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Design and Fabrication of Automatic Temperature Control for Chicken Shade

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ABSTRACT

One of the most crucial sectors to explore in Malaysia are agriculture and poultry. Indeed, there is a strong correlation between agricultural growth and economic growth. The inconsistent weather in Malaysia will cause the temperature to increase and decrease, and this problem will affect the health of the chicken. Small-sector farmers cannot afford the high cost of installing and maintaining the temperature control system. Therefore, new effective technological approaches were required to continuously improve the productivity, profitability, and sustainability of major farming systems. An automatic temperature control system was designed to control the temperature in the chicken shade. This system was controlled by Arduino UNO, which was programmed using Arduino IDE software. The system started to operate when the sensor detected the temperature in the chicken shade above 28°C. The exhaust fan, pump, and water sprinkler are the main components in this system that control the temperature in the chicken shade. The system reduced the temperature in the chicken shade by 1°C to 3°C. The system also affects the rate of chicken growth. By lowering the temperature in the chicken shade, the rate of the chicken growth increases. The chicken starts to grow faster in week 3 at 5 weeks. Starting in week 3, the chicken in controlled room temperature was 46g heavier than the average chicken weight in a normal room. In week four, the average chicken weight in a controlled room was 116.25g heavier than in a normal room. In week six, the average weight of chicken in the controlled room was 884.5, while in normal room conditions, it was 732g. The initial bar graph and week six bar graph for both conditions show significant differences in the chicken's growth rate.

Keywords: Automation, Internet of Things, Smart Farming.

1. INTRODUCTION

According to the Food and Agriculture Organization (FAO), in 2018, about 125 million metric tons of meat production in the world increased by 3% in 2019. FAO also analyzes that the decreasing production of meat was caused by animal disease and the increases in better technology and improved productivity. Most breeders choose to raise chickens in poultry houses, open areas and chicken shades for the small sector. Chicken shade should have good management to produce a good quality of meat for the world. Disease and chicken growth will affect the rate of production of meat. Temperature and humidity in the chicken shade should be controlled and maintained according to the chicken's requirements. Chicken shade and poultry houses should have good ventilation and temperature control to keep the chickens at a comfortable temperature.

Heat stress can cause hyperthermia in poultry. A good temperature control in poultry houses will increase chicken growth and reduce mortality [1]. Without a temperature control system in the poultry house, the birds will have problems maintaining their body temperature. More energy

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will be consumed by the birds to maintain the body temperature [2]. This extra energy will ultimately be supplied by the feed consumed. This will give less profit and require additional costs for the breeder to give more vitamins to the chicks, and it will take longer for the chick to grow. However, with today's technology, the temperature in poultry houses can be controlled with a good poultry house system.

2.0 MATERIAL AND METHODS

At first, three concept designs were sketched to get the main idea on how this project works. All three design systems were new and improved based on the previous design system. After considering a few factors, one of the best design systems was selected. Factors in selecting the best design system were the cost to build the system, project capability and system effectiveness. The components, project materials and tools used in the selected design system were identified. The weight of the chickens was monitored for 6 weeks. 4 chickens were placed in a different cage, one with a cooling system and another 4 chickens were placed in a non-cooling system cage.

Table 1 Morphological table.

Features	Concept Design 1	Concept Design 2	Concept Design 3
Power Supply	Solar Panel, Battery	Battery	Battery ✓
Cooling Method	Exhaust fan, roller motor for curtain	Cooling pad, exhaust fan, curtain	Exhaust fan, roof water sprinkler ✓
Operating	Automatic	Semi-Auto	Automatic ✓
Control Device	Arduino UNO	Arduino UNO	Arduino UNO ✓

Table 1 shows the morphological table based on the 3-concept designs. Concept Design 3 was selected. The roof shape was designed to ensure the water would drop only at one side. This makes it easier to collect water from the sprinkler to the tank. The exhaust fan and water sprinkler were used as cooling methods. Exhaust fans and water sprinklers were chosen as cooling methods because they have low installation costs and do not need high maintenance. The battery was a suitable power supply for powering the system. The chicken shade can be built anywhere using a battery power supply. This system was automatic and controlled by Arduino UNO. Arduino UNO was a suitable control device because it was easy to program and a low-cost product.

The weight of chickens was monitored in the controlled and normal room conditions. In controlled room conditions, the room was provided with a cooling system. In normal room temperature the chicken was exposed to the normal room temperature. The weight of the chickens was weighed for six weeks. The weight of the chicken was recorded weekly. The different weights experienced by the chicken in each room condition were observed. There are 4 chicks in each room condition. Average data was taken to see the difference between the growth rate of chickens in controlled room conditions and normal room conditions.

The temperature in the controlled room condition and normal room condition were recorded. The temperature was recorded for every 2 hours every day. Temperature was recorded to see the difference in temperature between controlled room and normal room conditions.

3.0 RESULTS AND DISCUSSION

The final design of automatic temperature control for chicken shade is shown in Figure 1. The material used in Figure 1 was PVC, asbestos, wood, plywood, plastic net and rubber pipe. All the pipelines in this project used PVC material. PVC pipes were selected for this project because they are a lightweight material. Lightweight material has smoothed the installation process. The roof was asbestos, and the frame of the chicken shade was 1.5″× 1.5″ and 1″× 2″solid 'meranti' wood. For the chicken wall, plywood with 6mm thickness. The plastic container was used to keep the electronic components. The rubber pipe functions as a water sprinkler. Rubber pipe was chosen because it was flexible, and the materials made it easier to make holes to allow water to come out from the rubber pipe. Only small holes were made along the pipe to prevent losses of water pressure in the rubber pipe.

Figure 1: Automatic Temperature Control for Chicken Shade System.

This system works when it is turned on. The temperature sensor in the chicken shade measured the inside temperature. The Arduino was programmed to detect temperature changes equal to or more than 28°C. If the temperature in the chicken shade is more than 28°C, the Arduino switched on the exhaust fan and water pump. If the temperature in the chicken shade is equal to or less than 28°C, the Arduino switches off the exhaust fan and water pump. The Arduino controlled the system based on the coding programmed in the Arduino. The temperature in the chicken shade was recorded on a micro secure digital (SD) card. The temperature data were recorded for every 2 hours.

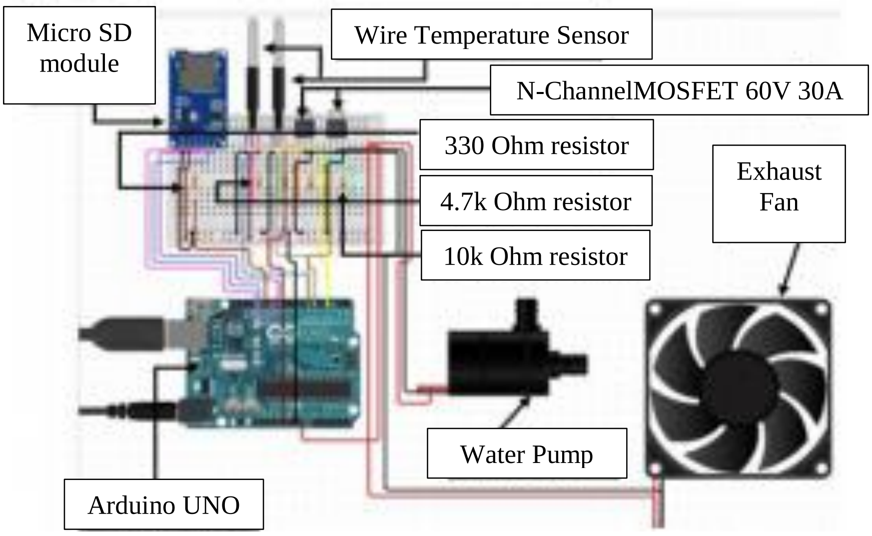

Figure 2: Circuit diagram of automatic temperature controlled for chicken shade.

Figure 2 shows the circuit diagram of the automatic temperature controlled for chicken shade. The components that were used in this system were Arduino UNO, micro SD module, wire temperature sensor, 330 Ohm resistor, 4.7k Ohm resistor, 10k Ohm resistor, N-Channel MOSFET 60V 30A transistor, Submersible Water Pump and PC Fan 12V. The Arduino UNO was powered with a 12V DC with a 2A power supply. Another 12V DC was connected to the water pump and exhaust fan. The power supply from the Arduino UNO was not enough to power the water pump and exhaust fan. The ground pin for the Arduino UNO was connected to the micro SD module ground pin. 5V pin connected to VCC micro SD module pin, number 13 pin on Arduino UNO to MISO pin on micro SD module, number 12 pin on Arduino UNO to 330 Ohm resistor and then enter MOSI pin on micro SD module, number 11 pin to SCK pin on micro SD module and number 10 on Arduino UNO to CS pin on micro SD module.

Two wire temperature sensors were used in this system. The first wire temperature sensor was used to measure the temperature in the first room, and another temperature sensor was used to measure the temperature in the second room. The GND pin on Arduino UNO was connected to the GND pin on the temperature sensor. The 5V pin on the Arduino UNO was connected to the VCC pin on the temperature sensor and to the 4.7k Ohm resistor. From the resistor, a wire connected the resistor to the Data pin on the temperature sensor. The data pin on the temperature sensor is connected to the 2 pins on the Arduino UNO. For the second temperature sensor, the GND pin and VCC pin connection were the same as the first temperature sensor. Only the data pin connected to the 3 pins on the Arduino UNO was different.

This system used two transistors that connected to the exhaust fan and water pump. The Base pin was connected to the 5 pin on the Arduino UNO. Then, the emitter pin of the transistor was connected to the exhaust fan, and the collector pin was connected to the GND pin on the Arduino UNO. The positive terminal of the exhaust fan was connected to the power supply. The second transistor was connected the same way as the first connection, but the connection to the water pump was changed. The entire system was controlled by the Arduino UNO, and the micro SD module transferred temperature data into the micro SD card.

3.0 CONCLUSION

In conclusion, all the objectives highlighted in this project were fulfilled. The first objective was to design and fabricate an automatic temperature control in the chicken shade. Automatic temperature control in the chicken shade removes heat and improves air circulation. The next objective was to study the effect of automatic temperature control for chicken shade on chicken growth. The bar graph and bar chart result showed the impact of the automatic temperature controlled for chicken shade on chicken growth. The chicken's growth rate decreases when the temperature surroundings increase and the growth rate increases when the temperature surroundings decrease. However, this cooling system can be improved with minor modifications for the next study.

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