Application of Electrical Conductivity (EC), Temperature and pH Sensors on IoT Based Red Ginger TOGA (Zingiber Officinale Var Rubrum) Planting Media

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Abstract— **The red ginger plant is a type of rhizome plant which is one of the spices that are needed in Indonesia. The number of requests for red ginger requires the right planting media composition. Charcoal husks and manure are often used as mixed materials, especially those that cultivate plants in the bottom or polybags. An important parameter in the farming system is Electrical Conductivity (EC), temperature and pH. The degree of acidity or pH of the soil is very influential on the growth of a plant with a value between 6.5 to 7.5. The room temperature for red ginger plants is good with a range of 22-35°C. The TDS meter value in PDAM water is good at 100 ppm but the smaller the TDS value the better the water conductivity. The results of the sample testing 1, 2 and 3 of the soil pH value are at 5.9 to 6.4, this has a large impact of plant nutrient not available, so that Plant growth is disrupted. The TDS value is in the value of 87 to 95 shows the conductivity of water during the trial period in good condition. The temperature value of the space is in the range of 20-34°C which the temperature value is in the right condition. Making IoT-Based Application in Red Ginger Plants can help find out the good value of water conductivity, room temperature and soil pH in planting red ginger plants that can be monitored through the application. Husk Charcoal Plant Media As a mixture of planting media, can maintain the condition of the soil loose because it has high and light porosity, manure is used to provide nutrients for plants.**

Keywords—DHT11, NTP server, red ginger, soil pH, TDS meter

I. INTRODUCTION

Ginger plant (Zingiber officinale) is a type of rhizome plant from the Zingiberiacea tribe which is widely cultivated in almost all regions of Indonesia. The number of requests for the consumption of red ginger requires the right planting media composition. Referring to previous studies, with the planting media cocopeat and compost provide poor growth results [1]. The Effect of Treatment of Combination of Rice Husk Rice Husking Media, Chicken Manure Fertilizer, Cocopeat, and Alluvial Soil on the Growth and Products of Red Ginger Plants This combination of planting media can provide the best red ginger plants. The results showed that in the treatment of the combination of soil planting media: Rice Husk Charcoal: Chicken fertilizer with a ratio of 1: 1: 1 significantly affected the number of puppies [2].

Husk charcoal has light, rough characteristics so that it has high air circulation, good porosity and low water absorption. Another benefit of husk charcoal as a mixture of planting media is to be able to maintain the condition of loose soil, spur the growth of microorganisms that are useful for plants [3]. Manure is fertilizer made from animal dung. The function of animal fertilizer is able to provide sufficient nutrients to plant growth [4]. Planting various types of plants using pots by utilizing home pages can be a solution for people who want to grow crops and make the home page more productive [5]. Cultivation of medicinal plants in the yard requires treatment such as fertilization, watering, weed weeds, socks, and control of pests [6].

An important parameter in the farming system is Electrical Conductivity (EC), temperature and pH. EC values that are too high inhibit nutrient absorption by increasing osmotic pressure, while low EC values can affect plant health [7]. The degree of acidity or pH of the soil is very influential on the growth and development of a plant. Soil pH or soil acidity does not exceed the limit between 6-8 or around 6.5 to 7.5 [8]. This red ginger plant can grow well in the tropics with temperatures ranging from 20-30 ° C [9]. By utilizing existing technology at this time to be able to monitor EC, temperature and pH whether it is in accordance with the standard or not.

The parameters to be tested in this study to determine the quality of good planting media in the red ginger toga are EC, temperature and pH on the soil. Based on the problem above, it is proposed that a device "Electrical Conductivity Sensor Application (EC), Temperature and PH on the Red Ginger Toga Planting Media (Zingiber Officinale var Rubrum) based on IoT."

II. METHOD

This section explains related to research design, system design, electronic design, application design, preparation of tools and materials from this study.

A. Research Design

The research design to be carried out in making the system is shown in Fig.1. In Fig. 1 the problem identification is done to examine the problem to be solved. Literature study studies all tools and materials that will be used in making systems. System design in the form of stages made by a work design of the system. System Implementation Stages in manufacturing the system in accordance with the system design that has been made starting from the microcontroller program to mechanical and electricity. System testing whether it goes according to what we want or not. The system that runs but is not in accordance with the design of the system that has been made will return to the system design stage. If the system is in accordance with the design of the system, it can go to the next stage. System Analysis and Conclusion That is the stages that analyze the work system including the program running as planned, then if the system is in accordance with the planning, conclusions can be drawn.

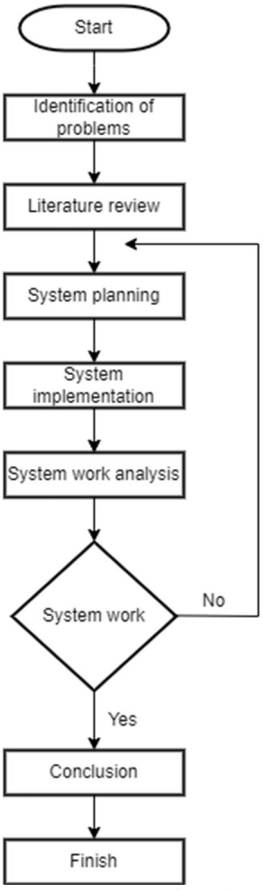

Figure 1. Research Design

B. System Design

The design to be made to facilitate system design requires a system block diagram and flowchart, in this study shown in Fig. 2 and Fig.3. In Fig. 2 the system diagram block explains the process, input and output of the system where the system input is EC/TDS meter sensor, soil pH sensor, temperature sensor and NTP server that is used as a reader or gauge of water conductivity values, space temperature values and acidity levels of planting media, then Processed by ESP32, then the relay gets the command to make the circuit normally close and the data from ESP32 is sent to the database. The results of the process will produce output, namely the DC pump rotates to do the watering process and with the help of an internet connection database can upload the results of the sensor then the application asks for data or value of the database and displayed on the Android application.

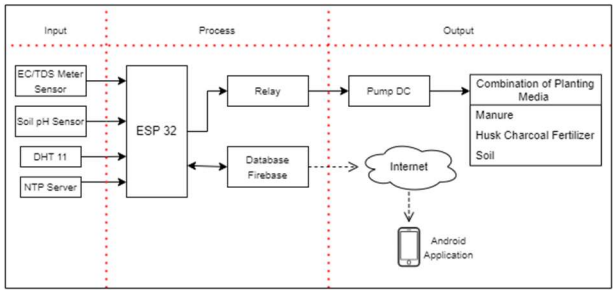

Figure 2. System Diagram Block

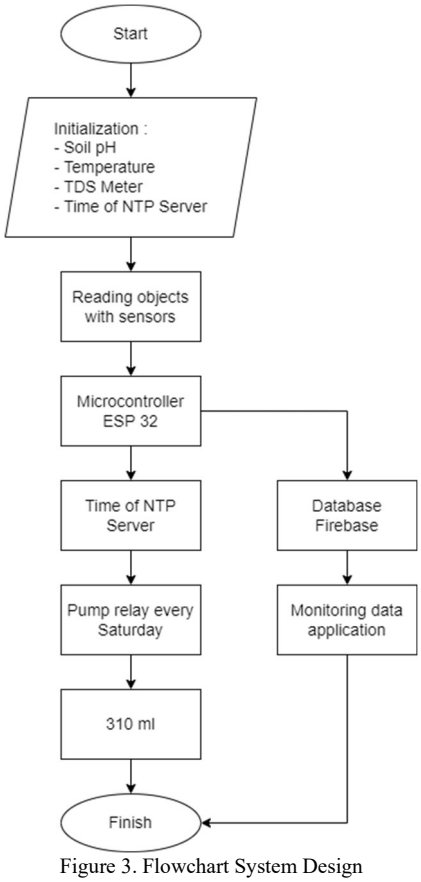

Figure 3. Flowchart System Design

In Fig. 3 the initialization is the preparation of the tool for reading object data, which is the soil pH sensor of the object to the ground, then the temperature sensor of the

object to the surrounding space temperature, the TDS meter of the object to the water for watering and the time of the NTP server follows the world hours. Reading objects with sensors used include soil pH sensors, temperature, and EC/TDS meter. Next send sensor value data to NTP server and database. Then regulating the relay for watering plants with pumps carried out every Saturday with a volume of 310 ml of water. Furthermore, the data from the database will be displayed to the Android application.

C. *Tool Design*

In Fig. 4 shows the design of the tool design where all components and samples tested are in one device with a length of 1 meter. In this design there is a water reservoir container to drain water when the watering time in which there is a DC pump, for the TDS meter sensor component, the relay and eSP are in the hardware box. Furthermore, the temperature sensor is located on the side of the hardware box to measure the room temperature around. In the middle there is an empty spot for the placement of red ginger pot samples when the test is carried out which will be plugged in the soil pH sensor on the object of the planting media composition.

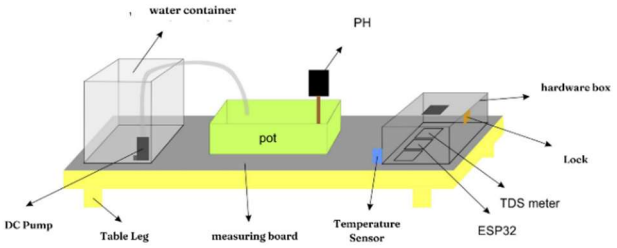

Figure 4. Tool Design

D. *Application Design*

In Fig. 5 is a design of the design of the red ginger planting media application that shows the initial menu in the form of user identity, then in the next menu shows the information in the form of a value of the three sensors, namely soil pH, EC/TDS meter, and temperature.

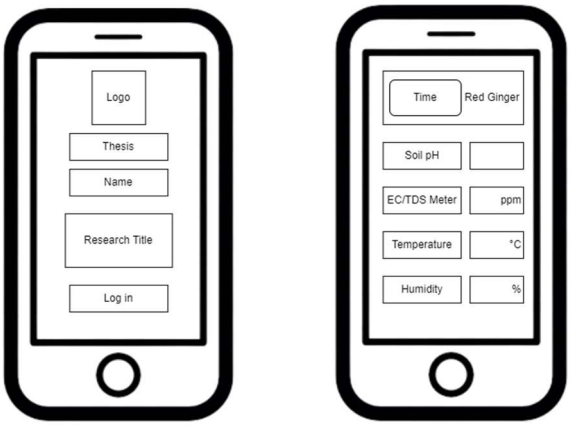

Figure 5. Application Design

E. *Tools and Materials*

The following are the tools and materials needed in this study, hardware: laptops, Android smartphones, soil pH sensors, EC sensors, DHT 11, ESP32, 5-volt DC pumps, 1 channel relay, OLED, husk charcoal, manure, land, Pot. Software: Firebase, Arduino Idea, Fritzing, Kodular, Gravity TDS Meter, ESP32 Wroom.

III. RESULT AND DISCUSSION

A. *Hardware Design Results*

In Fig. 6 shows a components in the box is a microcontroller component as an input of all sensors to detect temperature, pH and EC on planting media in real-time.

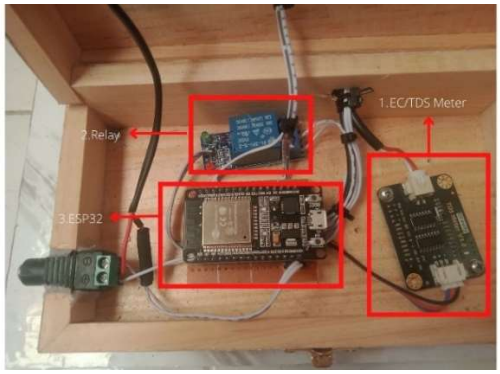

Figure 6. Components in The Box

In Fig. 7 is an OLED component as an output display media from the results of all sensors in the form of text. The physical form of DHT11 temperature sensor to measure the surrounding space temperature value. The switch is a component for deciding or connecting electricity.

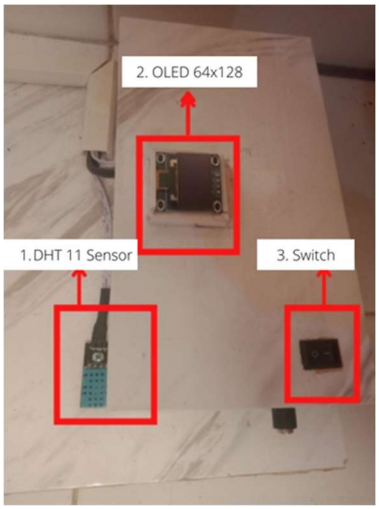

Figure 7. Outer components of the box

In Fig. 8 shows a physical form of water container for watering, in which there is a DC pump to drain water and TDS meter sensor for the measurement of the conductivity of the water.

In Fig. 9 shows the overall results of the hardware circuit which includes a box containing components of ESP32, TDS meter and relay then at the top of the box there is OLED as a display output of the results of all sensors in the form of text and switch. The temperature sensor is

located on the side of the box, then on the other side there is an acrylic for a water reservoir container in which there is a 5-volt DC pump and a TDS meter sensor for the conductivity measurement of the water.

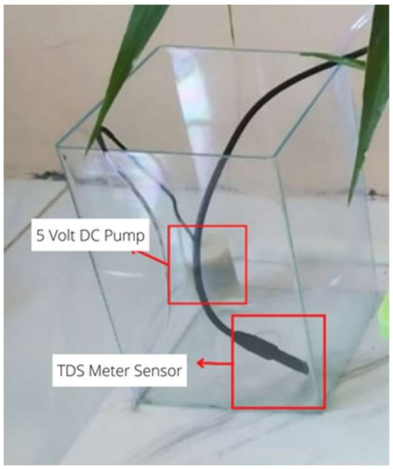

Figure 8. Water Container

Figure 9. Overall Tool Design

B. *Software Design Results*

In Fig. 10 shows a log in page that appears when the application on Android is opened.

Figure 10. Login

In Fig.11 shows the main display of the application which shows the results of the sensor test value.

Figure 11. The main page of the Android Application

C. *Sample Test Results 1*

Sample test results 1 red ginger with soil planting media composition 60%: manure 20%: husk charcoal 20%.

TABLE I
SAMPLE TEST RESULT 1

No	Date	Soil Ph Sensor	TDS Meter Sensor	Temperature Sensor	Watering Land
1	7 April 2022	6.2	94 ppm	24-30°C	-
2	8 April 2022	6.2	94 ppm	25-29°C	-
3	9 April 2022	6.2	94 ppm	25-29 °C	Watering
4	10 April 2022	6.2	94 ppm	23-32°C	-
5	11 April 2022	6.2	94 ppm	24-32°C	-
6	12 April 2022	6.2	94 ppm	23-32°C	-
7	13 April 2022	6.2	94 ppm	24-32°C	-
8	14 April 2022	6.2	94 ppm	24-33°C	-
9	15 April 2022	6.2	94 ppm	24-31°C	-
10	16 April 2022	6.2	94 ppm	23-32°C	Watering

In Table 2 above the average value of the soil pH sensor and TDS meter for sample testing 1 for 30 days, the average pH of the soil pH is 6.1 where the condition of the planting media is said to be normal or neutral. And the average value of the TDS meter is 93.5 ppm which is the level of conductivity in water in good condition.

Figure 12. Sample Test Result 1

In the Fig. 12 above displays the results of planting red ginger for 1 month which in this study, the results obtained show the growth of new shoots, but the plants wither and the leaves are brown.

D. Sample Test Results 2

Sample test results 2 red ginger with soil planting media composition 50%: manure 40%: charcoal husk 10%.

TABLE II
SAMPLE TEST RESULT 2

No	Date	Soil Ph Sensor	TDS Meter Sensor	Temperature Sensor	Watering Land
1	8 May 2022	6.0	88 ppm	26-30°C	-
2	9 May 2022	6.0	89 ppm	25-31°C	-
3	10 May 2022	6.0	89 ppm	22-28 °C	-
4	11 May 2022	6.0	89 ppm	21-30°C	-
5	12 May 2022	6.0	89 ppm	24-32°C	-
6	13 May 2022	6.1	89 ppm	23-32°C	-
7	14 May 2022	6.1	87 ppm	24-29°C	Watering
8	15 May 2022	6.1	87 ppm	24-30°C	-
9	16 May 2022	6.1	87 ppm	24-31°C	-
10	17 May 2022	6.1	87 ppm	23-32°C	-

In Table 2 above the average value of the soil pH sensor and TDS meter for sample testing 2 for 30 days, the average pH of the soil pH is 6.17 where the condition of the planting media is said to be normal or neutral. And the average value of the TDS meter is 88.7 ppm which is the level of conductivity in water in good condition.

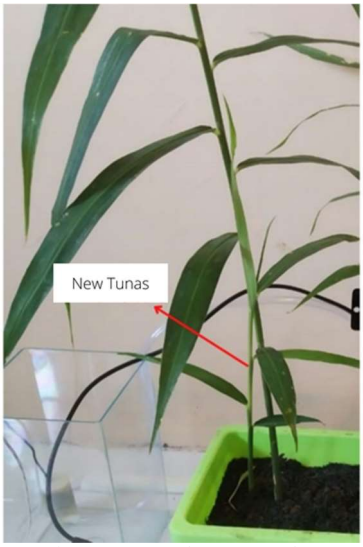

Figure 13. Sample Test Result 2

In the Fig. 13 above displays the results of planting red ginger for 1 month which in this study, the results obtained show the growth of new shoots and plants grow well with the condition of the plant not withered and green.

E. Sample Test Results 3

Sample test results 3 red ginger with the composition of planting media manure 70 %: husk charcoal 30 %.

TABLE III
SAMPLE TEST RESULT 3

No	Date	Soil Ph Sensor	TDS Meter Sensor	Temperature Sensor	Watering Land
1	10 Juny 2022	5.9	95 ppm	23-32°C	-
2	11 Juny 2022	5.9	95 ppm	24-32°C	Watering
3	12 Juny 2022	5.9	95 ppm	25-32°C	-
4	13 Juny 2022	6.0	95 ppm	25-31°C	-
5	14 Juny 2022	6.0	95 ppm	25-33°C	
6	15 Juny 2022	6.0	95 ppm	26-33°C	-
7	16 Juny 2022	6.0	95 ppm	26-32°C	-
8	17 Juny 2022	6.0	95 ppm	26-32°C	-
9	18 Juny 2022	6.0	95 ppm	24-31°C	Watering
10	19 Juny 2022	6.0	95 ppm	26-32°C	-

In the Table 3 above the average value of the soil pH sensor and TDS meter for a sample 3 testing for 30 days, the average pH of the soil pH is 5.9 which is said to be acidic. And the average value of TDS meters is 95 ppm which levels

of conductivity in water are in good condition.

Figure 14. Sample Test Result 3

In the Fig. 14 above displays the results of planting red ginger for 1 month which in this study, the results obtained show that plants do not grow new shoots, but the plants are in good condition and do not wither.

IV. CONCLUSION

Based on the results of the manufacture of tools to testing the system that has been carried out the following conclusions can be drawn:

1. Based on the test results from the three samples, a good planting media composition for the growth of the new shoots of red ginger, namely with a soil composition of 50%: 40% manure: 10% husk charcoal.
2. In the sample test results 1-3 obtained an average value of the soil pH and TDS meter. In sample 1 the average soil pH value is 6.1 and the average value of the TDS meter is 93.5 ppm. In sample 2 the average pH of the soil pH is 6.17 and the average value of the TDS meter is 88.7 ppm. And in sample 3 the average soil pH value is 5.9 and the average value of the TDS meter is 95 ppm.
3. The pH detection can detect the pH conditions in the red ginger planting media with the highest error of 1% and the smallest error 0 which can be said to be very accurate. The TDS detection can detect the TDS state in water for watering red ginger quite accurately with the highest error of 2% and the smallest error of 1%. This proves that the value of accuracy is large or good.

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