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Monitoring System for Soil Moisture and Lighting in Decorative Plants

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***Abstract*—Soil and light are very influential factors in farming activities, so you must pay close attention to getting the desired crop yields. However, many still have not produced maximum plants because many people still use manual technology in farming. One way to take advantage of technology is to monitor soil moisture and the lighting received by plants. Therefore, the purpose of establishing a decorative plant monitoring system is to determine the best condition of the plants by displaying the value of soil moisture and lighting received by plants in real-time using a soil moisture sensor and a photoresistor sensor. The results of this study indicate that the plant is in good condition if it displays the soil moisture value in the range of 50-70%, and the limit of the lighting value is 50%. Conversely, if the system shows a soil moisture value of less than 50% and a lighting value of less than 50%, it indicates that it is not in good condition. This research can also show information on the value of soil moisture and plant lighting obtained through the LCD Oled Display Module, and the results of this study are also able to assist in farming activities indoors or outdoors.**

Keywords—monitoring, soil moisture, lighting, decorative plants

I. INTRODUCTION

Soil is the layer of the earth's surface that functions as a place for plants and a source of water for plants. The need for water in plants is very important to pay attention to because giving too much water will result in soil surface density. Current technological developments, especially in the automation of a system, are increasingly demanding and cannot be separated by the community, especially in big cities in Indonesia. Indonesia is currently in the process of becoming a digital-oriented society. The development of information and communication technology has also been almost widely used in various fields, including agriculture [1].

Soil is a significant factor in farming that must be considered. Light is also a factor in the growth and development of a plant, and one must also consider the desired crop production. One way to take advantage of technology is to use a system that monitors soil moisture and lighting. The system can use the Arduino Nano as a primary controller. Arduino Nano is a microcontroller board that uses Atmega328. Arduino Nano has a 14 pin digital output configuration, some of which also function for PWM (Pulse Width Modulator) for analog output, six pins as an analog input, one pin RX-TX, and one pin AREF (Analogue Reference) [2]. One of the advantages of Arduino is that it does not need a chip programmer device because there is already a bootloader that will upload programs from the computer [3]. Then, the results of soil moisture and lighting received by plants will be displayed on the LCD Oled Display Module 128x64. LCD OLED Display is a display output media on the Arduino module or other microcontroller [4].

There are several related studies on this topic. Such as research conducted by Wahyudin et al. In this research, the design of monitoring systems and humidity automation of web-based hydroponic planting media has been carried out. The system response test results show that at low setpoint values, the system can provide a final humidity value that is close enough to the given setpoint value. The greater the given setpoint value, the system will give a greater error value [5].

In the research conducted by Pravin et al, the system will capture all the soil details and the temperature using different sensors. The sensed information will be sent to the processor and depends upon the outcome, the alert message will be passed, and the appropriate amount of water will be released to the crop. And further information related to the fertilizer quantity and whether there is any set of a severe attack on the crop will also be identified by the system [6].

The research conducted by Rizky Fitria Haya et al uses a microcontroller Arduino Nano as the central controller and is connected to other sensors such as the LDR sensor, soil moisture, and DHT11. This study indicates that the decorative plant is in good condition if it displays a happy face. That is when the lighting, soil moisture, and temperature results are obtained by the values set in the program [7].

Another related topic is research conducted by Arif Supriyanto and Fathurrahmani. Therefore, this study aims to create an intelligent greenhouse prototype for hydroponic plants. The intelligent greenhouse hardware is built based on the Arduino microcontroller, DHT11 sensor, pH sensor, TDS, DS18b20 temperature, ultrasonic, and esp8266 Wi-Fi module [8].

Another related topic is research conducted by Lu Zhuo et al 2020. In this study, there is a need to develop a systematic approach for soil moisture network design so that with a minimal number of sensors, the catchment spatial soil moisture information could be captured accurately. In this study, a simple and low-data requirement method is proposed. It is based on principal component analysis (PCA) for the investigation of the network redundancy degree and K- means cluster analysis (CA) and a selection of statistical criteria for the determination of the optimal sensor number and placements [9].

Research conducted by Abd. Hakim, the project offers a solution that integrates the Internet of Things (IoT) system and an Android application to monitor plant growth with real-time monitoring data and provide system control. IoT is a shared network of objects that interact with each other. In this project, sensors are used to detect soil moisture, observe humidity and air temperature, determine the light intensity and measure soil temperature [10].

Therefore, with the development of current technology, a system is formed to monitor a plant's condition in real-time by displaying the value of soil moisture and lighting received by plants in real-time using soil moisture sensors and photoresistor sensors. The soil moisture sensor is a module for detecting soil moisture, which can be accessed using a microcontroller such as Arduino, Node MCU ESP8266 [11]. And photoresistor sensor (LDR) is a sensor that reacts to the level of light [12]. LDR (Light Dependent Resistor) is a resistor component whose resistance value varies according to light intensity. LDR use for light sensors. The more light received, the lower the resistance value. If less light is received (dark), the resistance value will be higher so that the electric current flowing will hamper [13]. The LDR sensor has a resistance value of around 20 Ohm when in dark conditions and will decrease to 500 Ohm when it receives much light. Therefore, this light-sensitive electronic component widely uses as a sensor for streetlights, bedrooms, alarms, and others [14].

This system's design uses the Arduino Nano as a primary controller in the program to obtain soil moisture values in plants through the Soil Moisture Sensor, namely its place in the soil and the light received by plants using a Photoresistor Sensor. Then, the results of soil moisture and lighting received by plants will be displayed on the LCD Oled Display Module 128x64.

II. Research Methods

The design of the hardware system (Hardware) can see in Figure 1, which is as follows:

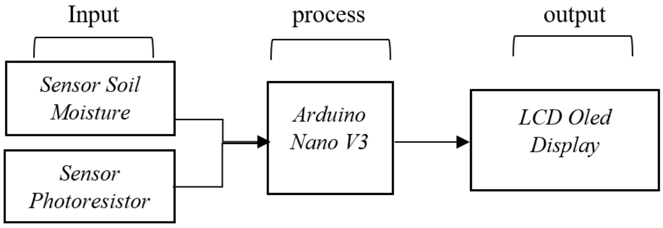

Fig. 1. Block diagram of hardware system design.

In Figure 1, the Soil Moisture Sensor functions to read soil moisture, and the Photoresistor (LDR) sensor reads the value of light received by plants as input from the system that Arduino Nano will process. Then data will process from the sensor, which will display on the LCD OLED Display. For more detail, the circuit sketch of the system created can see in Figure 2.

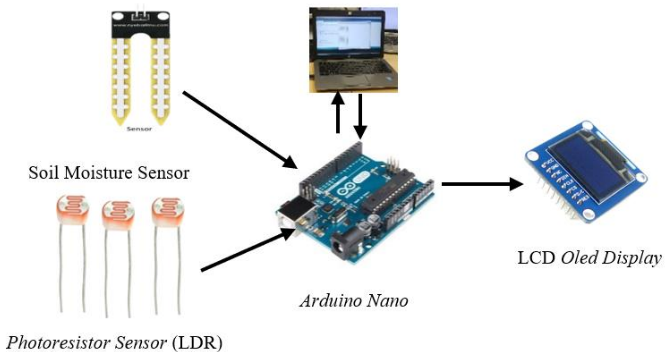

Fig. 2. Sketch of decorative plant monitoring system design.

Fig. 3. Hardware design.

Hardware implementation can be explained by designing a Soil Moisture Sensor and Photoresistor Sensor (LDR) connected to the Arduino Nano microcontroller by the existing system design (figure 3).

III. Results and Discussion

This system test determines the plants' best condition by displaying the value of soil moisture and lighting received by plants in real-time. In sensor testing, there are sensor readings generated for 14 hours with different humidity and lighting values. The following are some of the test results tables.

TABLE I. SOIL MOISTURE TEST RESULTS FOR 14 HOURS.

Time	Moisture
08:00	97%
09:00	50%
10:00	40%
11:00	60%
12:00	70%
13:00	65%
14:00	89%
15:00	76%
16:00	97%
17:00	80%
18:00	76%
19:00	97%
20:00	87%
21:00	81%
22:00	76%

Table one shows the percentage of soil moisture results from the monitoring tool made and tested within 14 hours. To display the soil moisture level results, use the Soil Moisture Sensor, which connects to the mainboard, namely Arduino Nano, and then the results are displayed on the LCD.

TABLE II. LIGHTING TEST RESULTS RECEIVED BY PLANTS WITHIN 14 HOURS

Time	Light
08:00	0%
09:00	10%
10:00	2%
11:00	12%
12:00	24%
13:00	31%
14:00	45%
15:00	50%
16:00	7%
17:00	7%
18:00	8%
19:00	80%
20:00	89%
21:00	30%
22:00	29%

Table two shows the percentage of lighting received by plants that result from monitoring tools made and tested within 14 hours. To display the light level results received by plants, use a Photoresistor Sensor (LDR) connected to the mainboard, namely the Arduino Nano, and then the results are displayed on the LCD screen. Next, in the sensor testing in table 1 and table 2, the sensor readings are obtained, which are display in graphical form.

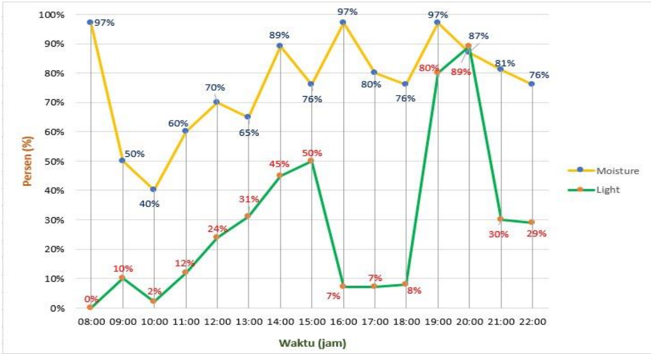

Fig. 4. Graph of plant monitoring system for 14 hours.

Figure 4 shows a graph of soil moisture and the lighting that plants receive where the blue line is the percent value of the soil moisture test results, while the orange line is the percent value of the lighting test results receive within 14 hours.

In the first test, a data acquisition test carries out using a Soil Moisture Sensor of testing and knowing the sensor's sensitivity level in reading or obtaining soil moisture results in a plant. The results (output) of the sensor each time are different, and the best soil moisture value limit has been set for the conditions for growing a plant, namely 50% to 70%. When the soil moisture sensor has not embedded into the soil, the sensor will be worth 0%.

Then when the soil moisture sensor implant into the soil, the reading has been able to detect what percentage of soil moisture is when it has been watered or not. We can monitor the plant whether the soil lacks or has excess moisture content needed. If the Soil Moisture sensor reads a humidity value below 50%, the soil condition is short of water. However, if the Soil Moisture sensor reads a soil moisture value above 70%, then the soil has an excessive moisture content, which can cause the plant to rot/die. A good moisture value is needed for these plants if the soil moisture sensor reads a percent value of more than 50% and less than 70%.

In the second test, testing carries out using a Photoresistor Sensor (LDR). The aim of testing and knowing the sensor's sensitivity level is to read the light received by plants. Where the output (output) from the sensor each time is different. When in a closed room, the light intensity received by the sensor is not there and will display a value of 10% to 0% on the LCD screen.

This situation does not meet the limits of a good value for light required by plants. If the plant place in an open room or bright daylight and the LDR sensor reads 50% and above, the conditions are by what the plant needs to carry out its photosynthesis. From these tests, it can conclude that the system used for monitoring plants using the LDR sensor can work well and detect the intensity of light received in real-time with a different percentage value each time.

IV. Conclusion

This system successfully detects plants by displaying the value of soil moisture and lighting from a plant in real-time. When the plant is in bad condition, such as lack of water content, it will display a less than 50% soil moisture value. Conversely, if the display value is more than 70%, it indicates that the plant is not in good condition because it is getting too much water. The results of the sensor each time are different, and the best soil moisture value limit has been set for plant growth requirements, namely 50-70%. When the soil moisture sensor is not embedded in the soil, it will be worth 0%. The sensitivity level of the sensor is reading the light received by plants also varies over time. Because when in a closed room, the light intensity received, the sensor is not there and will display a value of 10% to 0% on the LCD screen. This situation does not meet the limits of the best value for light required by plants. If the plant place in an open space or bright daylight and the LDR sensor reads 50% and above, the condition is by what the plant needs to perform its photosynthesis.

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