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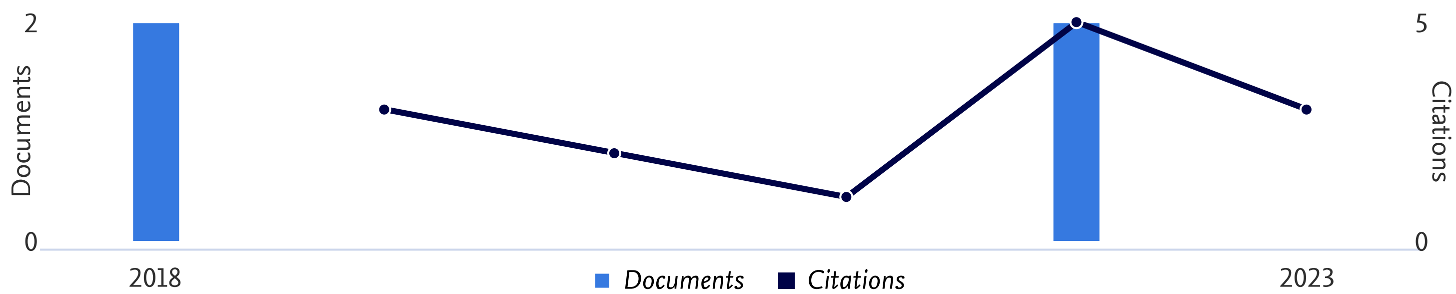

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Utilizing the Internet of Things technology to control oyster mushrooms

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***Abstract*— The objectives of this research were 1) Examine Internet of Things technologies for water spray and ventilation fan control in mushroom farms. 2) Develop tools and systems that enable users to monitor temperature, record it, and manage the amount of humidity in the House by adjusting humidity levels. These studies have selected NodeMCU ESP8266 and Arduino MEGA, AM2315, and KC-TH-280 modules for measuring digital temperature and humidity capture for load management of different electrical appliances. They utilized the application to switch on and off air humidity, drip irrigation, and water spraying automatically or manually to capture data acquired from a cloud system and demonstrate value to the Blynk System through mobile phones 3 meters wide, 6 meters long, and 3 meters high House. The investigation revealed that the sensor device readings measured and analyzed for on-off accuracy while the application was running were correct. There are 50 consecutive operations involving human control and automation. Through the application, the user controls the on/off state of the water pump and the operation of the ventilation fan. The water pump is active around 94% or 47 times. The quantity of pumps is disabled. The ventilation fan was turned off 49 times, or 98%, and the fan was turned off 48 times, or 96%, while testing the equipment's functionality with the humidity and temperature settings. The mushroom house was heated to 30-35 degrees Celsius and humidified to a relative humidity of 65-75 percent. This technique was an effective tool for managing mushroom farm equipment.**

Keywords*— *Oyster Mushroom, IoT, Temperature, Humidity, Machine control

I. INTRODUCTION

A. Background

Agriculture is now playing a more significant part in the country's long-term growth, keeping with the Thailand 4.0 government's strategy, which focuses on an innovation-driven economy, a Value-Based Economy, emphasizing the significance of innovation. To contribute to Thailand's 4.0 economy, with a concentration on food, agriculture, and biotechnology[1]. Looking at the pace of GDP growth over the previous 15 years, between 2002 and 2005, GDP growth was at 6-7%, but by 2006 and 2007, it had dropped to 4-5%, leaving only around 0.1 remaining. At the time, America was in the grip of an economic catastrophe. It arrived at a rate of 0-2% throughout the previous three years and 2.8% in the most recent year. The average GDP over 15 years is roughly 4% higher, more than 3% higher over 10 years, and just around 2% higher over 5 years. This isn't simply because of politics; our economic structure also has problems. The disparity gap is growing even more significant. The industrial sector is the most robust. The environment is being hurt, while the agricultural industry is shrinking. Compared to last year's deluge, this year has been a drought. If we continue in this manner, Thailand will face problems in the future. [2]

Thai farmers during the THAILAND era 4.0 Smart Farmer's beginning, or a portion of it, is not harmful to the environment. Make good use of your resources. When completed, it should be more comfortable and less exhausting, similar to having a little area, but it may be designed to develop together and support one another. True, technology is necessary. Because Smart Farmers must be able to connect to the outside world independently, they Smart Farmer must comprehend the manufacturing process. Management understands both technology and nature [3].

Pleurotus mushrooms are economically valuable because they are trendy in Thailand, with items such as oyster mushrooms, royal oyster mushrooms, and abalone mushrooms being extensively distributed. The cultivation of genus mushrooms is simple and may be done all year. The following are significant parameters that influence mushroom development in mushroom growing. 1) favorable weather The tropical mushroom prefers warm temperatures. Therefore, the air is an element that aids in the acceleration of mushroom development and blossoming. 2) Humidity is an essential aspect of mushroom cultivation because it affects the growth of mushroom mycelium; insufficient ventilation inside the lump or a lack of oxygen will cause mycelium atrophy or rot. 3) Sunshine Certain mushrooms dislike direct sunlight because it causes the mycelium to die, while some mushrooms will encourage the light to grow blooms (Fruiting). Each variety of mushrooms has distinct light needs, such as smashed mushrooms, white log mushrooms, fairy mushrooms, oyster mushrooms, ear mushrooms, and others.

Mushroom cultivation involves several factors as follows: 1) Temperature has a significant impact on mushroom development and production. The ideal temperature for growth is between 20 and 30 °C. 2) Humidity in the air Mushrooms demand relatively high humidity. Thus, the inoculum must be opened within the House to store humidity and maintain a humidity level of 70-80%. 3) The air in the House should be adequately aired; if the House has a high carbon dioxide concentration, the mushroom will appear weird. 4) The light during the mushroom opening requires a specific quantity of light for the mushrooms to develop correctly. 5) Nutrients: Each mushroom should include a suitable amount of carbohydrates, proteins, lipids, minerals, and vitamins. 6) An acidic medium to 23 medium levels with a pH of roughly 5.5-7 should be utilized for mycelium development. 7) No matter where it is placed, the umbrella-shaped mushroom of Earth's gravity will grow in resistance to the planet's gravity. Therefore, mushrooms will thrive despite the Earth's gravity. The shelf mushrooms will grow along the Earth's surface.

The researcher has developed an idea to employ Internet of Things technology linked to transmission and transmission microcontroller devices to maximize economic mushroom output in limited places. The control signal to turn on/off the water spraying system to adjust the humidity and temperature in the House, as well as control the on/off of the exhaust fan for use in reducing humidity and temperature inside the House by bringing data transmitted via the cloud and displaying mobile data to be controlled to recognize the temperature and humidity of various environments. To reduce weather uncertainty and increase output on the oyster mushroom farm, The researcher designed and built a prototype oyster mushroom dwelling for use in this study experiment at Maejo Phrae Chalermprakiet University.

B. Research objectives

1. Investigate Internet of Things (IoT) technologies for regulating water spray and ventilation fans in mushroom farms.
2. Develop tools and systems that allow users to monitor temperature, record it, and adjust humidity to regulate the quantity of it in the House.

II. Literature Review

NodeMCU is an open-source Internet of Things platform. It provides software that operates on the Espressif Systems Company's (Shanghai, China) ESP8266 WI-FI SoC (System-on-chip). It is a Microcontroller with 32 bits. In this study, NodeMCU made use of an ESP8266 UART WIFI IoT. NodeMCU is comparable to Arduino because it has input and output ports. NodeMCU is compatible with the Arduino IDE, which allows for C++ programming. Micro B-USB can be used to compile and flash programming programs. NodeMCU has an advantage over Arduino because it is smaller and can connect to WiFi. [4]

Blynk is an internet of things platform that aims to make it easier to create mobile and online apps for the Internet of Things. Connect 400+ hardware models such as Arduino, ESP8266, ESP32, Raspberry Pi, and similar MCUs easily, and create drag-and-drop IOT mobile apps for iOS and Android.[5]

Smart Mushroom Cultivation Using IoT System Implementation in the Agricultural Field is widely used to provide efficient farming solutions. This project develops a wireless network system for monitoring real-time data, as well as a user interface and system automation, by leveraging a dynamic website and teaching machine learning to our IoT system to automate the process. The critical difficulties in mushroom farming are irrigation, environmental parameter monitoring, and limited human participation. The Raspberry Pi model B+ also serves as the system's brain, to which various Esp8266 nodes connect to receive real-time data updates. The dynamic website functions as both a user interface and a tool for automating the process. All of the issues can be solved using the approach employed in this study. The Biosensors may be used to detect the presence of microorganisms and the moisture content of the soil.[6][7]

Mushrooms are currently popular foods due to their practicality and high nutritional content, and as a result, agriculturists are interested in mushroom production. Some agriculture succeeds, while others fail. Temperature impacts mushroom development since it is affected by the environment and weather each season. This project aims to design and build a mushroom greenhouse that uses a microcontroller to manage temperature and humidity. There are reviews on mushroom cultivation, including well-constructed greenhouse buildings. This project includes a control system as well as mushroom quantity testing. Every 300 packets of oyster mushrooms and phoenix mushrooms were tested. The yield of goods is then compared between the greenhouse that regulates temperature and humidity and the greenhouse. The average weight and standard deviation of the controlled greenhouse and general greenhouse are 1.506 kg, 0.17, and 1.206 kg, 0.28. Finally, the findings revealed that temperature and humidity affected mushroom development. Furthermore, it can enhance mushroom development throughout the incubation period. [8]

Phoenix Oyster Mushroom production, considered an economic mushroom in Thailand, requires temperature and humidity control to meet customer demand. This study aims to design and implement a smart farm system (SFS) designed ET-ESP8266-RS485 board to control temperature and humidity and operate and display data via a smartphone application. It can also collect data and analyze the Phoenix Oyster Mushroom farm installation with the SFS (the test set) and the Phoenix Oyster Mushroom farm non-installation with the SFS. The findings revealed that the SFS's control system could properly display temperature and humidity readings; the average error percentage was 0.61 and 1.19%, respectively. Furthermore, it kept the temperature and humidity at an average of 27.67 °C and 83.36%, respectively.[9][10][11]

The study's Purpose is to develop a prototype of an intelligent Lingzhi mushroom farm. The Internet of Things and a sensor were utilized in this study to detect and monitor humidity in the Lingzhi mushroom farm. NECTEC was created and made available as a free IoT service. NETPIE processed the humidity data. Data on humidity was kept in a NET FEED (a NETPIE sub-service) and displayed on mobile devices and desktops through NET FREEBOARD (another sub-service of NETPIE). This study also automatically controlled sprinkler and fog pumps, and the functional status (turning on and off for periods) sent notifications to the LINE Application using the LINE API. This investigation used a NodeMCU, humidity sensor, RTC (real-time clock), relay module, sprinkler, and fog pumps. As programming languages, C++ and Node.JS were employed. NETPIE services and protocols were used, with sub-services such as NETPIE FEED, NETPIE FREEBOARD, and NETPIE REST API. The study's findings revealed that combining IoT and sensors improved the prototype of intelligent farming. [12]

III. Research Methodology

We employed the waterfall paradigm of the system development life cycle (SDLC). This research has 5 steps. The following steps include requirement and feasibility, system analysis and design, implementation, system validation, and maintenance.

A. *Requirement and Feasibility study*

This research needed a study to assemble papers and equipment utilized in a research project on building temperature, humidity, and brightness control systems in a house using Internet of Things technology centered on receiving data from sensor devices. Various associated values via the Internet to the Blynk System for control and storage. Such research has chosen NodeMCU ESP8266 V3 and Arduino MEGA to be used with the sensor AM2315 Module and sensor KC-TH-280 Module to measure temperature and humidity in the same device capture as well as load control of various electrical appliances. The necessity to measure environmental conditions may be characterized as managing air humidity, drip irrigation, and spraying water via the application. To switch on/off. Data can be saved manually or automatically. A cloud system may gather air humidity values and show air humidity and temperature values on a mobile phone.

For this research, we selected tools and software shown in Figures 2-3 and table 1-2.

TABLE I. HARDWARE AND PURPOSE OF THE USE

Hardware	Purposes of use
NodeMCU ESP8266 V3	Control devices and send data into Internet via WIFI connection
Arduino MEGA	Control devices and send data.
Digital Temperature and Humidity Sensor (AM2315)	to measure digital temperature, and air humidity in the same device
Temperature & Humidity & Air Pressure sensor (KC-TH-280)	to measure digital temperature, and air humidity in the same device
Relay 2-Channel DC 5V 30A 220v	Connect the circuit like a switch by controlling the operation with an electrical Relay
Fog Pump	Make a fine mist spray to add humidity to the environment in the House.

TABLE II. SOFTWARE AND PURPOSE OF THE USE

Software	Purposes of use
Arduino IDE	The open-source Arduino Software (IDE) quickly writes and uploads code to the board.
C++ on Arduino IDE	Programming language on NodeMCU
Blynk Application	to control Arduino, ESP8266, Raspberry Pi, and the like over the Internet.

B. *System Analysis and Design*

The researcher built the oyster mushroom nursery using mushroom house construction for this investigation. The House is 3 meters wide, 6 meters long, and 3 meters high. For drainage, the floor is filled with sloping mortar, and the walls are brick. The roof is made of iron and steel. lvanize a double-corrugated top like the one seen in Figure 1.

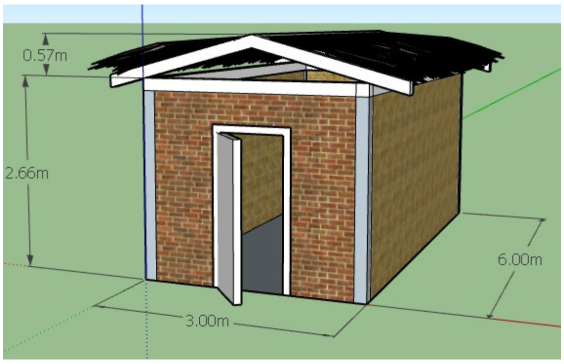

Fig. 1 Mushroom Cultivation House

The sensor was used in this study using NodeMCU ESP8266 and Arduino MEGA. AM2315 and KC-TH-280 modules measure digital temperature and humidity in the same device captured for load control of various electrical appliances. They used the program to turn on and off air humidity, drip irrigation, and water spraying automatically or manually to record data collected from a cloud system and show value to Blynk System through mobile phones.

Concept diagram

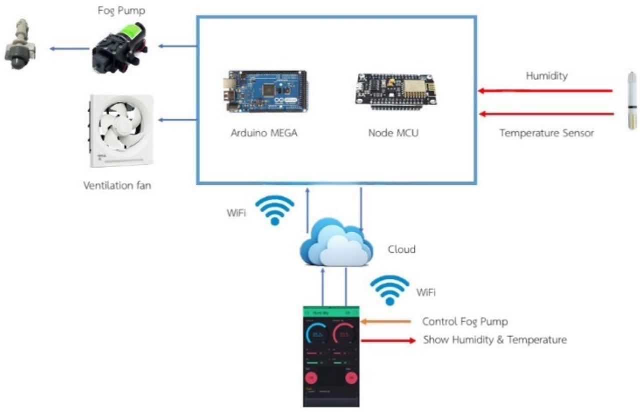

Fig. 2 System Conceptual Diagram

The researchers built the event for application design, development, and testing. The system may be split down as follows:

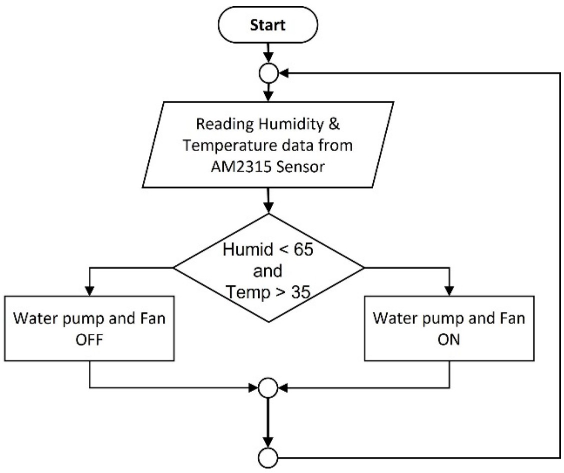

Fig. 3. System Flowchart for Fogging and Ventilation

Figure 3 shows that When the board MCU reads the humidity (HM) and temperature (Temp) and analyzes the results, the microcontroller board will run the water pump and fan relay board if the humidity is less than 65 percent. The temperature is more than 35 degrees. When the humidity exceeds 65 percent, and the temperature falls below 35 degrees, the water pump and fan stop working.

The definitions of the factors influencing oyster mushroom development in this study are provided below.

1) The temperature is between 30 and 35 degrees Celsius. When the temperature increases over 45 degrees Celsius, the system will activate the fan to reduce the indoor temperature.

2) Humidity The oyster mushroom house is meant to have a humidity level of 65 to 75 percent RH (Relative Humidity). When the outside humidity is less than 65%, the water pump will spray mist to boost the internal humidity to the appropriate level. When the humidity in the oyster mushroom house exceeds 75%, the water pump will stop working. The system will activate the fan to ensure that the interior humidity does not exceed 75%.

C. *Implementation*

From an overview of the system design and factors affecting the growth of oyster mushrooms, the researcher designed a set of temperature and humidity sensors. The water pump and ventilation fan are shown in figures 4-8.

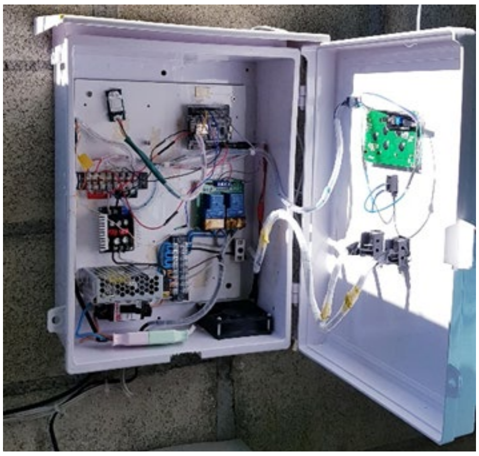

Fig. 4. The Oyster Mushroom Cultivation Sensor Control Box.

Fig. 5. Front of the Oyster Mushroom Cultivation Sensor Control Box.

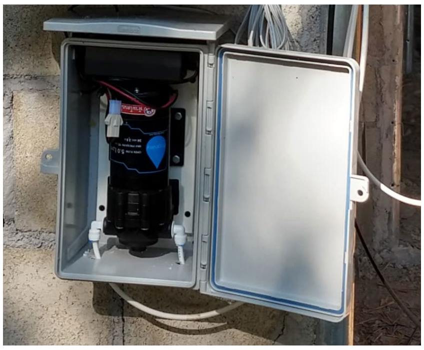

Fig. 6. Mist spraying diaphragm water pump

Fig. 7. Placing mushrooms inside the mushroom nursery.

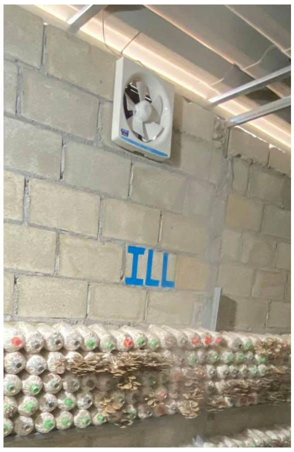

Fig. 8. Location of ventilation fan installation

D. *System Validation and Maintenance*

The researcher has coded the microcontroller board to receive and control devices from various sensors, such as temperature and humidity. Iterates when functioning by the program on the microcontroller board until it stops powering the board for programming and uploading the program to the microcontroller board. To connect to the Blynk Application, use the Arduino IDE application. The following will be included in the screen interface's user interface design and development:

Fig. 10. The screen displays the oyster mushroom incubator's values.

Fig. 11. The screen displays a chart displaying the various values of oyster mushroom cultivation.

In system testing, we have tested the system as follows.

1) Test the system on-off switch by the user.

This system evaluates the system by turning on and off two devices: a water pump to spray mist and a ventilation fan controlled by the user via the application. When users turn on or off a water pump or a ventilation fan, the device will record the number 1 if it functions well and the number 0 if it does not.

2) Test the automation of the Solenoid Valve.

This system was tested by setting the temperature to less than 30 degrees and a humidity value of more than 75% in the mushroom house for the water pump to work. If the device is operational, it will be displayed as "On"; otherwise, it will be stated as "Off."

3) Test the automation of the ventilation fans.

Testing the system by setting a temperature value of more than 35 degrees and a humidity value of more than 75% in the mushroom house for ventilation fans to work. If the device is working, it will show "On." If the device is not working, it will show "Off."

IV. Experimental Results

The researcher tested the system and equipment operation between 1-31 December 2020 by measuring the temperature and humidity. The study and conduct of this research show the results the researcher has designed. The research results are as follows.

1. System results

The test results are as follows. 1) Connecting to the Blynk System A wireless network (WiFi) router installed in an AIS network with a real-time link can send test results to the Blynk System. 2) Sending temperature values obtained by sensors Test data from the oyster house's interior and outside temperatures may be sent and shown using the Blynk application.

2. The results of testing the on-off system switch by users

The results are that 50 applications were switched on-off by the device 47 times, accounting for 94% of solenoid valves turned on, and 48 of the solenoid valves turned off, accounting for 96%. The ventilation fan turned on 49 times, accounting for 98%. The ventilation fan was turned off 48 times, accounting for 96%.

3. The results of the device control system are shown.

The researcher evaluated the system's functioning to determine if it could work automatically. The gadget will be activated and deactivated in the test, as shown below.

TABLE III. The results of testing the automatic operation of the water pump

Temperature	Humidity	Water pump
<30	<65	On
<30	65-75	Off
<30	>75	Off
30-35	<65	On
30-35	65-75	Off
30-35	>75	Off
>35	<65	On
>35	65-75	On
>35	>75	Off

TABLE IV. The results of testing the automatic operation of the ventilation fan

Temperature	Humidity	Ventilation Fan
<30	<65	Off
<30	65-75	Off
<30	>75	On
30-35	<65	Off
30-35	65-75	Off
30-35	>75	On
>35	<65	On
>35	65-75	On
>35	>75	On

TABLE V. THE RESULTS OF TESTING THE AUTOMATIC OPERATION OF THE VENTILATION FAN

Temperature	Humidity	Fog Pump	Ventilation Fan
<30	<65	On	Off
<30	65-75	Off	Off
<30	>75	Off	On
30-35	<65	On	Off
30-35	65-75	Off	Off
30-35	>75	Off	On
>35	<65	On	On
>35	65-75	On	On
>35	>75	Off	On

In Table 5, the researcher has programmed the sensor to operate at the optimal temperature and humidity for the oyster mushroom house. This resulted in mushroom development and improved yields, as shown in Figure 12.

Fig. 12. Production of Oyster Mushrooms.

V. CONCLUSION AND FUTURE RESEARCH

In this research work, the methodology for designing an application capable of watching and managing the environment in the oyster mushroom nursery is compatible with the aforementioned theoretical principles [13]. The study determined that the readings from the sensor devices that were measured and evaluated for on-off accuracy while the application was operating were accurate. There are 50 operations in succession, including human control and automation. The user controls the on/off status of the water pump and the operation of the ventilation fan via the application. The water pump is activated 47 times or 94% of the time. The number of pumps is deactivated. The ventilation fan was switched off 49 times, representing 98%, the fan was shut off 48 times, representing 96%, and the test results of the equipment functioning with the humidity and temperature settings were as follows: The mushroom house was heated to 30-35 degrees Celsius and humidified to 65-75 percent relative humidity. Consequently, it was able to function under the stated circumstances. By regulating and operating via the readings of numerous sensors [14], it was discovered that this technology might be utilized to manage mushroom farm equipment rather well.

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REFERENCES

[1] Office of Academic Affairs, Secretariat of the House of Representatives. "Thailand 4.0," Secretariat of the House of Representatives, 2016.

[2] S. Jatusripitak. "Future of Thai Economy 4.0," Keynote speech organized by the Chinese Chamber of Commerce on June 20, 2016, at the Thai Chamber of Commerce building 2016.

[3] S. Champrasit. "Thai farmers in the era of THAILAND 4.0". [online] Available at: http://www.qmlcorp.com/content/เกษตรกรไทยยุค-thailand-4.0 [Accessed 5 Aug. 2022], 2022.

[4] S. Panpaeng, P. Phanpeang, and E. Metharak, "Cigarette Smoke Detectors for Non-Smoking Areas in the Building," 2018 22nd International Computer Science and Engineering Conference (ICSEC), 2018, pp.1-4.

[5] GitHub, "What is Blynk? (doom369)," [online] Available at: https://github.com/blynkkk/blynk-server [Accessed 5 Aug. 2022], 2022.

[6] S. Singh, Simran, S. Anand, and Sushma S J. "Smart Mushroom Cultivation using IoT," International Journal of Engineering Research & Technology (IJERT), vol. 8, Issue 13, 2020, pp.65-69.

[7] C. Arkapati, and W. Embamrung, "Development of Temperature and Humidity Control System in Straw Mushroom Growing Farms with the Concept of Internet of Things (IoT)," Proceedings of the 3rd International Conference of Computer, Environment, Agriculture, Social Science, Health Science, Engineering and Technology (ICEST 2018), 2018, pp.84-91.

[8] W. Fongngern, S. Petcharan, and R. Yajo, "Application with the Internet of Things Technology Control in Smart Farms Mushroom," Academic Journal of Information Technology and Innovation Management Faculty of Information Technology Maha Sarakham Rajabhat University, vol. 5, Issue 1, January - June 2018, pp.172-182.

[9] K. Mahamad, P. Masuriwong, and W. Petlamul, "Application of Smart Farm System to Enhance Phoenix Oyster Mushroom Production," ASEAN J. Sci. Tech. Report. vol. 24, Issue 1, 2021, pp.47-57.

[10] S. Pravinthraja, R. Rozario. A.P, S. Nagarani, N.S. Kavitha, and R. Kumar, "IoT Based Mushroom Monitoring System – A Survey" International Journal of Recent Research Aspects, vol. 5, Issue 1, March 2018, pp.311-314

[11] P. Bhandari, and M. Kimothi, "IOT BASED DESIGN IMPLEMENTATION OF MUSHROOM FARM MONITORING USING ARDUINO MICROCONTROLLERS & SENSORS," International Journal of Engineering Sciences & Research Technology, vol.7, issue 5, May 2018, pp.550-560.

[12] O. Chieochan, A. Saokew, and A. Boonchieng, "IOT for Smart Farm: A case study of the Lingzhi Mushroom Farm at Maejo University." 2017 14th International Joint Conference on Computer Science and Software Engineering (JCSSE), 2017, pp.1-6.

[13] S. Phaka, S. Wongyai, and A. Thomaya, "Development of a temperature and humidity control system suitable for mushroom growth in Ban Thung Bo Paen mushroom nursery, Pong Yang Kok Subdistrict, Hang Chat District. Lampang Province." Academic journal of the Faculty of Industrial Technology Lampang Rajabhat University, vol. 7, issue 1, 2014, pp. 58-69.

[14] S. Miatthaisong, and T. Meadthaisong, "The Research and Development System of Environment for Grow Area Lemon with Wireless Sensor Network in Village of Reduce the use of chemicals and toxic residues the Phetchaburi River," 7th ECTI-Conference on Application Research and Development ECTI-CARD 2015, 2015, pp.1-4.