

Design of Monitoring and Control System For Air Temperature And Humidity In Oyster Mushroom Cultivation Room Based on IOT

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Abstract- Oyster mushroom cultivation is very popular among rural and urban communities, both on a small, medium and industrial scale. Oyster mushroom cultivation requires controlling the temperature and humidity in the mushroom barn to get optimal mushroom body growth. In general, the optimal temperature for oyster mushroom growth in the fruiting phase is 26-30°C with a humidity of 70-95%RH. This system describes the workings of the device used to monitor temperature and humidity using a DHT22 sensor through a microcontroller, which is displayed on the Blynk application and a 20x4 LCD. Measurements in lowland areas show a temperature of 29°C and humidity of 95%. The percentage error of the temperature measurement with the DHT22 sensor is 6.37%, with an average error of 1.60%. As for humidity, the measurement error is 0.71% with an average error of 0.82%. With this system, mushroom farmers can monitor the environmental conditions of the cultivation room in real-time through an IoT platform connected to the sensor.

Keywords: DHT 22, Oyster Mushroom, Blynk, LCD20x4, IoT

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I. Introduction

A. Background

Oyster mushrooms can naturally grow under broad-leaved trees in the forest or under woody plants. Oyster mushroom cultivation is increasingly in demand by people in rural and urban areas, both on a small, medium and large scale.

Currently, in some locations such as Limau Manis, Padang City, temperature and humidity control is done manually, using a sprayer from above the baglogs and utilising the floor moisture in the cultivation room. Farmers often just guess the temperature and humidity inside the mushroom barn, or use simple measuring devices such as hygrometers.

Good temperature and humidity control is essential to ensure optimal mushroom growth [2][3]. If environmental conditions are not controlled, mushroom

growth can be disrupted or even experience crop failure. Seeing this problem, an automatic tool is needed that can assist farmers in controlling the environmental conditions of oyster mushroom cultivation.

This Internet of Things (IoT)-based oyster mushroom cultivation system allows farmers to reduce operational costs and risks faced in the cultivation process. The system also reduces dependence on human labour to manually monitor temperature and humidity. Based on the above problems, the author took the initiative to design and build a monitoring and control system for air temperature and humidity in an IoT-based oyster mushroom cultivation room. This system is made through observation, literature study, design, tool making, and tool testing.

B. Brief Literature Review

a. Oyster Mushrooms

Oyster mushroom cultivation requires suitable environmental conditions, especially in the fruiting phase which requires a temperature between 26-30°C and humidity of 70-95%RH. Temperatures that are too high or too low will affect the growth of oyster mushrooms.

Oyster mushrooms also do not require much sun exposure; growth is better if not exposed to direct sunlight. Good air circulation is also necessary to ensure optimal growth. Figure 1 below shows the physical form of a white oyster mushroom that is in the growth phase towards harvest time.



Figure 1: Oyster Mushrooms

Shows the shape of the hood of a white oyster mushroom as it progresses through the growth phase to harvest time.

b. ESP32 Mikrokontroler

ESP32 is a microcontroller developed by Espressif Systems. Compared to its predecessor, the ESP8266, the ESP32 has more features, such as two CPU cores, larger memory, support for various wireless communication protocols, as well as additional peripherals. The ESP32 can be used either standalone or with other microcontrollers for control over the internet.

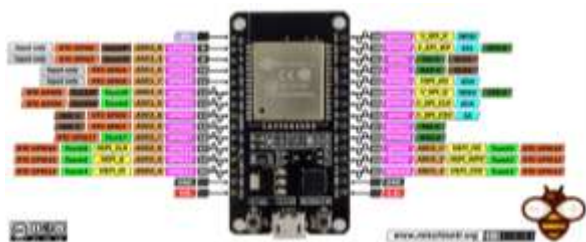


Figure 2. ESP32 Microcontroller

c. Sensor DHT22

DHT22 sensors are used to read air temperature and humidity, particularly in room temperature and humidity control applications. The DHT22 can measure temperature within the range of 40°C to 80°C and air

humidity between 0% to 100%RH. This sensor uses a power supply of 3.3V to 6V DC.

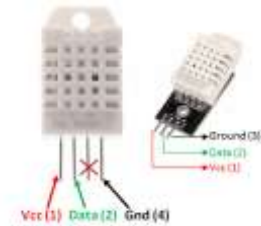


Figure 3. DHT22 sensor

d. Relay

Relay is an electromagnetic device that serves to move the connecting contacts, which allows the change of ON or OFF position automatically. Relay is a component or switch device running it using electricity. Relay consists of two main parts, namely coil and switch contact or mechanical.

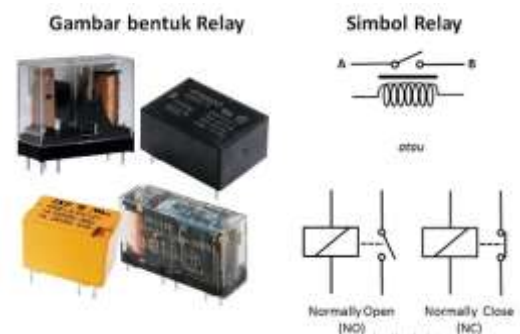


Figure 4. Relay

e. Keypad 4x4

A 4x4 keypad is an input device that serves to enter data or instructions into an electronic system. This keypad consists of 4 rows and 4 columns, resulting in a total of 16 keys that can be used for various functions in an HMI (Human-Machine Interface) system.

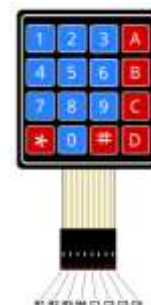


Figure 5. 4x4 Keypad

f. Blynk

Blynk is an iOS or Android-based platform used to control devices such as Arduino, Raspberry Pi, ESP8266,

ESP32, and others over the internet. In this application, Blynk acts as a user interface for controlling IoT-based systems.



Figure 5: Blynk

II. RESEARCH METHODS

This research begins with data collection and observation of temperature and humidity in the oyster mushroom cultivation room. After the data is obtained through field observations, the next step is to design a system based on the data. The design starts with making a block diagram that describes the flow of input, process, and output of the system, so that the designed tool can achieve the desired goal.

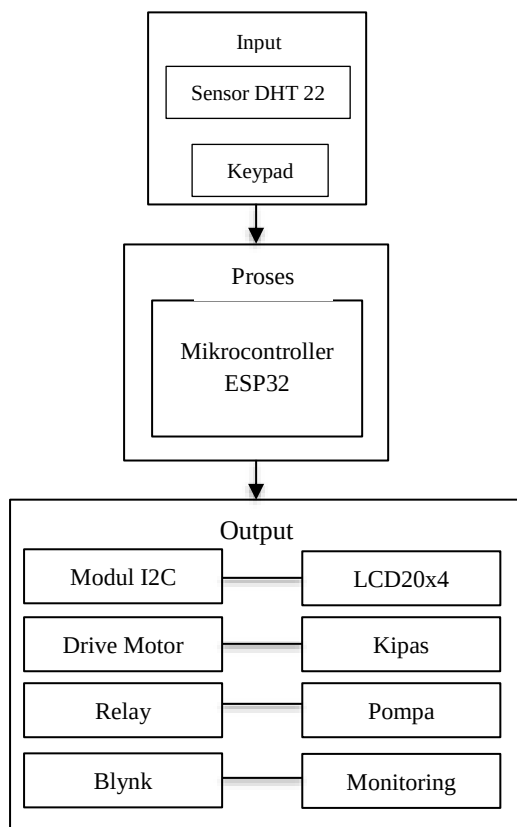


Figure 7 Block diagram of the system

Figure 7 shows the system diagram of the monitoring tool which includes hardware and software design. The system input consists of a DHT22 sensor and a 4x4 Keypad. The DHT22 sensor functions to read the temperature and humidity of the air in the oyster mushroom cultivation room, while the Keypad is used to enter data or commands that run the IoT system automatically. As an initial part of the final project, the design of the tool's working system is carried out. This system generally describes how the device performs monitoring using a DHT22 sensor connected to the microcontroller and displayed on the Blynk application and 20x4 LCD. The DHT22 sensor reads the temperature and humidity in the cultivation room, displays the temperature in degrees Celsius, and the humidity as a percentage. The appropriate temperature and humidity for oyster mushroom growth is no more than 30°C and no less than 70%RH. In this research, IoT-based ON/OFF control is explained in a flowchart that describes the sequence of the tool's work process, starting from the beginning until it reaches the final goal.

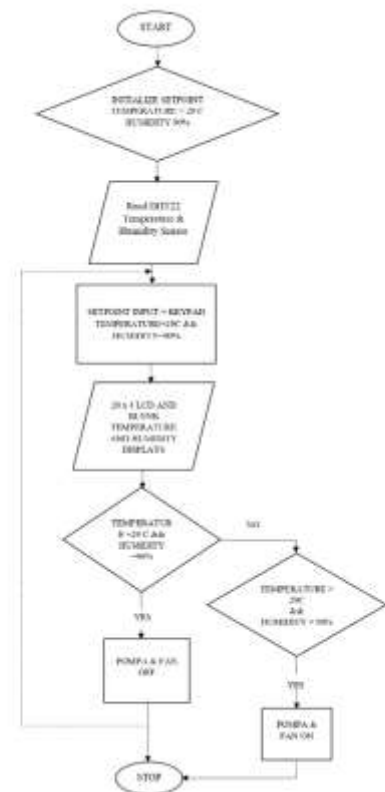


Figure 8. Flowchart of the tool system

III. RESULTS AND DISCUSSION

The purpose of testing this tool is to monitor and control the temperature in the oyster mushroom cultivation room automatically with the IoT system.

A. Sensor Comparison Testing

DHT22 sensor testing is carried out to measure the sensor's ability to accept changes in air temperature and humidity parameters in the oyster mushroom cultivation room. In this test, a comparison was made between the temperature and humidity measured by a simple Thermohygrometer tool, and the data obtained from the DHT22 sensor displayed in the Blynk application.

Table 1: Comparison of Temperature Measurement with DHT22 Sensor and Thermohygrometer

NO	Time	DHT22	Digital Thermometer (°C)	Measurement difference	Error (°C)
1	07.00	26,7	25,1	1,6	6,37%
2	07.05	26,5	26,1	0,4	1,53%
3	07.10	26,5	26,1	0,4	1,53%
4	07.15	26,3	26,1	0,2	0,77%
5	07.20	26,1	26,1	0	0,00%
6	07.25	26,1	26,1	0	0,00%
7	07.30	26,1	26,1	0	0,00%
8	07.35	26,2	26,2	0	0,00%
9	07.40	26,5	26,3	0,2	0,76%
10	07.45	26,7	26,3	0,4	1,52%
11	07.50	27	26,4	0,6	2,27%
12	07.55	27,1	26,4	0,7	2,65%
13	08.00	27,3	26,4	0,9	3,41%
Average Error =					1,60%

Figure 9.

Temperature Comparison of DHT22 Sensor and ThermoHygrometer

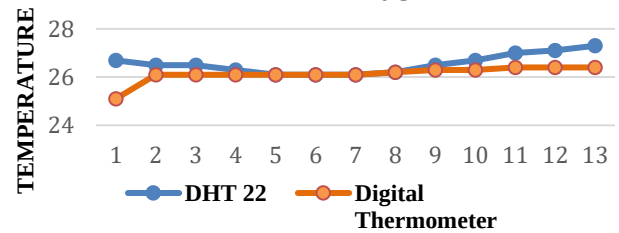


Figure 10. Temperature Testing Graph of Mushroom Room against DHT 22 Sensor and Thermohygrometer

In Figure 10, it can be seen that the DHT22 sensor and Thermohygrometer experience the same temperature approach in the process of experiments 5 to 8.

Table 2: Comparison of Humidity Measurement with DHT22 Sensor and Thermohygrometer.

NO	Time	DHT22	Digital Hygrometer (%)	Measurement difference	Error (%)
1	07.00	99,7	99	0,7	0,71%
2	07.05	99,9	99	0,9	0,91%
3	07.10	99,9	99	0,9	0,91%
4	07.15	99,9	99	0,9	0,91%
5	07.20	99,9	99	0,9	0,91%
6	07.25	99,9	99	0,9	0,91%
7	07.30	99,9	99	0,9	0,91%
8	07.35	99,9	99	0,9	0,91%
9	07.40	99,5	99	0,5	0,51%
10	07.45	99,7	99	0,7	0,71%
11	07.50	99,8	99	0,8	0,81%
12	07.55	99,8	99	0,8	0,81%
13	08.00	99,7	99	0,7	0,71%
Average Error =					0,82%

Table 2 is a comparison of the DHT 22 Sensor and Thermohygrometer for humidity input. In the table above, the average calculation of ON/OFF control on ESP32 is 0.82% with a test time displayed with a delay of

5 seconds, and the comparison of these two devices has a good equation.

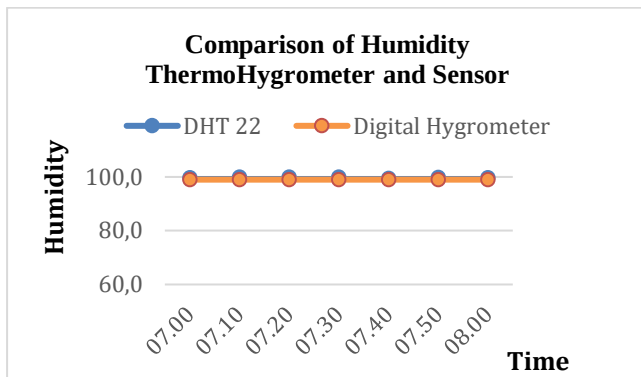


Figure 11. Humidity Testing Graph of Mushroom Room against dht 22 Sensor and Thermohygrometer

B. Temperature and Humidity Response Testing

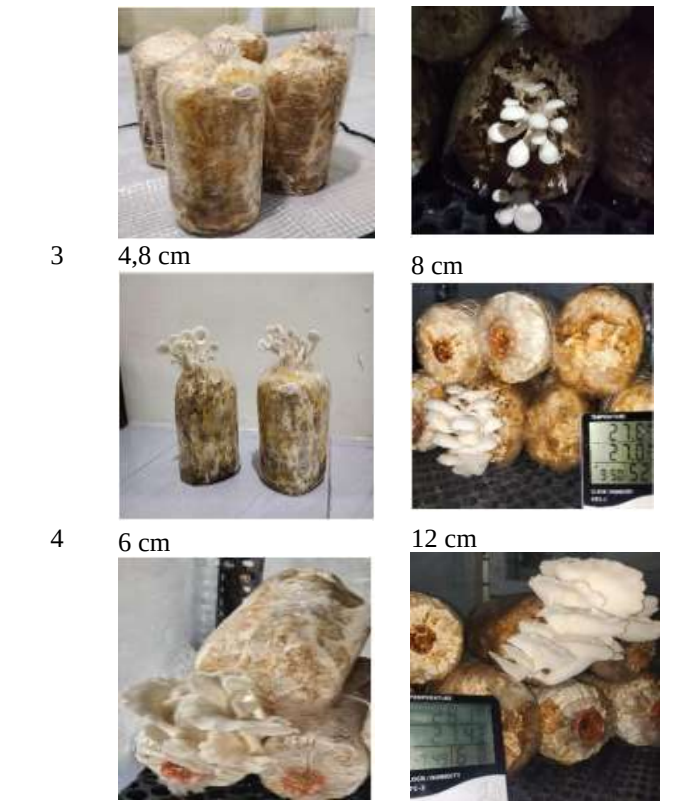
This test aims to remotely monitor the temperature and humidity in the oyster mushroom cultivation room using the Blynk application. When the temperature or humidity exceeds the predetermined setpoint value, the system will automatically turn on the motor to adjust the environmental conditions. The output displayed on the Blynk app experiences a delay of 5 seconds before the actual value appears below the setpoint.

C. Comparison of Mushroom Growth

This test was conducted to determine the effect of IoT control on oyster mushroom growth. The test is conducted by comparing the physical growth of mushrooms grown in the cultivation room with IoT control, and mushrooms grown without IoT control. Mushrooms controlled with the IoT system grow faster and have better growth quality.

Table 3: Oyster Mushroom Growth Monitoring Results

Day to	Manual	Using Tools
1	0 cm 	0 cm 
2	2,5 cm 	4 cm 



Based on the results in the field, oyster mushrooms cultivated with the IoT system grow faster than the manual method.

IV. CONCLUSIONS

Ased on the results of research on the monitoring and control system of temperature and humidity in oyster mushroom cultivation based on IoT, it can be concluded that:

1. This system can monitor and control environmental conditions automatically through the Blynk application, with a setpoint temperature of 29°C and humidity of 90%. The percentage of temperature measurement error is 1.60%, while humidity is 0.82%.
2. The use of this IoT system makes oyster mushroom cultivation more efficient because it allows users to monitor and control the condition of the cultivation room remotely. Optimal environmental conditions can increase the growth and production of oyster mushrooms.

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