RESEARCH ARTICLE

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pOn Implementing Wireless Smart Egg-Laying Hens Coop Control System

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Egg-laying hens are a type of chicken that are particularly vulnerable to the risk of stress impacting on reducing the amount of egg production. Proper feeding schedule and coop temperature are two important factors in reducing such a risk. A chicken farm usually has many coops and scattered over several places requiring a lot of labors for maintenance. Advances in science and technology, especially in computer and embedded systems offer various solutions to address such an issue by automating the coops of egg-laying hens, so that labors can be greatly reduced. This paper proposed a remote automation system that employs Arduino Mega 2560 board as the central control system, equipped with a Wi-Fi module ESP8266 for remote accessibility, an electromechanical relay for controlling heating bulbs on and off, servo motor as the actuator for food container's lid. The system uses DHT11 sensor to read room temperature and HC-SR04 sensor to read distance that relates to the food availability in coops. The result of this research is the system capable of automating the coops that can be remotely controlled through the Blynk application on an Android device. Error measured from this system is $\pm 2^{\circ}$C in temperature readings and 0 cm in reading distance. The actuator of food container's lid test shows a considerably linear result between open time and the amount of food being released.

Keywords: Arduino, Blynk, Coop, Egg-Laying Hens, Sensors.

1. INTRODUCTION

Egg-laying hens are a type of chicken that are particularly vulnerable to the risk of stress, which has a direct effect on decreasing the amount of egg production.[1] Because of that, feeding schedule must be on time and periodic, as well as the coops' temperature must always be made stable. In general, feeding activity is done by breeders manually, by pouring the food to every food tray. Besides, the breeder must manually maintain every coop temperature.

A big poultry company usually looks after a lot of chicken in coops which, consequently, take a lot of time to look after them. Besides, it is labor intensive for running feeding schedule. The higher the number of labors needed, the higher the cost that businessmen spent to run their poultry.

In literature, Wu et al.[2] proposed a set of remote environment control system employing ARM and ZIGBEE network technology. This system employed the S3C2440 of ARM9 microprocessor and information is transmitted through the ZIGBEE wireless network. The operator can remotely control and monitor the facilities and indicators over broadband network.

Valerio et al.[3] were mainly concerned with the development of a system aided in maintaining the required temperature in the Pampanga Agricultural College (PAC) chicken egg farm controlled by a computer or a microcontroller device and can be remotely controlled via Short Message Service (SMS). With the requirements of having a specified range of temperature to maintain, the system was deemed to regulate the farm's temperature by switching on/off cooling fans and heating bulbs. A time-based music function was also integrated in the system in order to minimize the stress of the chicken during the period of laying eggs.

Imran[4] employed the Blynk application for automating the temperature control. The system employed Raspberry Pi and the Blynk library for providing remote communication over the Internet.[5]

This paper discussed another version of coop automation that controls temperature, food stock for hens and feeding schedule maintenance. Wi-Fi is integrated to the system to enable wireless communication on an Android device.

2. SYSTEM'S DESIGN AND IMPLEMENTATION

The system provides remote automation on monitoring and controlling functions in egg-laying hens' coops. The automation includes feeding schedule and temperature maintenance. The system is capable of providing manual feeding scheme apart from the set schedule.

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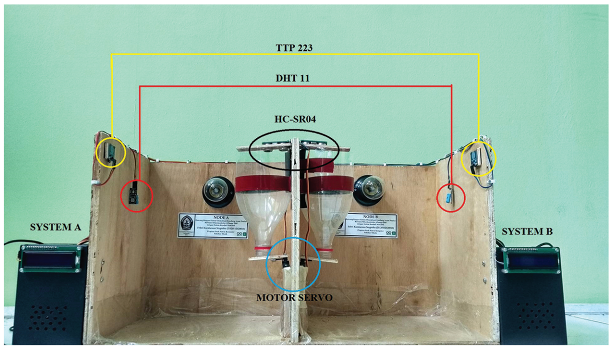

Fig. 1. Prototype of the system.

The system uses Arduino Mega 2560 board with ATmega 2560 microcontroller[6] integrated with the Wi-Fi module ESP8266 module,[7] timer RTC DS1307,[8] humidity and temperature sensor DHT11,[9] distance sensor HC-SR049,[10] as well as touch sensor TTP223.[11] The system runs on Arduino IDE 1.6.4.[12]

The DHT11 sensor detects the coop's temperature. When the temperature from the sensor shows the value is beyond the expected temperature range, the system induces the electromechanical relay to activate heating system. To provide information of food left, distance sensor HC-SR04 is used for measuring the distance of food surface in a container from the sensor. When considered to supply additional food, the touch sensor TTP223 opens the lid of feeding container apart from the feeding schedule. The RTC DS1307 automates the feeding schedule. Information is sent over Wi-Fi module ESP8266 updated every second. In general, the system can always communicate with the Blynk server as long as it is connected with Wi-Fi and can be accessed everywhere when the Internet network is available on Android device.

The software is designed as follows. On initialization, the system calls libraries which are needed for the programming environment: I2C, RTC, EEPROM, LCD, Blynk, Wi-Fi module, temperature sensor, distance sensor, servo, and scheduling communication libraries. Following it, the software defines variables and constants required. The egg-laying hens coop prototype consists of two rooms which considered as two separate coops, each of it has its own identical system (see Fig. 1).

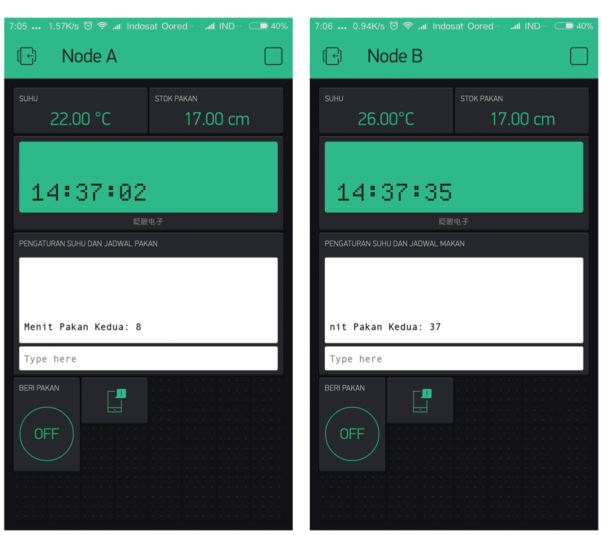

Fig. 2. Interface Blynk application for node/system A and B.

Programming on Arduino is in C programming language. Widgets are added in the Blynk application. Two different projects are made, so each system has a different authentication token. Both system A and system B, consist of a button widget, two display widgets, an LCD widget, a terminal widget, and a notification widget (see Fig. 2).

3. SYSTEM TESTING

The system test is done by testing the value read from each sensor and other inputs. The sensor reading test is conducted by comparing the system with available measuring tools. The testing is divided into two parameters which can be measured: temperature and distance. The coop temperature benchmark is conducted with a room thermometer in 10 times reading. The test results show that sensor has ±2° Celsius error reading from the temperature which is suggested by the thermometer. Figure 3 shows the temperature comparisons between the sensor and thermometer.

The distance sensor test is conducted by comparing the sensor's output values with a ruler. Distance to measure is from a

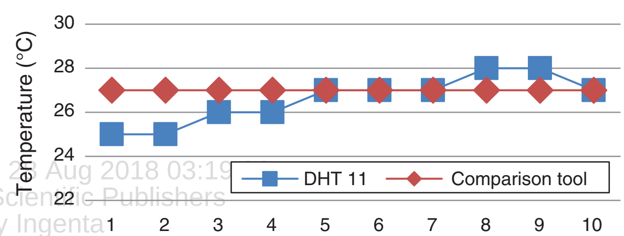

Fig. 3. DHT11 accuracy test.

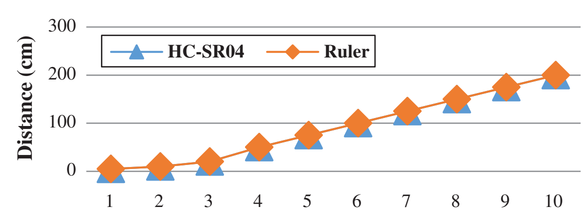

Fig. 4. HC-SR04 accuracy test.

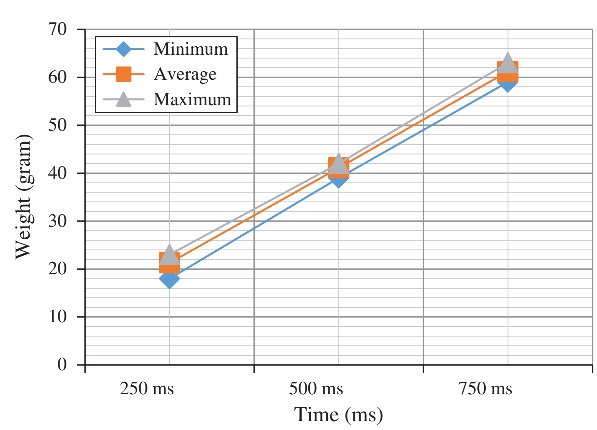

Fig. 5. Lid opening to food dropped accuracy test.

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point where the sensor is placed to the surface of the food located in the container. The test results show that the sensor has 0 cm error reading from the distance measured with the ruler. Figure 4 shows the distance comparison suggested from the sensor and from measurement with a ruler.

The servo motor is used for moving the container's lid. The test is by comparing the food weight released against the weight suggested by a digital scale. The test shows that the average weight of the food released at $t = 250$ ms is 21.3 gr, $t = 500$ ms is 41.1 gr, and $t = 750$ ms is 61.2 gr (see Fig. 5).

4. CONCLUSION

Based on the test done, it can be concluded that this system can read some parameters which are needed by user for example temperature and distance, also displays those parameters on LCD. The error reading test in DHT11 is known about 2° Celsius. When the temperature is less than the set threshold, system will automatically turn on the heating system. The distance sensor HC-SR04 has result of error reading test 0.0 cm. The average weight of the released food is considerably linear against container's lid open time. Variations on the temperature and the amount of food released are not so significant and tolerable to be implemented in the egg-laying hens coops.

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