IO33 pins are connected to AO pins in gas sensors, while dimmers use IO 14 and IO25 pins. All sensors are associated with a voltage of 3.3 volts. To control the cooling and heating equipment, use dimmers. This dimmer uses Pulse Width Modulator (PWM) system that increases and lowers the voltage so that the heater and more astonishing work according to the average temperature needs needing. The dimmer's voltage uses the VIN pin on the ESP32, and this pin has a voltage of 5 volts. This system was tested for 14 days using 14-day-old chickens as many as 100 heads; during the trial period, we saw chicken reactions at specific temperatures.

**Figure 1. System Design Diagram**
Flow chart of the system created from ESP32 as the primary control to get data from temperature, humidity, and gas sensors. Then the data is sent to the server to be compared with the desired value and match accordingly. If the sensor reading is abnormal, the fan will rotate according to the dimmer's speed range.

![Flowchart System](image)

**Figure 2 Flowchart System**

Figure 3 shows the results of assembling all components ranging from ESP32, sensors, dimmers, and support devices to run according to the design. As for the dimmer is connected by using a jumper cable. Dimmers use terminal blocks to connect dimmers with blower fans. The sensor is associated with three pins, namely IO pin, ground pin, and 3.3 V power pin.

![Assembled components](image)

**Figure 3 Assembled components**

3. Result and Discussion

In broilers aged 14 to 21 days, the chicken coop's ideal temperature ranges from 26°C to 28°C. Monitoring devices are tested at certain hours if the weather changes significantly, such as in the morning time at 00.00 western Indonesian times, at 04.00 western Indonesian times, 08.00 western Indonesian times, at 12.00 western Indonesian time, at 16.00 western Indonesian time, and at 20.00 western Indonesian time. Temperature data taken from the monitoring system is compiled with temperature data from Thermo hygrometers taken at certain hours. The comparison results can be seen in figure 5. From the test results obtained, there is a difference between measurements using IoT monitoring systems using Thermo hygrometers; the differences that are applied can be tolerated. From
the temperature outside the cage with inside the cell, there is also a difference, which means that in the cage, the temperature will rise.

![Grafik Temperature](image)

**Figure 4** Temperature Comparison

The effectiveness of use is carried out testing by observing the reaction of chickens in the coop. The chickens tested amounted to 100 chickens, with the age of chickens reaching the age of chickens from 14 days to 21 days. They were seen when the average temperature of chicken reaction would spread. These conditions affect the ideal temperature of the cage. This normal temperature ranges from 28°C with 55% humidity. At normal temperature, the coolant and heater conditions are off. In abnormal conditions with indications of temperature too high or hot with a temperature of 30°C and humidity of 60%, then the chicken will pull over close to the wall of the chicken coop because, if seen from figure 5, the temperature outside the cage is lower than the temperature in the enclosure. In this condition, the heater will turn on with a medium voltage. This medium voltage heating condition does not work 100% because the temperature increase is not very significant, so electricity does not go up immediately, so it will save electricity usage. In abnormal cage conditions with too cold temperatures around 23°C and humidity of about 50% usually occurs in the morning, then the heater will turn on with moderate intensity. In general, observations for seven days obtained the condition of chickens often spread, so that the temperature of chickens under normal conditions.

| Conditions                  | Pictures | Explanation                                           | Temperature / Humidity | Status                      |
|-----------------------------|---------|-------------------------------------------------------|------------------------|-----------------------------|
| Normal                      | ![Image](image) | This condition occurs the effect of the ideal temperature. | 28°C / 55%             | Coolant Off / Heater Off    |
| Not normal with Hot temperature | ![Image](image) | Overheating exceeds normal limits, but normal humidity usually occurs during the day | 30°C / 60%             | The heater turns on with the medium voltage |
| Not normal with Cold Temperature temperatures | ![Image](image) | The temperature is too cold, but normal development usually occurs in the morning. | 23°C / 50%             | Coolant turns on with the medium voltage |

### 4. Conclusion

Testing was conducted by observing the reaction of chickens in the cage for one week. There are three types of observations that are normal conditions, abnormal conditions due to high temperatures, and abnormal conditions due to low temperatures. From these three observations, the cooling fan lights up at a speed that adjusts the temperature conditions of the three observations. From observations made for one week, the reaction of chickens looks normal, so this monitoring tool proved
effective to maintain the temperature and humidity of the chicken coop according to the needs of chickens. Observations of chicken reaction testing were also conducted by comparing the sensor value with a Thermo hygrometer. From the results of the comparison, there is no significant difference in value because each sensor value has a tolerable error value.

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