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Design And Building of A Temperature and Humidity Control System For an Oyster Mushroom Cultivation Room Based on Arduino Mega

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ABSTRACT

Mushrooms are a type of exotic vegetable commodity that has quite high economic value and has great potential for cultivation. Oyster mushrooms are a type of mushroom that is much loved by Indonesian people and are a food source that is popular with people and contains quite high nutrition. The factors that determine mushrooms to grow well are temperature, humidity, CO2 levels and light intensity. This research aims to increase the efficiency of oyster mushroom cultivation by utilizing Arduino Mega technology in the oyster mushroom cultivation room and using a DHT-11 temperature sensor as a temperature and humidity detector in the oyster mushroom cultivation room. cultivation room. The parameters used to test the quality of the DHT-11 sensor are accuracy and normality test. The DHT-11 temperature sensor data is processed on the Arduino Mega and then displayed via LCD in real time. The system test results obtained in this research show that the system can work to control well with temperature values between 26-29°C with humidity 70-90%. From the results of the system test, the mushrooms will grow well.
***Keywords**: Oyster mushroom, Arduino Mega, DHT-11, Monitoring, Control*

Introduction

Oyster mushrooms (Pleurotus sp.) are a type of mushroom that has quite high economic value and is good for cultivation, ranking third after button mushrooms and shiitake mushrooms [1]-[4]. Oyster mushrooms (Pleurotus sp.) are saprophytic plants that grow and live in softwood and obtain food by utilizing the remains of organic material. Mushrooms are a food source that is popular with the public and contain quite high levels of nutrition [3]. Given the needs and content of oyster mushrooms, it would be very good to cultivate them widely.

Oyster mushroom cultivation is best done in highland areas with a cool climate. Oyster mushrooms live on rotting logs. To maintain temperature and humidity conditions at the desired conditions and avoid pests, wind, too much rain, oyster mushrooms are cultivated in mushroom houses or what are called kumbung. Mushroom mushrooms in Indonesia are usually made from bamboo and oyster mushroom cultivation is done conventionally, where temperature and humidity conditioning is done by spraying water every morning and evening with a hand sprayer [5].

This method can cause problems, namely, the resulting temperature and humidity levels are only based on estimates. This also requires continuous consistent effort. So the results that are felt are not effective and optimal. Temperature and humidity control in the kumbung must be carried out to maintain good and optimal growth of oyster mushrooms. Oyster mushrooms grow optimally at a temperature of 26-29°C with humidity of 70-90%. [2].

Given the problems above, the author created a tool that utilizes a humidity temperature sensor to control the temperature and humidity in an Arduino Mega-based oyster mushroom cultivation room.

Research Methods

This research method uses a design and build method with several stages which can be seen in Figure 1, namely literature study, system requirements analysis, system planning and design, tool testing, data collection, sensor quality testing, and data analysis. Then literature studies and problem identification are carried out before the research by collecting theories and literature in journals, books and other references. Design and system design includes tool design and 3D design, mushroom cultivation room design with 3D design, creation of the Arduino IDE program, and installation tools in the mushroom cultivation room. Next, test the tools by testing the temperature and humidity settings in the cultivation room. Then data collection is carried out by taking the data displayed on the LCD in real time.

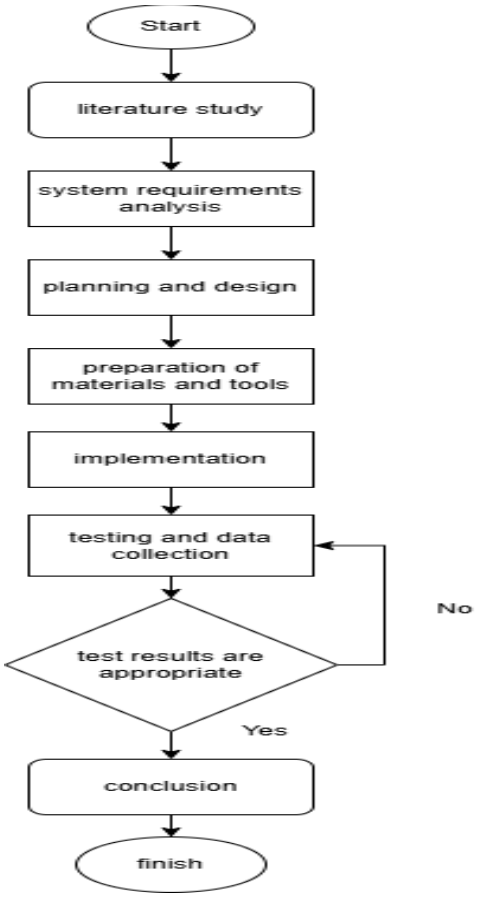


Figure 1 Research Flow Diagram

Hardware Design

This design is divided into two stages, namely creating a tool system mechanism and creating an oyster mushroom cultivation roomSystem alat kontrol

In Figure 2, the wiring diagram of the control system. From this picture, the control system components include, among other things, a power supply which functions as a voltage source for the Arduino and also components such as the LCD and sensors. The Arduino Mega functions as a microcontroller which regulates all sensors and also components such as LCD, relay, keypad and infrared. Then DHT 11 functions as a temperature sensor that detects temperature and humidity in the cultivation room, LCD functions to display sensor data sent by Arduino, Keypad functions as input to set the upper and lower temperature limits, specified humidity, Relay and Contactor function as a switch to turn on and deactivate the 12 eye ultrasonic mist maker, Infrared functions to turn on and off the AC (Air conditioner) by sending infrared rays to the AC, Air conditioner functions to lower the temperature in the cultivation room, Mist The 12 eye Ultrasonic maker functions to increase humidity in the cultivation room, the electric MCB functions as a safety device, and finally the Electrical Terminal.

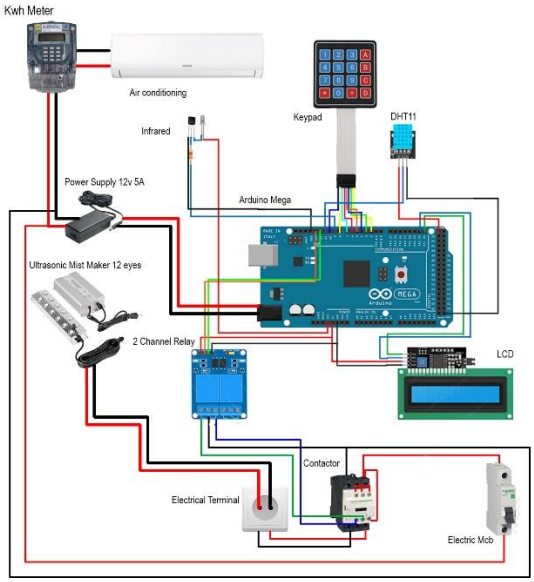


Figure 2. Control Device Circuit Schematic

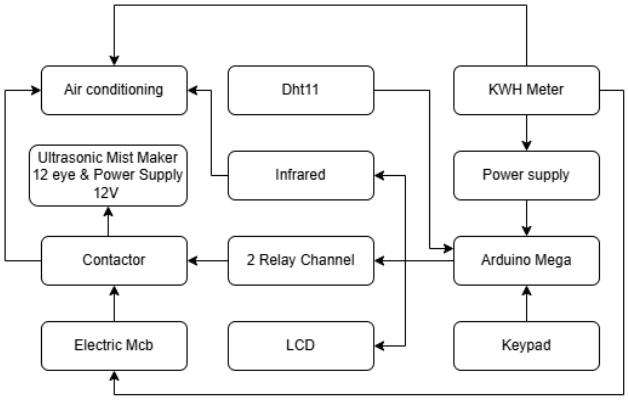


Figure 3. Control device circuit block diagram

A. Cultivation Room

Mushroom cultivation room design using Sketcup software which can display the 3D shape of the design and layout of the cultivation room. In Figure 4 you can see the shape and layout of the mushroom cultivation room. The size of the cultivation room is 4 meters x 2.5 meters with 4 shelves for storing mushroom seeds.

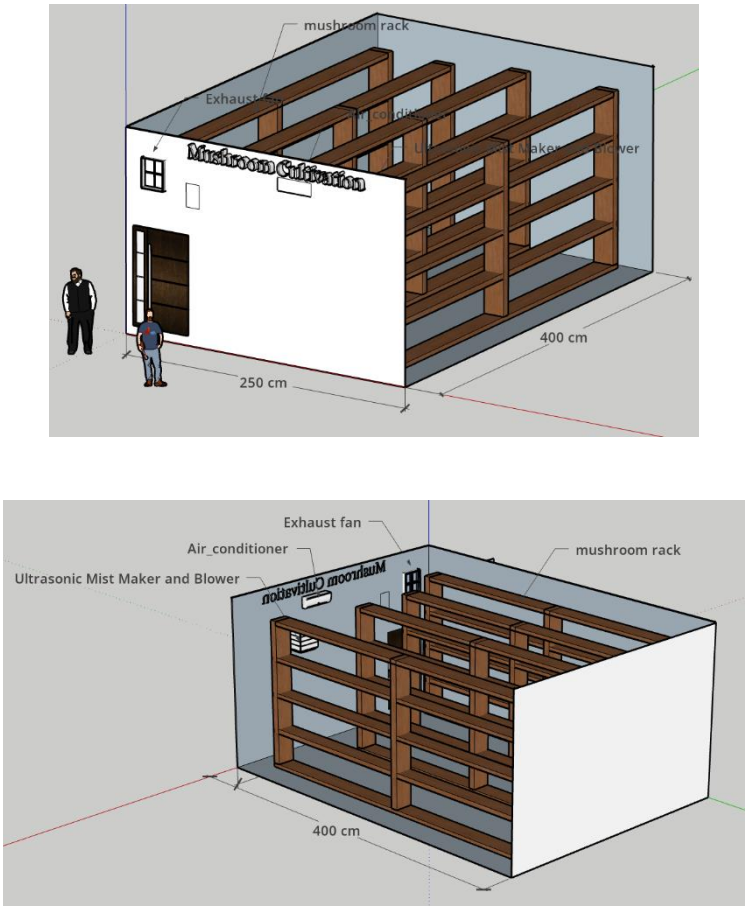


Figure 4. Cultivation room design

Software Design

For the design of this research software, the Arduino IDE application is used to program the Arduino Mega in C++, and the flowchart can be seen in Figure 6. Where the flowchart is made using Draw.io software, Figure 6 shows how it works. from the control system. The control system begins by providing input voltage from the power supply to the Arduino Mega microcontroller. After that, enter the upper limit value and lower limit value for temperature and humidity by pressing the button on the keypad that has been determined, then the sensor will read the temperature and humidity values in the cultivation room. On the DHT11 temperature and humidity sensor there is a decision, if the temperature value in the cultivation room is higher. from 28 then infrared will send a command in the form of infrared rays to the air conditioner (AC) so that the AC will turn on, and when the temperature reaches 26 then infrared will send a command in the form of infrared rays to deactivate the AC, then for humidity when the humidity value is less than 85 then Arduino will give a command to the relay then the relay gives a command to the contactor which will make the switch on the contactor turn ON and automatically the Ultrasonic Mist Maker turns on and will produce mist, then when the humidity reaches 90 then the Arduino automatically gives a command to the relay then the relay gives a command to contactor so that the Ultrasonic mist maker will be deactivated. This control system process is carried out continuously or repeated (Looping).

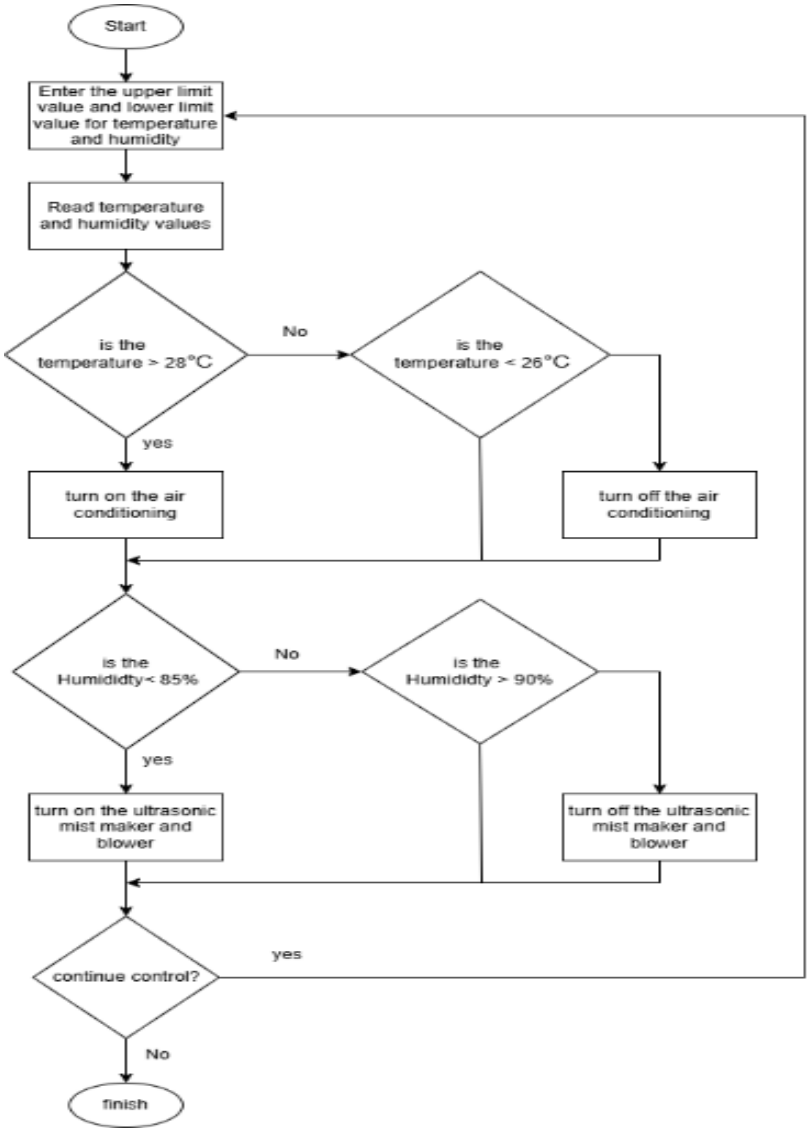


Figure 5. Flowchat Software Design

Results And Discussion

This control system test aims to determine the performance of the sensors and control equipment, whether they function properly for reading temperature, humidity and controlling the cultivation room. There are two tests, namely sensor testing and overall control equipment testing. For sensor testing, use measuring equipment available on the market or factory as a comparison.

1. DHT11 sensor
   The DHT11 sensor test aims to determine the accuracy of the sensor in detecting temperature and humidity with a comparison, namely the value of the digital thermometer temperature data. The comparison is used to calculate the error percentage value, using the equation (1).

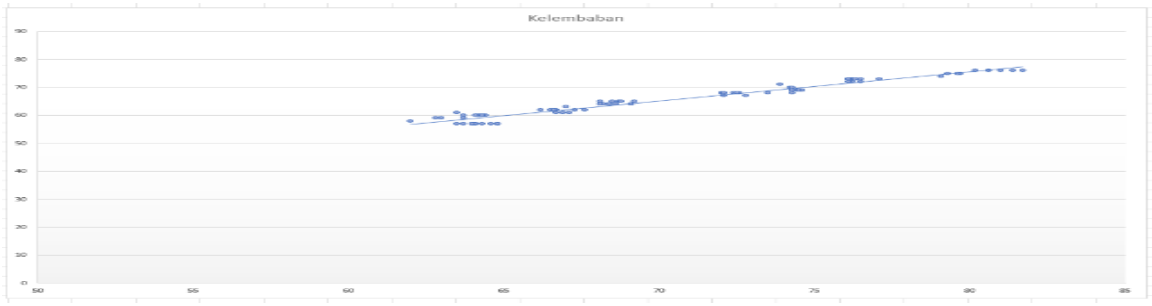
$$\%Error = \left|\frac{Value\ Sensor - Reference\ Value}{Reference\ Value}\right| x100\% \quad (1)$$

Tabel 1 Calculation Results Of Sensor Temperature Accuracy

No	Time	Temperature (sensor)	Temperature (thermometer)	|Sensor Value-Reference value|	Error (%)	Accuracy (%)
1	08.00	26.10	26	0,10	0,38	99,62
2	08.05	26.30	26	0,30	1,15	98,85
3	08.10	26,40	26	0,40	1,53	98,47
4	08.15	26,50	26	0,50	1,92	98,08
5	08.20	26,70	26	0,70	2,69	97,31
6	08.25	27,80	27	0,80	2,96	97,04
7	08.30	27,70	27	0,70	2,59	97,41
8	08.35	27,70	27	0,70	2,59	97,41
9	08.40	27,80	27	0,80	2,96	97,04
10	08.45	28,40	27	1,40	5,18	94,82
…	…	…	…	…	…	…
80	15.55	30,10	30	0,10	0,33	99,67

Tabel 2 Calculation Results of Sensor Humidity Accuracy

No	Time	Humidity (sensor)	Humidity (thermometer)	|Sensor Value-Reference Value|	Error (%)	Accuracy(%)
1	08.00	81,00	76	5,00	6.57	93,43
2	08.05	81,70	76	5,70	7,50	92,50
3	08.10	80,60	76	4,60	6,05	93,95
4	08.15	81,40	76	5,40	7,10	92,90
5	08.20	80,20	76	5,20	5,52	94,48
6	08.25	79,10	74	5,10	6,89	93,11
7	08.30	77,10	73	4,10	5,61	94,39
8	08.35	76,50	73	3,50	4,79	95,21
9	08.40	76,20	73	3,20	4,38	95,62
10	08.45	74,20	71	3,20	4,50	95,50
…	…	…	…	…	…	…
80	15.55	68,40	64	4,40	6,87	93,13



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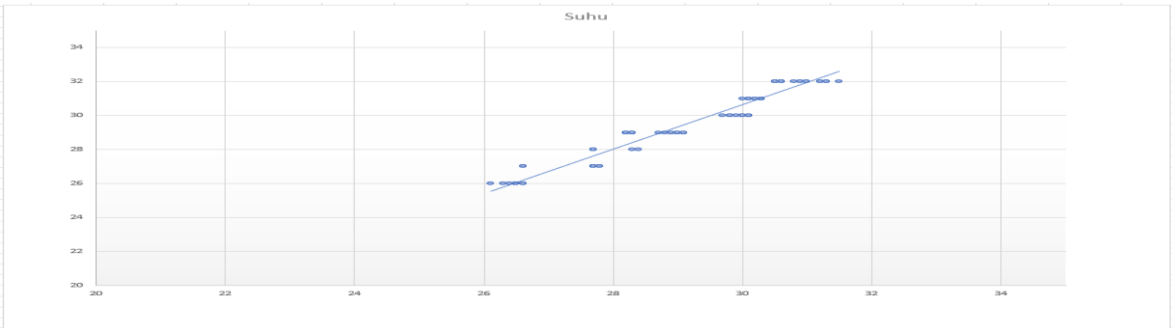


b

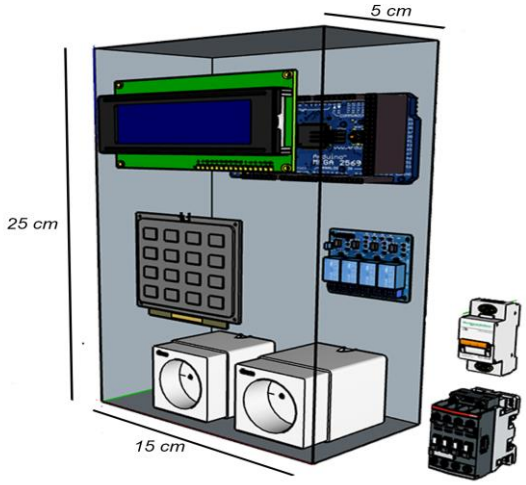
Figure 6. (a) Temperature regression graph (b) humidity regression graph

Based on Table 1, the calculation of the DHT11 temperature sensor in the room is at 08.00 the accuracy is 99.62%, at 08.05 the accuracy is 98.85%, at 08.10 the accuracy is 98.47%, at 08.15 the accuracy is 98.08%, at 08.20 the accuracy is of 97.31%, at 08.25 the accuracy was 97.04%, at 08.30 the accuracy was 97.41%, at 08.35 the accuracy was 97.41%, at 08.40 the accuracy was 97.04%, at 08.45 the accuracy was 94.82%, ..., and at 15.55 the accuracy was 99.67%. From the 80 data samples taken, the accuracy can be concluded that the difference in data values between the sensor and the digital thermometer is not much different.

Based on Table 2, the calculation of the DHT11 humidity sensor in the room is at 08.00 the accuracy is 93.43%, at 08.05 the accuracy is 92.50%, at 08.10 the accuracy is 93.95%, at 08.15 the accuracy is 92.90%, at 08.20 the accuracy is of 94.48%, at 08.25 the accuracy was 93.11%, at 08.30 the accuracy was 94.39%, at 08.35 the accuracy was 95.21%, at 08.40 the accuracy was 95.62%, at 08.45 the accuracy was 95.50%, ..., and at 15.55 the accuracy was 93.13%. From the 80 data samples taken, the accuracy can be concluded that the difference in data values between the sensor and the digital thermometer is not much different.

Control System Testing

Testing the control equipment aims to find out whether the control system can work well and can maintain the temperature and humidity values in the cultivation room. The control box measuring 25 cm x 15 cm uses acrylic as a medium for the box, which can be seen in Figure 7.



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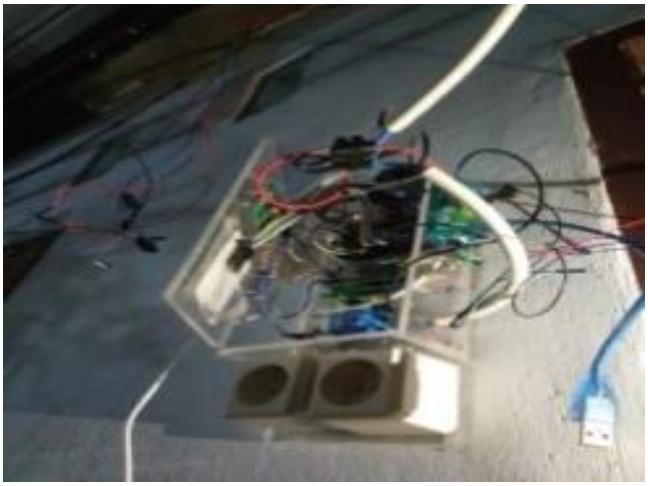

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Figure 7. (a) 3D control box design (b) Control box

TABEL 3 Results Of Temperature And Humidity Measurements In The Cultivation Room

Number	Temperature (°C)	Humidity (%)
Minute -1	27,1	89
Minute -2	25,9	89
Minute -3	28	88
Minute -4	26,2	85
Minute -5	28	90
Minute -6	27,6	86
Minute -7	25,8	90
Minute -8	28	90
Minute -9	27,6	86
Minute t -10	25,8	89
....	.....	.....
Minute -85	27,1	90

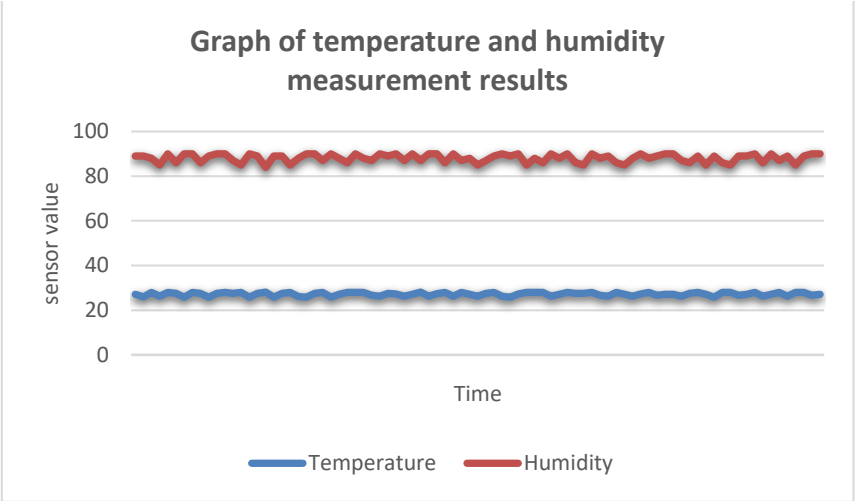

Figure 8. Temperature and humidity graph in the cultivation room

Conclusion

Based on the research results, the design of a temperature and humidity control system in the Arduino Mega based oyster mushroom cultivation room can maintain temperature and humidity in the oyster mushroom cultivation room. Based on the results of temperature and humidity measurements which were monitored for 8 hours, namely the temperature limit was between 26-28 and humidity 85 -90% can be categorized as good. The sensor accuracy test shows that the sensor can work well and is not much different from a digital thermometer.

Thank You Note

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