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Urbanized Chicken Coop Monitoring System using IoT

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ABSTRACT

This paper presents the development of Urbanized Chicken Coop Monitoring system using IoT for residential area. Mostly, people who live in a residential area are working people. They usually have the problem to monitor the chicken coop regularly. With the implementation of the IoT in this urbanized chicken coop, monitoring chicken will not become a big trouble. The input of this system is from sensors that will be controlled by microcontroller and will be used to send data to the cloud. Then, to complete the system, the data stored in cloud are then sent to the chicken coop's owner's smart phone for notification. The outcome of this project is to provide healthy chicken for the people in any residential and simplifying the coop monitoring.

Key words: Monitoring system, Chicken coop, IOT module, Wi-Fi shield, Arduino

1. INTRODUCTION

Malaysia has one of the highest per capita chicken consumption rates in the world. 32 kg per capita [7] consumption of chicken reported and making chicken is the most famous and low-cost source of protein among Malaysians. Hence, the government has encouraged people to start rearing to make sure that Malaysians are not burdened by the rapid economic growth. Other than that, rearing promotes a healthy lifestyle where people can get fresh and healthy food as it is a self-monitored process.

Project Background

Generally, there are many types of system to rear chicken that can be applied. Some of them are free-range, semi-intensive and intensive system. Conventionally, the Open House system for chicken can be conducted in a healthy environment as the ventilation system is using natural ventilation from outside. At night, the chicken will automatically look for a shelter to avoid from extreme weather and predators. Thus, CHS (Close house System) chicken coop is needed to secure the chicken [1]. This paper also focuses on Chicken Coop in residential area.

Conventionally, feeding and giving water for chicken are done manually that is by filling the containers with grains and food, and water. It is not practical to maintain this method nowadays as most of the breeders cannot manage to monitor their chicken all the time. Moreover, feeding and giving water to the chicken manually may lead to the wastage of food and water because there is no accurate amount prepared for the chicken. In this paper written by Zainal h [2], improvement was done especially on the feeding and watering system. Some Intelligent elements have been implemented by considering surrounding conditions such as humidity, temperature, and quality of climate of the chicken farm. Papers in [3],[4]and [8] explained the chicken farm can be monitored and remotely controlled by using mobile phone. The owners will be able to receive information about the farm and can simply resend the message to the system. The Internet Of things (IoT) is a system that widely used not only in simple application but applied in a complex system that connected to internet. For example, this paper titled: Safety and Security for School children's Vehicles using GPS and IoT Technology [9] explained about safety monitoring system. The application of IoT also can be found in agriculture [12] and [13], smart building [14] and in medical and health domain [15].

Contributions

This project proposes an Urbanized Chicken Coop for residential area. The feeder system will monitor the food supply in the chicken coop. It will notify the owner if the food supply is nearly finished and refill the container provided. For water feeding system, the system was built to monitor the level of water in the container. This is to ensure that the chickens get enough water supply. Next, to ensure that the coop is in optimal temperature for the chickens, the temperature system is installed in the coop. All systems are connected to Arduino UNO with Wi-Fi shield (ESP8266) by using electrical wiring while BLYNK cloud system will be the

interface for the systems. All Automation systems with an IOT application commonly use sensors as Inputs to send and receive data from the controller. For example, in this paper [10], Temperature and Humidity sensor act as an alarm to the system developed.

2. METHODOLOGY

This Project uses 3 inputs and 4 outputs. The input and output communicate to run the system. Basically, all the sensors will sense the parameter, then, all the data collected from the sensors will be sent to Arduino UNO. By using Wi-Fi shield (ESP8266), all the data from Arduino UNO will be stored in the cloud and then transmitted to the owner's smartphones to notify him or her. Figure 1 shows the system block diagram. As the Arduino UNO receives input signal from the temperature and humidity sensor, 12Vdc lamp will be ON showing that the temperature is LOW. The information will be sent to BLYNK cloud and then notify the coop's owner to switch on light to increase temperature. Once the temperature is in optimal condition, 12Vdc lamp OFF. The feeder system uses load cell to detect the food weight. Once the weight is low than the set value, the input data will be received from Arduino UNO and sent to the cloud. Then, the output will be sent to the owner's smartphone to notify that the food in the container is running out. Servomotor will on in order to release food from tank. The float switch is used to detect the level of water. Two levels of indication were set which are high and low level. As the water reaches low level point, the valve will be ON to allow water to be supplied into the container. Then, if the water reaches the high-level point, the valve will be OFF and the water supply will be stopped. For cleaning system, a timer is used to notify the owner. Once notification is received, the owner needs to manually change the sawdust in the coop. This timer is programmed, and the data is stored in BLYNK cloud. To ensure the safety of the chicken, a Wi-Fi camera was installed inside the chicken coop. This camera also enables the coop's owner to monitor the coop remotely.

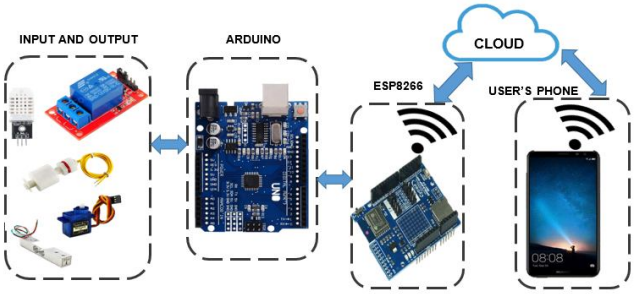

Figure 1: System Block Diagram

2.1 Hardware development

Figure 2 shows the design proposed for the chicken coop. This design was developed using Sketchup software. Basically, the coop was divided into two sections which are Open House System and Closed House System. The Closed House System was made of plywood with size of 30cm X 60cm X 30cm. The nesting room attached was made of plywood with size of 30cm X 20cm X 20cm. While, for the Open House System, the frame was made up from PVC pipes with the size of the frame is 60cm X 60cm X 30cm. Then, the frame was covered with a poultry netting with the size of 60cm X 60cm X 30cm. For this size, chicken coop can only accommodate 3 chickens [5].

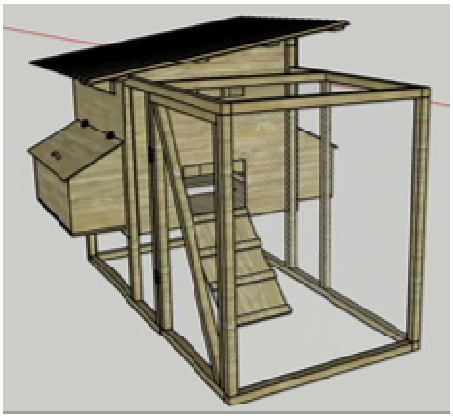

Figure 2: Chicken Coop design

The purpose of combining these two types of coop system for residential area is to make sure that the chicken can adapt to the environment. Chickens usually move freely during the day. As it is a limited area, the Open House System coop allows the chickens to comfort themselves. Closed House System coop allows chickens to protect themselves from any undesired conditions such as rain and hot weather.

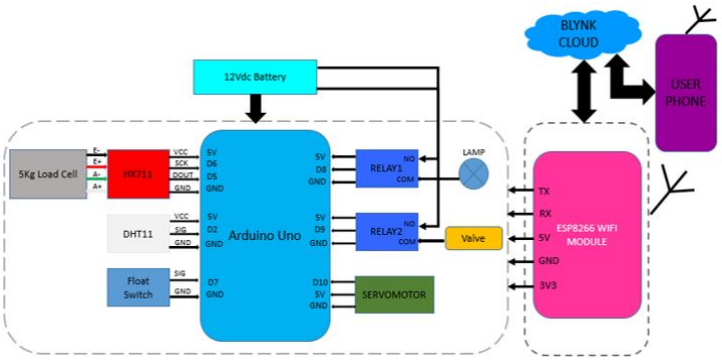

Figure 3: Schematic Diagram

Figure 3 shows the schematic diagram of the full system. Arduino is supplied by 12Vdc battery, where all the input and output will be connected to the 5V and ground from Arduino. Lamp and valve are directly connected to 12vdc. Wi-Fi shield ESP8266 and ARDUINO were connected. Cloud is used to store input and output data before they are retrieved by owner's smartphone. ESP8266 Wi-Fi Module is a self-contained SOC (System On a Chip) with integrated TCP/IP protocol stack that can give any microcontroller access to Wi-Fi network [11].

Schematic Diagram for Input

i. Load Cell

For feeder system, Load Cell was used to detect the weight of the food in the container. The load cell was connected to HX711 module, HX711 is the interfacing between sensors and Arduino. The connection to Arduino is done by connecting SCK pin from HX711 to pin 6 Arduino and pin DOUT to pin 6 Arduino as shown in Figure 4 below.

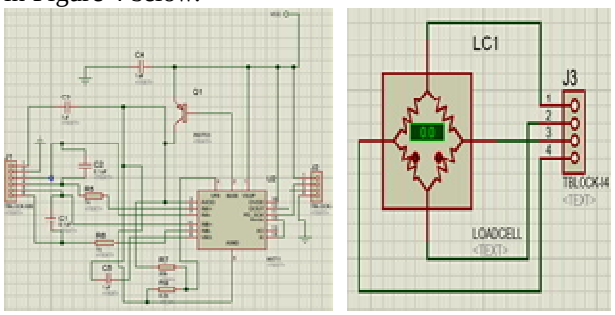

Figure 4: Load Cell schematic diagram

ii. Float Switch

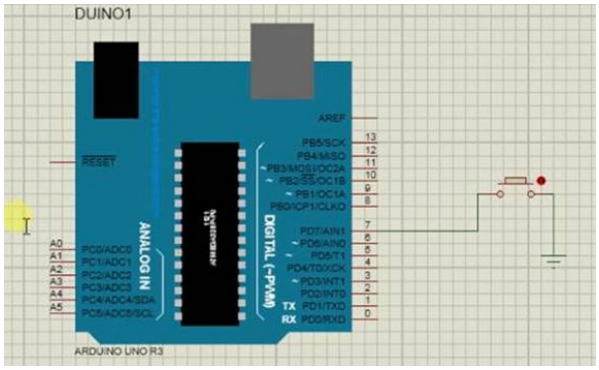

Figure 5: Float Switch schematic diagram

Figure 5 shows the Float switch schematic diagram where the float switch is used as the input for water feeding system. It will detect the water level in the tank. It is connected to the Arduino by pin 7 and supplied with 5vdc supply from Arduino. The switch represents the float switch in Proteus.

iii. Temperature and Humidity Sensor

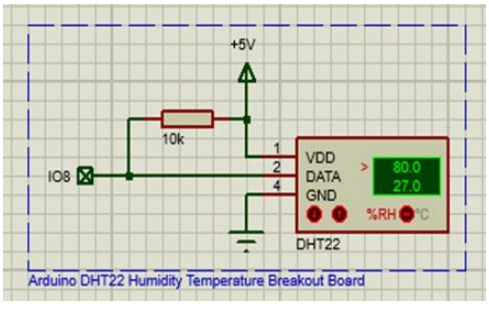

Figure 6: Temperature Sensor schematic Diagram

For the temperature system, DHT11 humidity and temperature sensor was used to detect the temperature inside the closed house. Pin 2 was used to connect the sensor to Arduino.

Schematic Diagram for Output

i. Relay

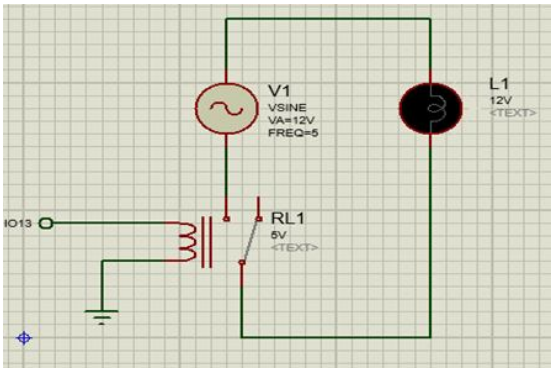

Figure 7: Schematic diagram for relay

Figure 7 shows the relay's schematic diagram. For water and temperature system, the output is relay. This relay is used to control the circuit which represents the valve and lamp. The valve will open and close when there are any changes in the water level. For the lamp, it will turn on and off if there is changes in temperature.

ii. Servo Motor

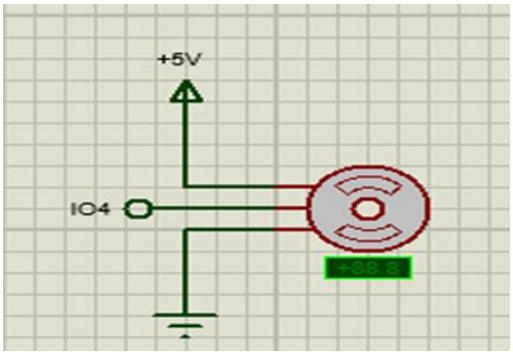

Figure 8: Schematic Diagram for Servo Motor

Figure 8 shows the schematic diagram for Servo Motor. As the load cell sense the different reading of the food in the container, it will allow the servomotor to perform the action needed.

2.2. Software Development

i. Arduino IDE and BLYNK

The System monitoring used Blynk as a medium for coop's owner to monitor the whole system. Blynk is an IOT platform which is widely used because it is an open source software. Figure 9 shows the widget used in this project. Arduino IDE is used to program the Controller.

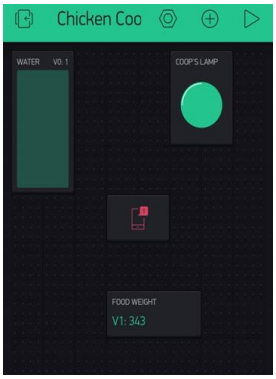

Figure 9: BLYNK main page

Arduino IDE is used to program the controller based on each process' sequence. For example, Figure 9 shows the flow chart of temperature system.

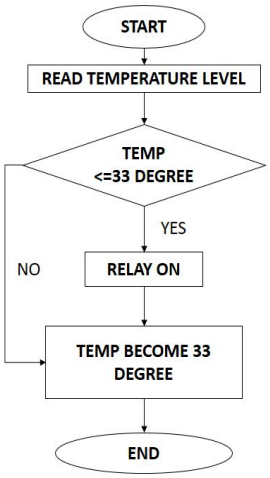

Figure 10: Temperature process

From the flow chart in figure 10, the coding for this temperature process is shown in Figure 11. The temperature system coding in ARDUINO IDE used dht.h libraries. The variable used are *max_temp*, *min_temp* and *temperature*. DHT11 sensor is connected to pin 2 Arduino while the relay is connected to pin 9.

```
void loop() {
  if ( DHT.temperature >= maxtemp) {
    digitalWrite(relay, LOW);
    flag = 0;
  }
  else if ( DHT.temperature <= mintemp) {
    digitalWrite(relay, HIGH);
    delay(1000);
    flag=1;
  }

  DHT.read11(dht_dpin);
  Serial.print("Humidity = ");
  Serial.print(DHT.humidity);
  Serial.print(" %  ");
  Serial.print("Temperature = ");
  Serial.print(DHT.temperature);
  Serial.println(" C  ");
  delay(500);
}
```

Figure 11: Temperature system coding

3. RESULTS AND DISCUSSIONS

3.1 Notifications

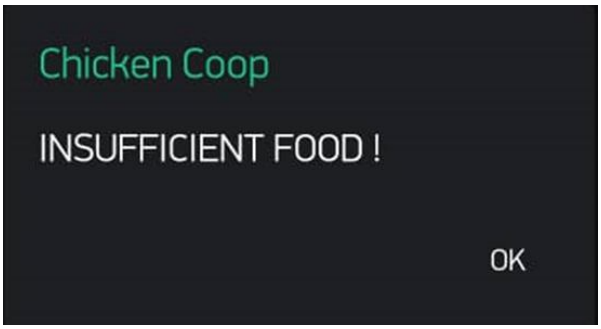

Figure 12: Notification for Insufficient Food

Figure 12 shows the notification page sent to the owner's phone to notify that the food in the container has decreased from 100g of the initial weight set. Then, the supply of food from upper container will be released. Once the weight of the food reaches 100g, the food supply will be disabled and BLYNK will send the notification to the owner as shown in Figure 13.

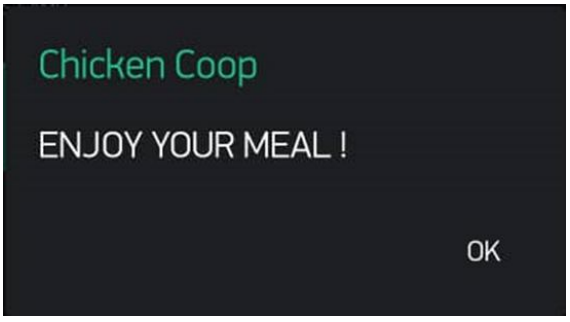

Figure 13: Notification for Sufficient Food

3.2 Results for weighing and temperature process

The results are based on the functionality of the system. For example system, Table 1 shows the reading from Temperature sensor (DHT11) and the condition of the lamp and relay. When the temperature sensor detects a value lower than 27º Celsius, the light will be ON to heat up the coop until it reaches 33 º Celsius. This value is optimal for the chicken. [6] The light will be switched OFF when temperature is equal to 33ºCelsius.

Table 1: Temperature System

Temperature sensor (ºCelsius)	RELAY	LAMP
27	On	On
30	On	On
33	On	On
35	Off	Off
36	Off	Off

The second functionality which need to be tested are Load cell and servo motor. Reading from the load cell shows the weight of food in gram, while the position of the servomotor shows the percentage opening of the valve. Some calibrations need to be considered before testing the load cell. Table 2 shows when a load cell detects less than 100 gm, valve for food loading will open.

Table 2: food weight

Weight (gram)	Valve opening state
< 100 gm	Open - 50%
> 100 gm	Close – 0 %

FUTURE WORKS

Cleaning system that can monitor and control the cleanliness of the chicken coop is the idea to upgrade this system. Due to time constraint and budget, this cleaning process cannot be realized. This cleaning system will make the chicken and the owners more comfortable with the surroundings especially in residential area.

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