Temperature and Humidity Monitoring System in Broiler Poultry Farm

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Temperature and Humidity Monitoring System in Broiler Poultry Farm

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Abstract. Broiler chicken is a livestock that is characterized by fast growing. Temperature and humidity become the most important factors during their growth. Unmonitored and uncontrolled temperature and humidity within the cage can lead to reduced productivity and high rate of mortality. This paper presents a prototype that is able to monitor such factors automatically. A prototype of sensor using DHT11 and Arduino DUE microcontroller has been developed. Android-based app is deployed to support the prototype. A web-based application is also built to show the monitoring result comprehensively. The result shows that the sensor is able to continuously capture the current temperature and humidity of the chicken cage for some periods. After the implementation, the number of death chicks are decreasing from 5 to 4 chicks per day. Controlling both factors will be the future work.

1. Introduction

Poultry meat is the most preferred halal cheap protein source. As one of nations with the largest Muslim population in the world (85% of total population), data from Frost and Sullivan in 2017 shows that Indonesia poultry consumption is only 10.1 kg per capita compared with Malaysia (47.5 kg) and Thailand (16 kg) [2]. This situation makes poultry sector remain promising and needs further improvement to all stakeholders.

However, poultry farming, especially chickens, is not an easy task in Indonesia during dry season. High temperature imposes severe stress to chickens [3] [4] because they have difficulties to cast away the heat from their body. Chicken is a hot-blood animal that has no sweat-gland and most of their body is covered with feather. Such kind of stress leads to reduced performance and increase the mortality rate.

In this paper, we presents a prototype system that can monitor temperature and humidity level in chicken house/cage. Monitoring such parameters is expected able to reduce the mortality rate to avoid further productivity loss on broiler. The rest of this paper as follows. Section 2 provides the system design and development phase. Section 3 presents some of the captured data and the prototype. Lastly, summaries are provided in the section 5.

2. System Design and Development

Figure 1 depicts the architecture of the system. It contains the hardware and software that are used during development. DHT11 sensor is used to detect temperature and humidity [1]. DHT11 is a very low price and low power consumption sensor that has basic capability data logging, converting from analog to digital. It is good at 0-50ºC temperature reading with ±2ºC accuracy and 20-80% humidity readings with 5% accuracy. Such measurement is suitable enough for any chicken cage in Indonesia.

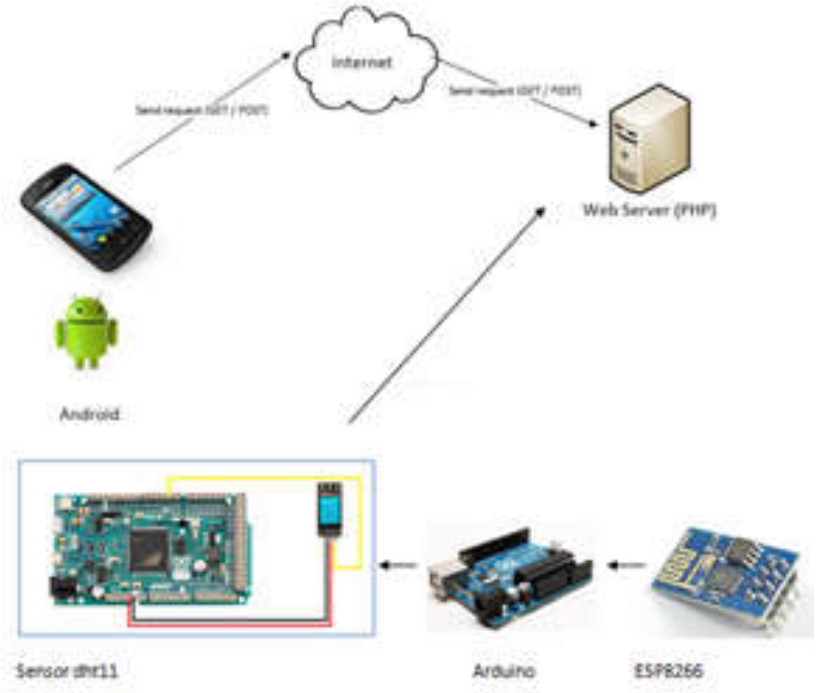

Figure 1. System Architecture.

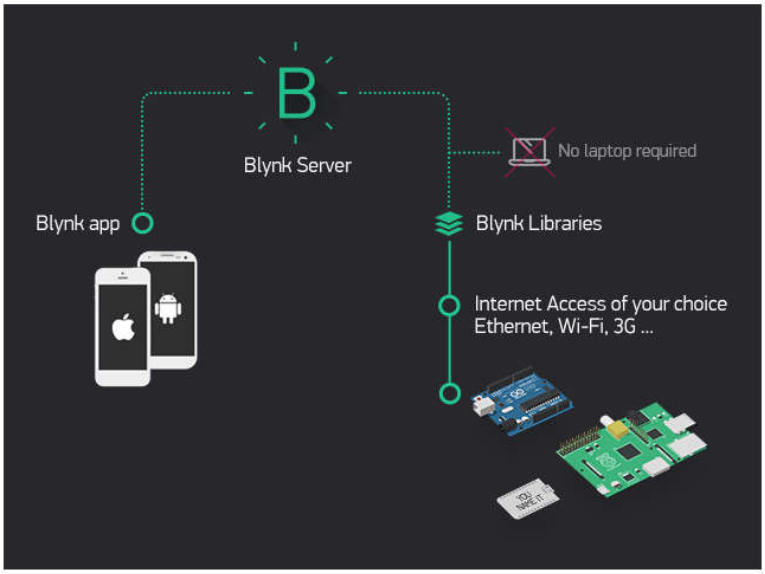

Figure 2. Blynk Architecture

Arduino DUE [5] [6] is used to capture the sensor data from DHT11. Arduino DUE is a powerful 84 MHz and 32-bit processor microcontroller. It has Direct Memory Access (DMA) feature that is able to support multi-tasking within the microcontroller. USB OTG capability is also a benefit of this

Arduino to enable Wi-Fi module connection. Low cost Wi-Fi module ESP8266 is added to the prototype to support internet connection. Using such connection, the data that has been processed in Arduino will be transmitted to the IoT platform.

Blynk app [7] is used as a platform to control and monitor the deployed device. This platform is also very useful to connect the device to the Blynk cloud server and analyse the telemetry data over Wi-Fi or any internet connection. It has several libraries to support data analysis. Another pros is Blynk cloud server is open-source and deployable in minutes. See Figure 2.

The sensor is then installed in the chicken cage with some broilers inside. The cage area is 80 x 11 m. Sensor is placed every 15 m in one side of the cage. The monitoring prototype is deployed and obtaining data from the sensor that is connected using Wi-Fi.

3. Result and Discussion

Figure 3 shows the temperature and humidity that are reported in Blynk app. This app makes user able to acknowledge the statusof the chicken cage from time to time and from anywhere. Figure 4 depicts the web-based monitoring system that has been deployed. Such website is able to show the status within the cage and will be used later during controlling the humidity and temperature.

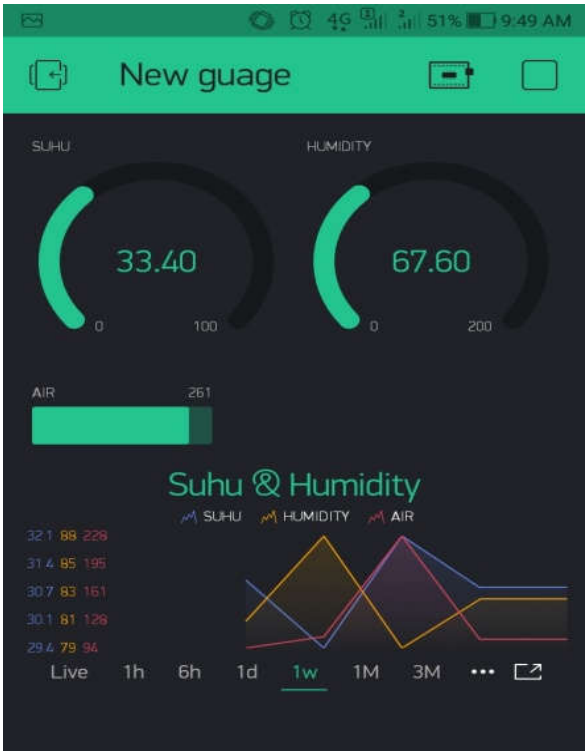

Figure 3. Blynk app for monitoring

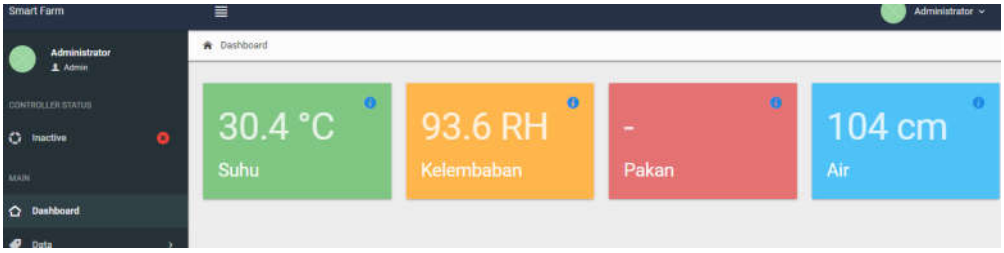

Figure 4. Web-based monitoring

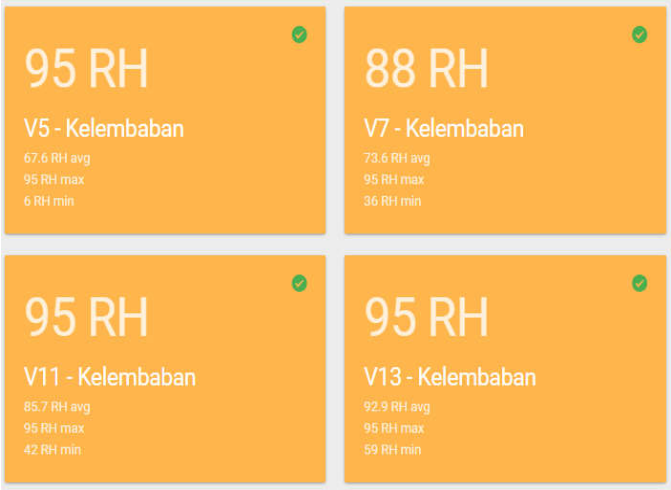

Figure 5. Humidity rate

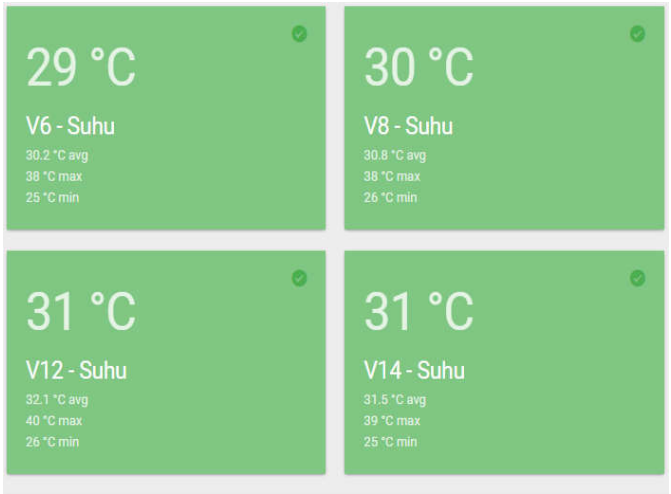

Figure 6. Temperature rate

Figure 5 and 6 are the screen captured from the website that shows some humidity and temperature level based on continuous monitoring. The chicken cage where the experiment is taken place is shown in Figure 7. Some chicks are now growing up well during monitoring.

Figure 7. Chick's house

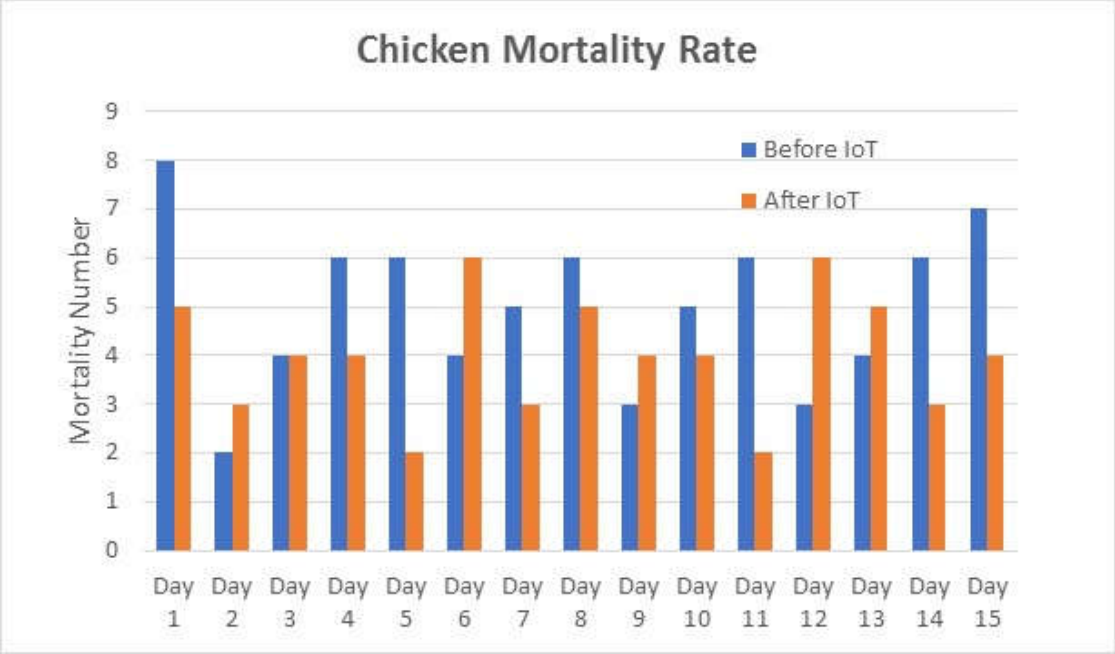

Figure 8. Mortality Rate Comparison for 15 days

Figure 8 depicts the mortality rate of the chicken during observation period (14 days). Chicks are difficult to adapt the environment within the age of 14 days [8]. It shows that, in average, 5 chicken died before the monitoring system implementation and 4 chicken after the implementation. It means that the system is able to support in reducing the number of chicken mortality rate.

During observation, the average humidity level during observation period is 95% and the average temperature is 28 ºC. Such values are off from the comfort zone of any chicks. See Table 1 on the ideal value of temperature and humidity. Such situation makes chicks are prone to death after some days in the cage. See Table 2 on the temperature felt by the chicks based on humidity level.

Table 1. Ideal temperature and humidity for chicken

Broiler		
age (days)	temperature (°C)	humidity (%)
1	32-29	60-70
3	30-27	60-70
6	28-25	60-70
9	27-25	60-70
12	26-25	60-70
>=15	25-24	60-70

Table 2. How chicken feels the temperature

Effective Temperature felt by the chicken (°C)	Cage Humidity level (%)				
	40	50	60	70	80
	Cage Temperature (°C)				
30	36.0	33.2	30.8	29.2	27.0
28	33.7	31.2	28.9	27.3	26.0
27	32.5	29.9	27.7	26.0	25.0
26	31.3	28.6	26.7	25.0	24.0
25	30.2	27.8	25.7	24.0	23.0
24	29.0	26.8	24.8	23.0	22.0

4. Summary

The development of humidity and temperature monitoring equipment for poultry farm is a stepping stone toward Internet of Things (IoT) implementation. IoT is a new emerging area of using any devices that are connected to the internet. Such devices are used to collect some data to be sent to the server for further processing. The use of IoT in poultry farm is very beneficial in improving the broiler quality by monitoring and controlling the environment.

This paper has presented part of monitoring and controlling the humidity and temperature within a chicken cage. Monitoring has been done for 14 days while controlling will be performed in the next period after most of the chicken is replaced with newborn ones. Adding some lamps in the cage is suggested in order to keep the cage warm (higher temperature and lower humidity).

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