Oyster mushroom cultivation solution based IoT for Nova Farmers

R M Fauzi¹*, F S Waranti², I K Rais³ and Y Somantri¹

¹Department of Electrical Engineering Education, Universitas Pendidikan Indonesia, Jl Dr. Setiabudhi No.229, Bandung, Indonesia
²Department of Physics Education, Universitas Pendidikan Indonesia, Jl Dr. Setiabudhi No.229, Bandung, Indonesia
³Department of Mechanical Engineering Education, Universitas Pendidikan Indonesia, Jl Dr. Setiabudhi No.229, Bandung, Indonesia

*mochamadrizki@student.upi.edu

Abstract. Nova Farmers is a group of oyster mushroom farmers in Pasirhalang Village, Cikarangmulya, West Bandung, which has a vertical mushroom baglog. Farmers who are dominated by women need to climb Baglog to water Baglog at every level. The purpose of this study is to design a tool that can maximize the growth of oyster mushrooms, temperature, and humidity of the kumbung to be maintained at temperatures of 28 °C and 80% through watering. To improve watering techniques by farmers, oyster mushroom sprinklers are automatically made based on the Internet of Things that takes into account temperature and humidity factors that can be monitored and controlled through the ABUJAT android application using Android Studio software. The sprinkler section can move vertically up and down to be able to sprinkle all baglogs at each level. This system is made using a DC PG45 motor to drive the sprinkler section which is controlled by DOIT ESP32 DevKit V1 as a microcontroller and combined with a DHT22 sensor as a temperature and humidity sensor, DS1307 RTC module, water sensor, buzzer module for watering the alarm notification, 12VDC pump for pumping water, 16x2 LCD to display sensor values, limit switches, and BTS7960 motor drivers. Based on the results of the experiment, our application can function properly and can be used by Nova Farmers.

1. Introduction

Oyster mushroom or in Latin called Pleurotus sp. is one of the high value consumption mushrooms. In addition to consumption, oyster mushrooms can be used for the treatment and cure of diseases. Oyster mushrooms have high economic value and are prospective for farmers [1-3].

In Indonesia, white oyster mushrooms are the most widely cultivated mushrooms. But the market demand for white oyster mushrooms is still not being met every day. This is due to the availability of oyster mushrooms whose numbers are below market demand [4,5]. This condition can be an opportunity for farmers or the community to open an oyster mushroom business, as did Nova Farmers, a group of women farmers in Pasirhalang Village, Cikarangmulya, West Bandung Regency. This farmer group utilizes their yard to make kumbung measuring ± 10m x 5 m.

To maximize the amount of oyster mushroom production with the width of the kumbung, the farmers took the initiative to arrange baglog on the shelf vertically so that the number of baglogs loaded in the kumbung was higher when compared horizontally. During the watering process, farmers who are...
dominated by middle-aged women, water the baglog by climbing the baglog rack level by level. In this paper, we propose watering techniques carried out by farmers using ABUJAT technology with the aim of simplifying the work of oyster mushroom farmers.

2. Method

2.1. Material
In making ABUJAT technology, some electronic components and modules used consist of; DOIT ESP32 DevKit V1 as an integrated microcontroller with WiFi module for data transmission using the internet, DHT22 for air temperature and humidity sensors, RTC DS1307 module as a time data provider, water sensor as a sensor to detect watering, buzzer as a sound indicator, control relay to control 12 V water pump so that water can be sucked in and out through the sprayer, 16x4 LCD as display media for display time values, temperature and humidity and watering status, limit switches as electromechanical devices, PG45 DC motors as sprinkler actuators, and BTS7960 motor drivers to control speed and the direction of the DC motor.

2.2. Method
The implementation of this research refers to the stages of the research and development approach. This approach is used to produce certain products and test the effectiveness of a product [6]. Figure 1 shows the steps taken.

![Implementation stages flowchart](image)

**Figure 1.** Implementation stages flowchart.

2.2.1. Preliminary studies. This activity is the process of finding basic knowledge of making tools. This activity is divided into literature studies and field studies. Literature study aims to find information that is relevant to the research topic as a basis for making theories sourced from the internet, books, journals, and others. While the field study aims to collect data found in the field as a reference basis for product design. In this case, we visited the Nova Kumbung Farmer Group.

2.2.2. Planning and product design. At the product planning and design stage, planning and design tools consist of mechanical system design, hardware, software, and user interfaces of the ABUJAT android application. Watering system with ABUJAT is made by compiling the work instructions of the tool through a programming language. The ABUJAT watering system consists of a manual system and an automatic system. Manual watering system is controlled through the buttons on the hardware and the
ABUJAT android application. While the automatic control of the watering system is consistent every day when the time is 8:00 a.m. and 3:00 p.m. while detecting the temperature and humidity of the kumbung. Table 1 shows the performance of our system regarding the temperature (T) and humidity (H) of the kumbung.

**Table 1. References value of temperature and humidity.**

| Humidity | Temperature < 26°C | Temperature 26°C-28°C | Temperature >28°C |
|----------|---------------------|------------------------|-------------------|
| < 80%    | Not Watering        | Not Watering           | Watering          |
| 80-90%   | Not Watering        | Not Watering           | Not Watering      |
| ≥ 80%    | Not Watering        | Not Watering           | Not Watering      |

Based on the system requirements that have been designed, then other system designs are carried out such as hardware, mechanics, and UI design of the ABUJAT android application.

**Figure 2.** Block diagram system of ABUJAT.

**Figure 3.** ABUJAT PCB layout design on EAGLE 6.4.0 application.

**Figure 4.** Design of ABUJAT on Solidwork application.
2.2.3. **Product manufacture.** The process of making a product is based on the design that has been made and has been revised. Revision of the design is based on the evaluation results from the previous design to maximize the functionalities of the tool.

2.2.4. **Product testing and analysis.** Products are tested according to the automatic and manual work systems that have been designed. If the work of the tool is appropriate, the process continues to the evaluation and report stages. If it is not appropriate, the process will be reviewed back to the product design and design stage to be repaired until finally the tool works properly according to the system designed.

2.2.5. **Evaluation and report.** Evaluation is carried out from the beginning of the preliminary study until the product is finished. The conditions and working system of members are also evaluated to improve work efficiency. Then after that report is made.

2.3. **Place and time of implementation**
The process of creating and function testing of ABUJAT held in UKM Komunitas Mahasiswa Penggemar Otomasi dan Robotika Universitas Pendidikan Indonesia (KOMPOR UPI) in April-June 2019.

3. **Results and discussion**
Testing is carried out on the performance of the ABUJAT tool both manual and automatic systems and the performance of the ABUJAT android application. With T representing temperature and H is humidity, the test result data are shown in Table 2, Table 3, and Table 4.

**Table 2.** Data from the ABUJAT automatic system test results.

| Day  | 8 AM. | 3 P.M. |
|------|-------|--------|
|      | Watering status | $T_{\text{average}}$ (°C) | $H_{\text{average}}$ (%) | Watering status |
| 1    | √     | 26     | 77     | ×     |
| 2    | √     | 27     | 79     | ×     |
| 3    | √     | 27     | 78     | ×     |
| 4    | √     | 26     | 77     | ×     |
| 5    | √     | 26     | 77     | ×     |
Table 3. Data from the manual system testing of ABUJAT with push button hardware (Hw) and android application ABUJAT (App).

| Day-   | Watering Status |
|--------|-----------------|
|        | Hw   | App   |
| 1      | √    | √     |
| 2      | √    | √     |
| 3      | √    | √     |
| 4      | √    | √     |
| 5      | √    | √     |

Table 4. Data from the ABUJAT android application testing results.

| Day-   | Display LCD | Display Apl. |
|--------|-------------|--------------|
|        | T (°C)     | H (%)       | T (°C)    | H (%)    |
| 1      | 22          | 78          | 22        | 78       |
| 2      | 23          | 79          | 23        | 79       |
| 3      | 23          | 78          | 23        | 78       |
| 4      | 21          | 78          | 21        | 78       |
| 5      | 22          | 78          | 22        | 78       |

In our design, there are two operating systems namely automatic and manual systems. In an automatic system, this tool will do watering every day scheduled at 08.00 a.m. and will do the watering at 3:00 p.m. If the average temperature and humidity conditions in the mushroom house are from 08.00 a.m. obtained temperature $> 28^\circ C$ and humidity $< 80\%$, thus indicating unfavorable conditions.

The results of the automatic functioning of the ABUJAT system are shown in Table 2 for 5 days of testing. Based on trial results, the tool is functioning properly. Table 3 is a table of results of a 5 day manual trial system. This experiment was carried out through a manual watering system button found on the ABUJAT tool and on the ABUJAT android application features. In every manual system trial, ABUJAT flushes the well when the flush button on the device or application is pressed. In addition, communication testing between DOIT ESP32 DevKit V1 and the ABUJAT Android application was tested by comparing the display of air temperature and humidity values on the LCD and the ABUJAT Android application. The results of this communication test can be seen in table 4. Displays the temperature and humidity values on the LCD and the ABUJAT android application always displays the same value. Every time there is an update of the temperature and humidity value displayed on the LCD, the display of the temperature and humidity value of the Android application ABUJAT changes immediately.

4. Conclusion

Automatic and manual watering systems in our application can work well according to the planned system. Functionally this ABUJAT technology can be applied in the cultivation of oyster mushrooms. One thing we need to think about in the future is how the impact of this system on oyster mushroom production.

References

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