Monitoring And Control System In Chicken Raising Cages Based On The Internet Of Things

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***Abstract*— One industry with excellent potential for growth in Indonesia is the chicken farming industry. Chicken growers in Indonesia would undoubtedly encounter significant issues with temperature, humidity, and ammonia gas in chicken coops, particularly in tropical nations. This study develops an internet of things-based monitoring and management system for chicken-rearing cages. The Internet of Things-based monitoring and control system for cages used to raise chickens can be well-designed to detect and control ammonia gas, humidity, and temperature. Within 20 days of data sampling, the Monitoring and Control System in the chicken rearing coop can maintain an ideal average temperature between 28°C and 33°C, humidity 50% to 70%, and ammonia gas 20ppm.**

***Keywords—chicken, ammonia gas, internet of things, humidity, temperatur*e**

I. Introduction

Indonesia's livestock industry is one that has great potential and aims to supply half the world's food by 2045. The country's Gross Domestic Product, which totaled IDR 231.71 trillion in 2018, is strongly influenced by the livestock industry [1]. Indonesians consumed 0.142 kg of purebred or free-range chicken meat per capita per week in 2021, more than they did for beef [2]. Farmers of chickens face difficulties due to the tropical environment of the nation, which has three seasons: dry, transitional, and rainy [3][4]. Reduced ration consumption and decreased output in chicken coops can result from temperature, humidity, and ammonia gas instability [5]. A significant source of air pollution and a danger to the eyes and respiratory system is ammonia gas, which is created when the microbial components in chicken manure break down[6][7]. Alkalosis, or an alkaline pH of body fluids, including blood plasma fluid, can also be brought on in hens by ammonia gas concentrations more than 30 ppm [8]. Humans are able to detect levels above 5 ppm, which can negatively affect poultry growth and result in health issues for workers, animals, and those living around the farm [9][10].

Table I. Optimal Parameter Values for Chicken Cage

Parameters	Optimal Value	Reference
Temperature	28°C - 33°C	[11]
Humidity	50% - 70%	[11]
Ammonia Gas	< 20ppm	[12]

This research aims to design a prototype monitoring system for temperature, humidity, and ammonia gas in a chicken coop using an Arduino microcontroller device and smartphone app.

II. Methods

A. Diagram Block

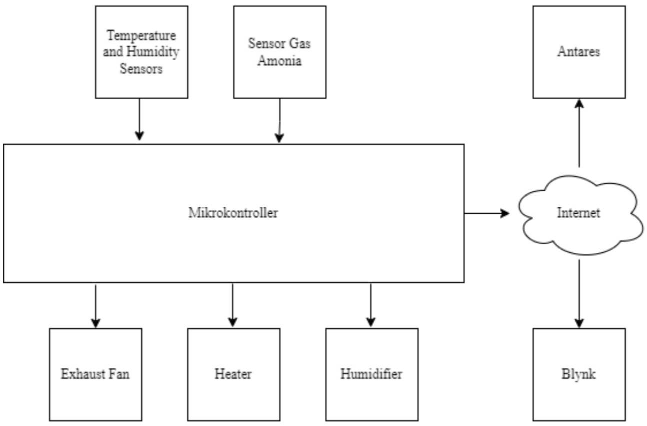

Figure I. Diagram Block System

The nodeMCU microcontroller is used to design a monitoring and control system for chicken rearing coops based on the internet of things. This design is broken down into two parts: hardware design and software design. Hardware design serves as a guide for connecting devices on the microcontroller, while software design serves as a guide for programming the microcontroller so that it can read data and perform its function.

B. Hardware Design

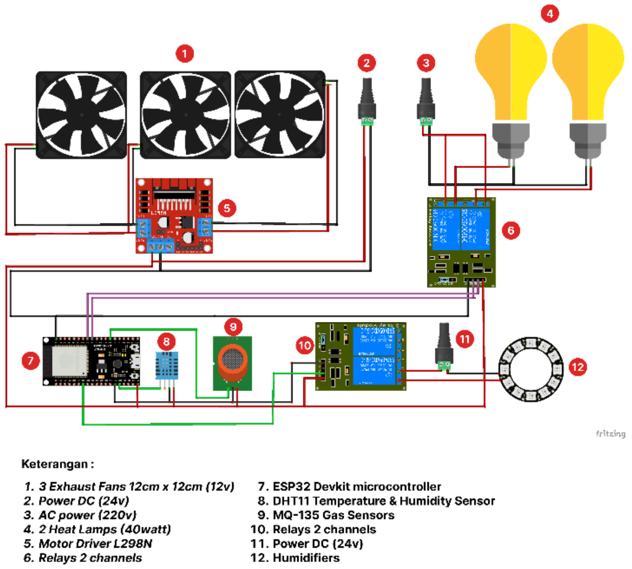

Figure II. Wiring Diagram System

The nodeMCU microcontroller, MQ-135 gas sensor, DHT11 temperature and humidity sensor, dual channel relay, lights, exhaust fan, and two voltage inputs comprise the hardware design of a monitoring and control system for chicken rearing cages based on the internet of things. Figure II. shows the plan for creating a hardware monitoring and control system in a chicken-rearing cage based on the internet of things. As a controller between devices, the device is attached to the nodeMCU microcontroller. The exhaust fan and lights are controlled by the relay, which also serves as a switch. The temperature and humidity in the chicken coop are measured using the DHT11 temperature and humidity sensor. ns. The MQ-135 gas sensor measures the amount of ammonia gas in the coop for the chickens. The lamp serves as a heater in the coop for the chickens. If the temperature within the chicken coop rises beyond a set threshold, the exhaust fan acts as a cooling device; if the ammonia gas rises above a certain threshold, it acts as a decomposition device. The microcontroller serves as a tool for transferring analog data that has been converted into digital data to smartphones that have the blynk application loaded, as well as a control system for DHT11 temperature and humidity sensors, MQ-135 ammonia gas sensors, and relays. The use of 3 exhaust fan units and 40-watt lamps—which had previously been tested with 5 and 15-watt lamps—was necessary because, in the early stages of testing, they were unable to change the cage's temperature with just 2 exhaust fan units.

C. Flowchart System

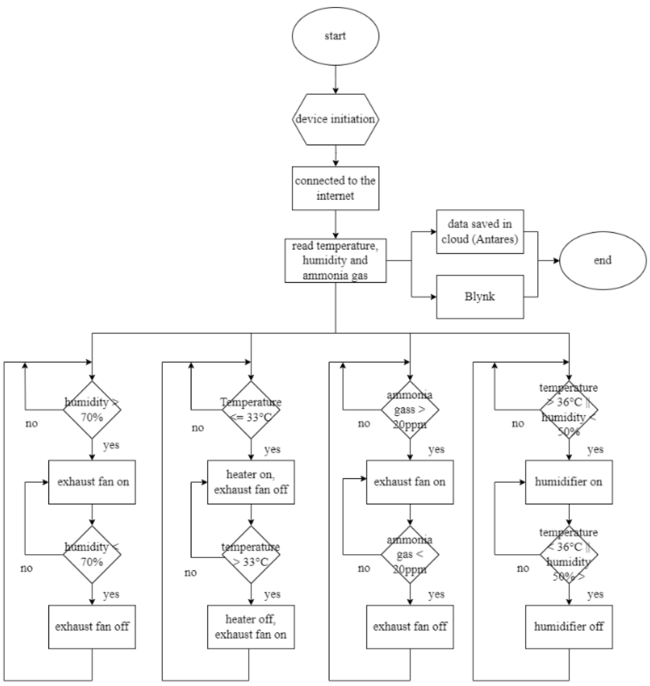

Figure III. Flowchart Diagram System

In order to program the microcontroller so that it can be used and operated in accordance with its function, namely, to monitor and control temperature, humidity, and ammonia gas in the chicken coop, the design of a monitoring and control system software for chicken rearing coops based on the internet of things is used as a guide. Programming software, specifically the Arduino IDE and the C programming language, are used in the construction of the monitoring and control system software for chicken coops based on the internet of things. This software will be built or coded in accordance with the flow diagram in Figure III. The DHT11 temperature and humidity sensors, MQ-135 ammonia gas sensors, relays, internet networks, and Antares and blynk as software which is used to read sensor parameters on smartphone devices are the first devices connected to the microcontroller in the flowchart diagram for the monitoring and control system in chicken rearing cages.

The initiated temperature, humidity, and gas sensors will detect the original state of the temperature, humidity, and ammonia gas in the chicken coop and will assess it every time. If the DHT11 sensor detects a temperature in the cage that is less than 28°C, the relay will conduct electricity to the heating lamp while cutting off the electricity to the exhaust fan. If the temperature in the chicken coop exceeds 33°C, the relay will conduct electricity to the exhaust fan while cutting off the electricity to the heating lamp. For humidity, if the sensor detects that the humidity in the chicken coop is greater than 70%, the relay will conduct electricity to the heating lamp while cutting off the electricity to the exhaust fan, In contrast, when the relative humidity is above 50%, the relay will turn off the electric current to the humidifier and flow it when the relative humidity is below 50%. In order to lower the temperature of the drum and provide humidity, the relay will carry an electric current to the humidifier if the ambient temperature is over 36°C. In contrast, if the ambient temperature is below 36°C, the relay will turn off the power to the humidifier. When the ammonia level in the chicken coop reaches 20 ppm, the relay will carry power to the exhaust fan, and when the level is below 20 ppm, the current to the exhaust fan will be switched off. The information gathered from the sensors for temperature and humidity, along with the ammonia gas sensor will be provided to the blynk application and saved in the cloud (Antares), allowing it to monitor temperature, humidity, and ammonia gas using a smartphone.

III. RESULT AND DISCUSSION

A. Hardware Implementation

The image below shows how the hardware design of an Internet of Things (IoT) based chicken coop monitoring system was implemented in a coop with the dimensions 120 cm x 80 cm x 60 cm. The hardware for the testing enclosure is shown in Figure V, and it includes an ESP32-type microcontroller, an L298N motor driver that acts as a speed control device/PWM, a 4 channel relay that acts as a voltage regulator switch between the microcontrollers, a heating lamp, exhaust fans, and humidifiers. The position of the exhaust fan, ammonia gas sensor (MQ-135), and temperature or humidity sensor (DHT11) are depicted in the figure. The locations of the two heating lamps and the exhaust fan are shown in Figure VI The hardware is depicted as a humidifier in Figure VII.

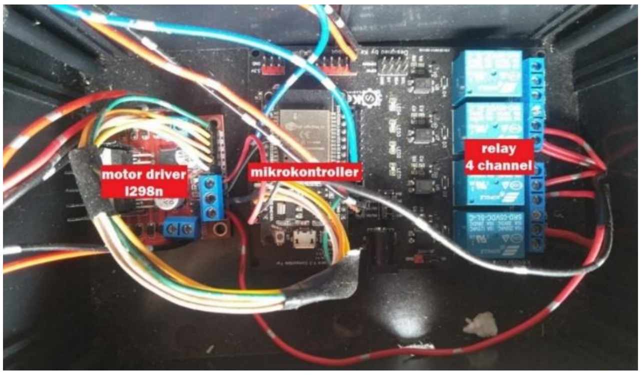

Figure IV. Hardware

Figure V. The Chicken Cage is Viewed on the Right Side

Figure VI. The Chicken Cage is Viewed on the Left Side

Figure VII. Humidifier

B. Software Implementation

Two platforms are used to develop the software design for the Internet of Things (IoT)-based chicken coop monitoring system. First, Telkom Antares was employed as the implementation platform for this system. Telkom Antares is used to store data obtained from sensors for ammonia gas, temperature, humidity, and actuator status that are transmitted by the microcontroller via the internet network using the http communication protocol. Figure VIII shows the Telkom Antares dashboard, and Figure IX displays the data's results. Figure X blynk dashboard.

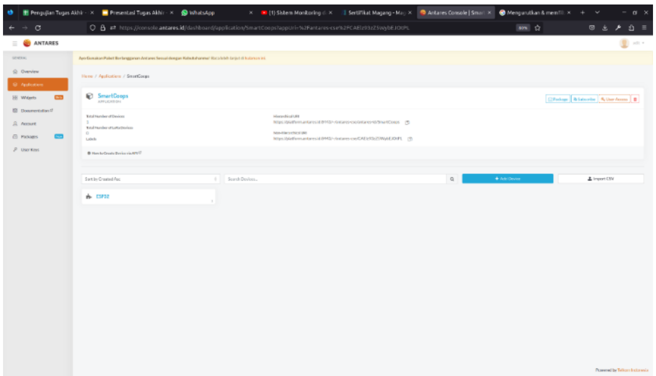

Figure VIII. Antares Dashboard

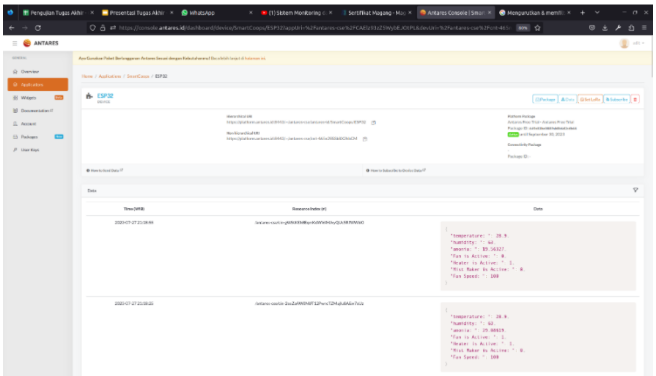

Figure IX. Antares Data Dashboard

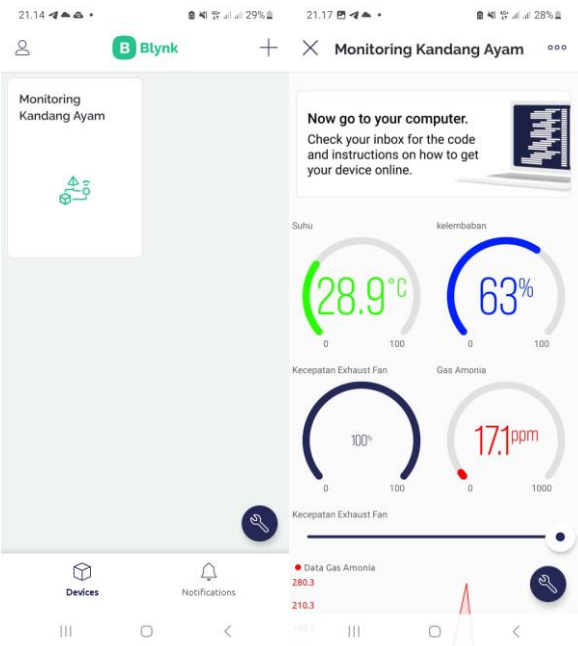

Figure X. Blynk Dashboard

C. Data Collection

Data collection took place in Trowulan village, Mojokerto district, East Java, between July 10 and July 30, 2023. Within 20 days, data gathering was done to establish the cage's typical temperature, humidity, and ammonia gas levels. Data collecting is also done to determine how long the system will take to operate correctly.

Table II. Data Collecting

Days	**Averages**			**Explanation**
	Temperature (°C)	**Humidity (%)**	**Ammonia (ppm)**	
1	31,0	68,1	8,8	 The condition of the chickens in the first week is in good condition and healthy.
2	30,2	67,3	13,3	
3	30,0	60,7	5,6	
4	30,8	64,7	6,4	
5	31,0	64,8	3,9	
6	29,7	70,5	6,8	
7	29,4	69,7	68563,3	
8	31,0	64,8	2,9	 The condition of the chickens in the second week is in good condition and healthy
9	30,2	67,5	13,1	
10	29,2	68,4	6,2	
11	29,9	56,2	7,5	
12	29,8	57,9	9,4	
13	30,4	59,1	3,9	
14	31,1	60,5	8,7	
15	30,7	61,3	14,1	 The condition of the chickens in the third week is in good condition and healthy
16	31,0	63,0	18,7	
17	30,5	61,7	5,2	
18	30,6	60,6	10,2	
19	29,4	63,4	10,8	
20	30,3	59,6	4,7	

As shown in Table II, the Chicken Coop Control and Monitoring System was able to achieve an average temperature and humidity level within 20 days that was within the 28°C to 33°C and 50% to 70% ranges needed by doc chickens. The value obtained for typical ammonia gas is similarly less than the 20 ppm limit. On days 6 and 7, the MQ-135 gas sensor, which can be seen on the attachment page, had issues sensing ammonia gas. The MQ-135 sensor cannot read ammonia gas in the cage or has encountered an unstable detection. The ammonia gas sensor reads a value between 0 and 1000 parts per million (ppm) and infinity (∞).

Identify applicable funding agency here. If none, delete this text box.

IV. Conclusions

The Monitoring and Control System has been tested in chicken-rearing cages using the Internet of Things, and the results indicate that::

1. The Internet of Things-based monitoring and control system for cages used to raise chickens can be well-designed to detect and control ammonia gas, humidity, and temperature.
2. Within 20 days of data sampling, the Monitoring and Control System in the chicken rearing coop can maintain an ideal average temperature between 28°C and 33°C, humidity 50% to 70%, and ammonia gas 20ppm.

Acknowledgment

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