Evolution in Electrical and Electronic Engineering Vol. 3 No. 1 (2022) 545-553

EEEE

Homepage: http://publisher.uthm.edu.my/periodicals/index.php/eeee
e-ISSN : 2756-8458

Mushroom House Monitoring System Using Internet of Things (IoT)

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DOI: https://doi.org/10.30880/eeee.2022.03.01.063
Received 04 July 2021; Accepted 30 May 2022; Available online 30 June 2022

Abstract: This paper aims to enable people to understand that the Internet of Things (IoT) helps humans in any kind of agriculture activities such as monitoring, controlling, adjusting the environment and updating real-time data. Most agriculture plantings are based on traditional farming and demand a lot of human work processes. Therefore, this project involves the development of a Mushroom house monitoring kit and automatic control of temperature and humidity that can overcome this problem. The works in this project involve the development of a monitoring kit with a control system using an Arduino board as the microcontroller and NODE MCU ESP 32 as the open-source IoT platform firmware. The Arduino is programmed to monitor the temperature and humidity of the mushroom house. After receiving the data, Arduino will control the DC fan turning it on and off automatically depending on the data received by the sensor. In addition, to make sure the surrounding of the mushroom house is conducive to mushroom cultivation, a water level system serves to channel the water below the mushroom growing kit from a reserve water tank. The most important thing in this project is that the system can update the real-time data to the cloud via Wi-Fi. Users can access the cloud platform (Thingspeak) using a computer or gadget as long as the internet connection is available. The results for this project show that the data of temperature and humidity are changing depending on the weather, this is because when the weather is cloudy and rainy, the reading of humidity can increase to 98% and the temperature can drop below 27ºC. Furthermore, the preliminary experimental results demonstrated that all the systems were optimized and successful to achieve the objective.

Keywords: Monitoring System, Internet of Things (IoT), Monitoring Kits

1. Introduction

Mushroom cultivation in Malaysia become important in the agriculture industry. This is because of the flexibility of its farming method that can live everywhere, especially in places such as cold, high humidity and low temperature [1][2]. In Malaysia, the mushroom plantation industry is growing and

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thriving due to high demand in the local and outside of Malaysia market[3]. Mushroom that contains high in nutrition and protein have been used for century for food, medicines and flavoring. The need of food and limitation of space or land as an Agro-economic activity make urban farming technology is becoming popular and has become one of promising solution for securing food supply [4]. Apart from that, extreme weather changes and climates affect the production of crop, thus increasing their prices and lowering the quality of the crops produced.

The increase in extracting good in mushroom has make the agriculture sector push for more demands of import and export. The mushroom grower are mostly local villagers that produces mushroom in their own farm using traditional ways [5]. This method of mushroom cultivation cannot satisfy the increase in demand of mushroom order and request. Thus, making the mushroom production faced a little difficulty. Furthermore, this project is dedicated to improve the traditional ways in mushroom cultivation implementing indoor mushroom house that equipped with smart monitoring system and able to upload data to the cloud website using Internet of Things (IoT).

1.1 Internet of Things (IoT)

To maintain and control the growth process and monitor mushroom growth in real time online, the design scheme of the environment monitoring system based on Internet of things was put forward on the main climatic conditions that influence the growth of mushroom [4][6]. And according to the mushroom climatic conditions, the appropriate sensor and sensor placement were place inside mushroom house. By using Arduino, the board can program sensor to sense temperature and humidity, based on this result it will either turning on and off the Dc fan accordingly. In order to ease the access from user, we allow the real time data monitoring by uploading the result in Thingspeak. Using IoT platform will enhance the capability of current equipment for remote monitoring purpose and at the same time log the data for analysis and references.

1.2 Mushroom House

The mushroom house was built to allow the mushroom to grow more suitable, conducive and increase the humidity of surroundings. By doing this, mushroom house provides much darker place and low temperature space for mushroom growth [7][8]. Oyster mushrooms are known to be sensitive to the climatic conditions, favorable temperature and moisture condition enhanced the production of mushrooms fruitbodies and yield [9]. Other than that, we install DC fan inside the mushroom house to create a ventilation system to allow the flow of air from the outside.

1.3 Related Article

Mostly many of the project regarding mushroom cultivation is conducted indoor. This is because it is much easier to preserve the environment and surrounding. As an example, in India, there were a group of students that develop a monitoring system of mushroom house using various of sensor to monitor humidity, temperature, concentration of carbon dioxide and light intensity using android device and real live data platform called adafruit.io [10]. The main algorithm implies that the control system is adjusted by receiving the feedback from the monitoring data. Other than that, in Indonesia, they control the humidity of Oyster mushroom by spraying the water granule and using an exhaust fan [5].

2. Methodology

In this methodology the project has two system which is the monitoring system and the water level balance system. Both of the system goal is to create a most optimum condition for the mushroom to grow. The Hardware system consist of Arduino Uno, Node MCU ESP32 and DHT 11. This component capable to detect the changing of temperature and humidity of the mushroom house. Node MCU ESP 32 serve as a Wi-Fi to upload the data into the Thingspeak that act as IoT platform. The water level system is an additional humidity regulator to keep the temperature low. During the mid-day temperature

can risen to 35℃ which is can harm the mushroom cultivation process. The water level system allows the water flowing inside the mushroom house at the bottom of the racks.

The flowchart as shown in Figure 1 reveals the process operates as sensors required to monitor the vital parameters connected to the microcontroller. The program is written in such a way to monitor and to automate surrounding. The microcontroller will both do the process and send the sensor data and upload the performance status to the server, whenever the temperature exceeds its limit, the dc fan will turn on until the it regulated back to its temperature. This condition also applied to humidity changes, whenever it goes lower than normal, the dc fan is expected to operate until it adjusted. In the moment this thing happened, the monitoring data will be uploaded to the Thingspeak. This means that the system is able to fix the environment while host a real time data monitoring.

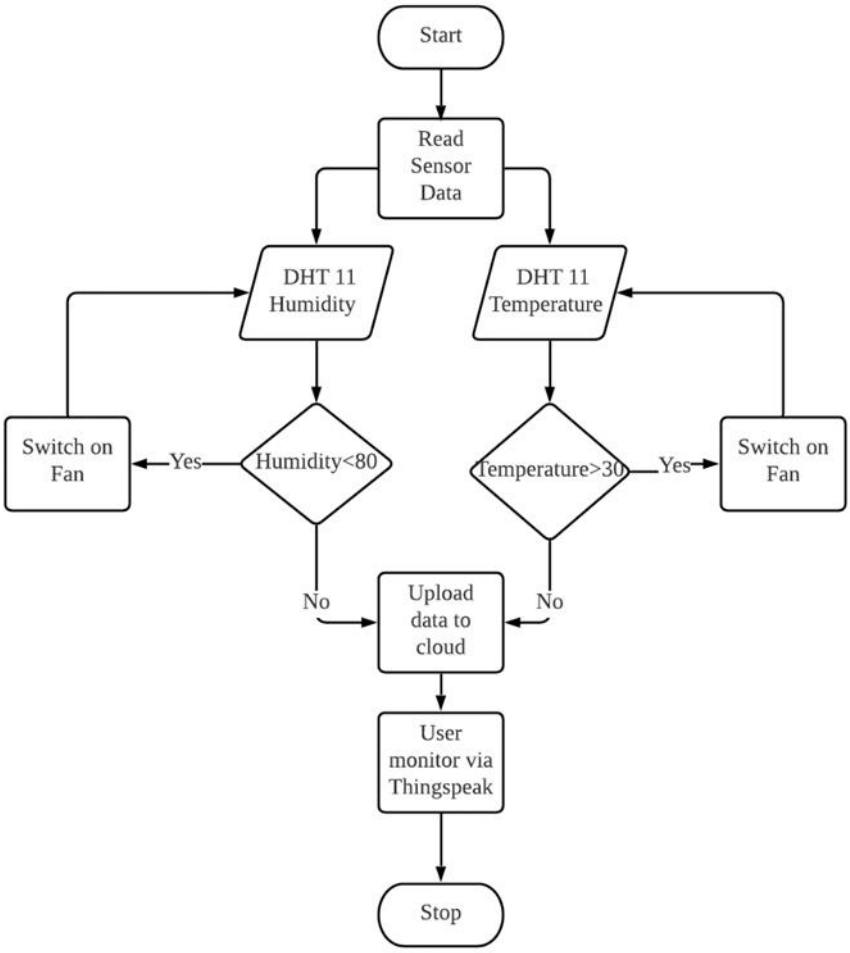

Figure 1: Overall flowchart

2.1 Concept diagram

The DHT11 are connected with Arduino Uno, the board is required to program the sensor to detect the temperature and humidity, the sensor need to be calibrated first so that it gets the accurate result by writing the instruction using IDE. The NODE MCU ESP 32 is the enabler for IoT features in this project.it connect to the nearest WIFI, so that any data that received can be transfer to the destination. These settings can be written in the software IDE, the address and nearby WIFI details need to be correct so that the module recognize it. Figure 2 shows the DC fan that used to adjusting humidity by allowing the air flow are automated based on instructions from Arduino uno.

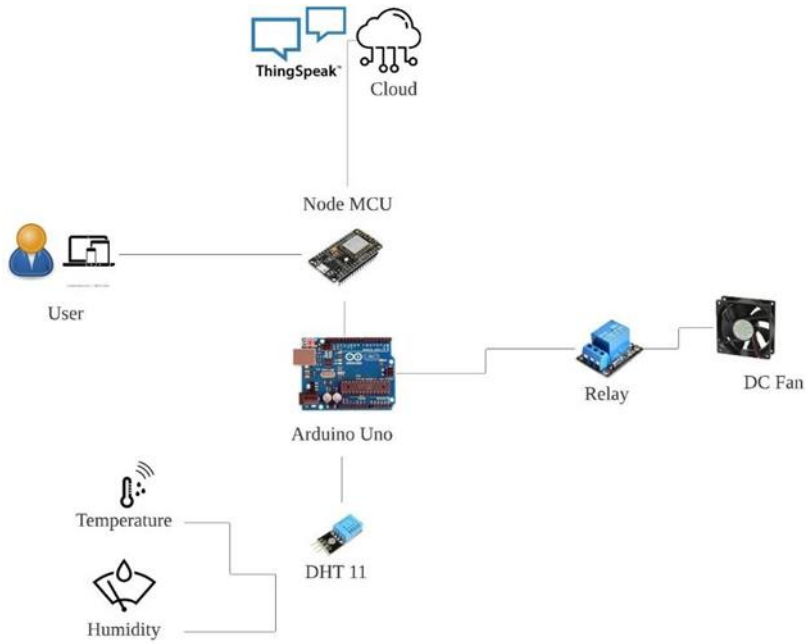

Figure 2: Concept diagram of the integrated system of Mushroom House monitoring

In oyster mushrooms cultivation there are several techniques for raising humidity, such as spraying water mist using spray, soaking the soil (if the foundation of the house), and wetting the fabric wall (if the wall is a cloth). To reduce the humidity can be done by sucking the moist air from the house so that the air inside the house to dry. In order to support the mechanism of controlling temperature and humidity, water level system add the presence of water below the mushroom growing bag. The water is placed inside the mushroom house to make sure that the humidity inside is higher than 70%.

3. Results and Discussion

In this project, there are two parameters that we monitor every day during mushroom growth period. In this phase we analyze the results in three-time, which is morning noon evening and night. The reading of the temperature and humidity were collected in 5 days.

ThingSpeak function as a platform for cloud and data. Other than that, user can also view the live real time data using any device that can connect to the internet. In Figure 3, the humidity results are displayed in form of graph. This results also show the date received, approximate time according to specific time zone. The feedback of the results is been uploaded twice in one minute. Figure 4 shows the value of temperature starting from 21:10 to 21:30. The value are exceeding 33.25℃ at 21:20 and return below the limit after 21:25.

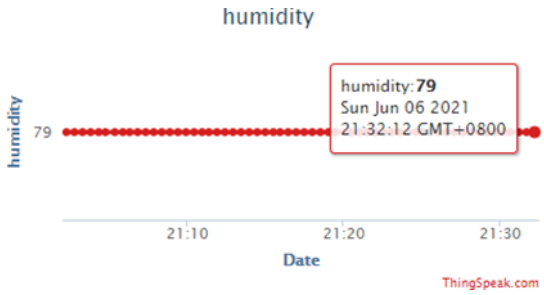

Figure 3: Humidity result

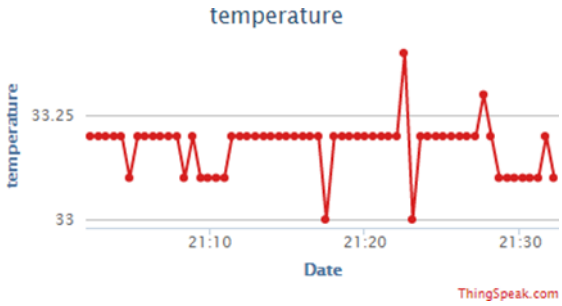

Figure 4: Temperature result

Figure 5 shows the monitoring dashboard for the system.

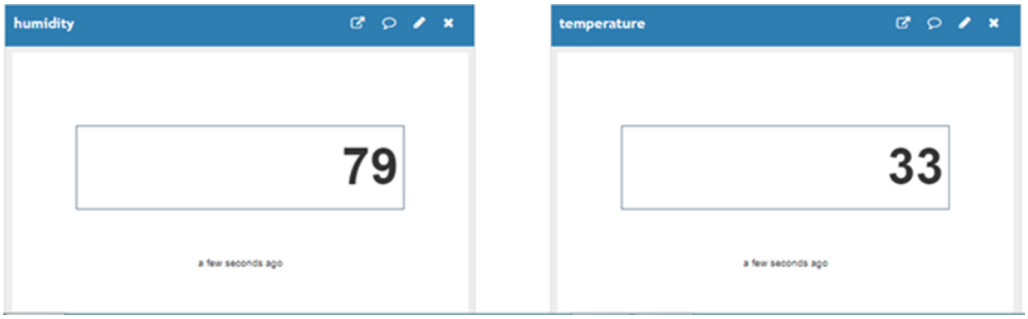

Figure 5: Dashboard show latest update real data monitoring

Figure 6 shows the mushroom house while Figure 7 depicts the grey oyster mushroom cultivation.

Figure 6: Mushroom House

Figure 7: Grey oyster mushroom cultivation

3.1 Discussions

The mushroom house monitoring system was implemented in Bandar Indera Mahkota, Kuantan, Pahang. The experimental process takes five days to complete. The monitoring process of mushroom cultivation is conducted inside the mushroom house. Based on the results obtained, the reading of the temperature and humidity is different depending on the weather changes. Normal temperature will be around 32℃ and humidity is 80%. This reading also depends on the sensitivity of the DHT 11 sensor. Whenever the reading of the temperature exceeding 25℃ and humidity below 80% the DC fan will automatically be activated.

The lower value of humidity below 80% show that the surrounding is not moist enough. The higher temperature of reading show that inside the mushroom house is boiling. If this case happens, the water level system will channel water to the tray to make the environment become soggy and steamy.

The results were taken in 5 days during mushroom cultivation.to prove that the sensor is accurate we use the Accuweather website to compare the data and analyze it value. The measured reading is from DHT11 sensor while actual reading is from the forecast website. Table 1- 4 show the results taken in 5 days for all day.

Table 1 The results taken in 5 days in the morning

Date	Time Duration (Minutes)	Measured Reading		Actual Reading	
		Temperature (℃)	Humidity (%)	Temperature (℃)	Humidity (%)
15th of June 2021	10	30.1-30.4	89-91	24	94
16th of June 2021	10	30.7-31	89-90	24	94
17th of June 2021	10	30.8-31.1	93-94	25	94
18th of June 2021	10	30.4-30.8	90-91	24	88
19th of June 2021	10	30.9-31.4	95	26	88

Table 2 The results taken in 5 days in the noon

Date	Time Duration (Minutes)	Measured Reading		Actual Reading	
		Temperature (℃)	Humidity (%)	Temperature (℃)	Humidity (%)
15th of June 2021	10	31.3-32	91-94	31	70
16th of June 2021	10	31-31.5	93-94	31	70
17th of June 2021	10	31.3-31.7	91-92	32	70
18th of June 2021	10	30.6-31	87-88	29	69
19th of June 2021	10	31.7	92-93	30	74

Table 3 The results taken in 5 days in the evening

Date	Time Duration (Minutes)	Measured Reading		Actual Reading	
		Temperature (℃)	Humidity (%)	Temperature (℃)	Humidity (%)
15th of June 2021	10	31.8-32	86-88	28	78
16th of June 2021	10	31.8	89-91	31	70
17th of June 2021	10	32-32.2	87	31	70
18th of June 2021	10	32	85-86	32	66
19th of June 2021	10	31.9-32	88-87	31	70

Table 4 The results taken in 5 days in the night

Date	Time Duration (Minutes)	Measured Reading		Actual Reading	
		Temperature (℃)	Humidity (%)	Temperature (℃)	Humidity (%)
15th of June 2021	10	31.6-31.7	92-94	26	83
16th of June 2021	10	31.4	94-95	29	78
17th of June 2021	10	31.8	92-92	25	88
18th of June 2021	10	32	92	30	74
19th of June 2021	10	32	88	27	83

Figure 8 shows the graph of humidity and temperature are compiled between 5 days. The trend of the temperature and humidity pattern are analyzed. Start in the morning, both of the reading is at low value, this is because the existent of fog and moist from natural environment at 12:00 pm, The reading of temperature will increase and the humidity value will decrease, this is because condition of the surrounding start to heat up. By evening, the temperature normally will stay or decrease from 32ºC to 31ºC.The heat are slowly reduced when its turn to night. Gradually the value of humidity will rise up from 88% into 95%. This behavior shows the same pattern every day from 15th June until 19th June.

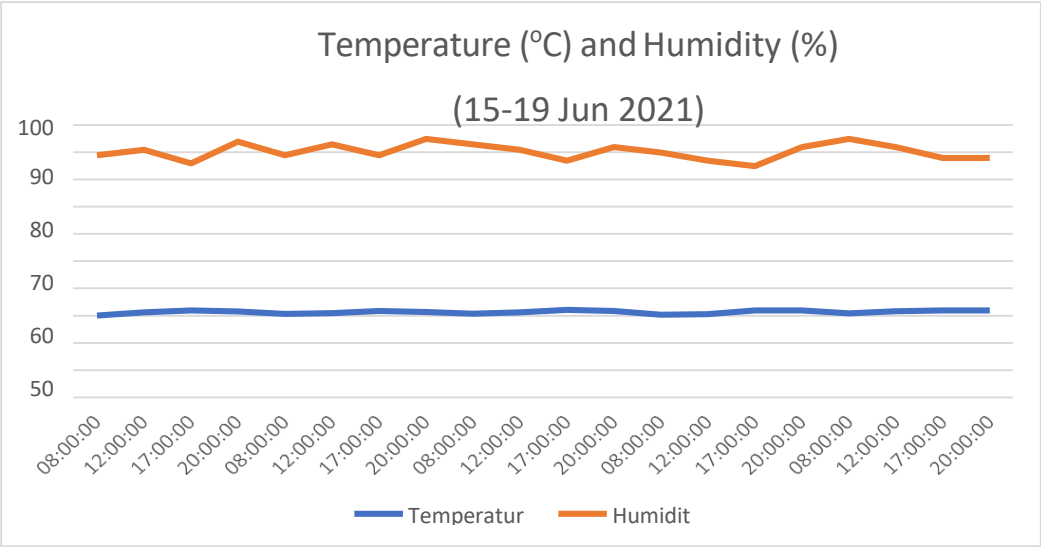

Figure 8: Temperature and Humidity graph

4. Conclusion

As a conclusion, the Mushroom House Monitoring system using IoT has achieve all of the objective listed in chapter 1. The mushroom monitoring system are able to monitor the temperature and humidity. Other than that, the system also included the IoT features which is also capable to upload the result into the cloud. The result taken throughout 5 days prove the accuracy of the sensor by compare it with the actual data from forecast weather station. In addition, this project is completed with the mushroom house that was manufacture from PVC pipe and black shade as the outer layer. This mushroom house capable to become a place for mushroom cultivation, indirectly fulfilled the objective

Subsequently, the next objectives are accomplished, when the results of temperature and humidity are taken by sensor DHT 11, transfer it to Thingspeak via NODE MCU ESP 32. This makes the reading of the data can be monitor by accessing from the website. Nonetheless, by using this modern technique, farmer can improvise their technique of mushroom harvest in the food industry, rather than still using the traditional method. This achievement in agriculture will affect the productivity of food and help local farmer increase their income profit.

Acknowledgement

The authors would like to thank the Faculty of Electrical and Electronic Engineering, Universiti Tun Hussein Onn Malaysia for its support.

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