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MOISTURE DETECTION FOR GROWING MEDIUM USING ARDUINO UNO

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Abstrak. Kadar kelembaban tanah atau media tanam adalah faktor penting yang secara signifikan mempengaruhi pertumbuhan tanaman dan agar mencapai hasil panen yang optimal. Oleh karena itu, mendeteksi kelembaban tanah/media tanam sangat penting untuk mencegah tanaman mengering karena kekurangan air atau rusak akibat penyiraman yang berlebihan. Penelitian ini menggunakan Arduino Uno untuk mengukur tingkat kelembaban media tanam. Berdasarkan hasil pengujian, alat yang dibangun dalam penelitian ini telah mampu mendeteksi perubahan tingkat kelembaban media tanam setelah dilakukan penyiraman dan dapat berfungsi sebagai tanda peringatan jika media tanam menjadi terlalu kering, seperti yang ditunjukkan oleh LED yang terpasang pada alat.

Abstract. *The moisture content of soil or growing medium is a crucial factor that significantly affects plant growth and achieving optimal harvest results. Therefore, detecting soil/growing medium moisture is essential to prevent plants from drying out due to insufficient water or being damaged by excessive watering. This study utilized an Arduino Uno to measure the moisture of the growing medium. Based on from the results and discussions, the device designed in this study has been able to detect changes in the moisture levels of the growing medium after watering and can serve as an alert if the growing medium becomes too dry, as indicated by the LED installed on the device.*

1. INTRODUCTION

The moisture content of the soil/growing medium is an important factor that can influence the growth of the plant to obtain optimum harvesting results. Soil moisture has an important role in plant cultivation because it can function as a nutrient[1]. In addition, an adequate level of soil moisture will also ensure that the soil has enough pore space for good air circulation[2].

The development of technological advances in the agricultural sector will be able to facilitate the work activities in the agricultural sector, the quality of agricultural products will be increased and it will be easier to achieve optimal harvest results. There have been several studies on soil moisture monitoring in previous studies[3]–[5]. On the basis of these previous studies, the focus of this study is on the detection of the growing medium moisture used in this study. The microcontroller Arduino Uno used in this study to detect the moisture of growing medium.

The purpose of this study is focused on to detect the changes of the moisture value of growing medium by using arduino uno for preventing the plant from becoming rotten due to too much watering or to prevent the plant from wilting / drying up due to lack of water so it can minimise the possibility of crop damage. The detection results of the growing media used in this study are then displayed on

the LCD installed in this design. In addition, the detection result can be used as a warning sign through the LED installed in this design, which function as an indicator light for the level of growing media moisture, and it can be used as a warning sign when the soil moisture of growing media is too dry. This detection is expected to be able to work well in detecting the change of the moisture levels of the growing medium used in this study.

2. LITERATURE STUDY

In this study, various devices were utilized to detect soil moisture in the growing medium, including a soil moisture sensor, an Arduino Uno microcontroller, a 2x16 LCD, and Light Emitting Diode (LED). The Arduino board is a commonly used electronic platform for studying and creating a range of electronic projects[6]. It is user-friendly and easy to program, making it suitable for developing electronic projects that involve sensors[7].

In order to measure soil/growing medium moisture used in this study, soil moisture sensors were used. Soil moisture sensors are an important tool to measure moisture levels in the soil[8]. The soil moisture sensor detects the soil's/growing medium's moisture level in this study with arduino uno.

The processing results from the Arduino Uno microcontroller are subsequently displayed on a 2x16 LCD screen, showing the percentage and moisture status of the medium. The LCD functions as a data display, presenting information in the form of characters, letters, and numbers[9].

The LEDs on the device will indicate the moisture level of the growing medium. A Light Emitting Diode (LED) is a type of electronic component that produces light when an electrical current flows through it. LEDs are made from semiconductor materials.

3. RESEARCH METHOD

This study utilized the following tools and materials:

Arduino Uno: A microcontroller used to process data from the sensor.

Soil Moisture Sensor: Used to measure the moisture content of soil or growing media.

LCD 2x16: Used to display moisture data in percentage form.

LEDs (Red, Yellow, Green): As the visual indicators for soil moisture status.

Breadboard and Jumper Wires: For connecting electronic components.

Rechargeable Battery and Charger: As the power source for the device.

Soil or Growing Media in Polybags: The medium used for testing.

Water: Used for watering during testing.

The moisture detection system was designed by connecting a soil moisture sensor to an Arduino Uno. The moisture data read by the sensor is then processed by the Arduino and displayed on the LCD in percentage form. LEDs are used to provide visual indicators of moisture status: red for dry, yellow for moist, and green for wet. The device design also includes the use of rechargeable batteries for mobility and energy efficiency. The probe of the soil moisture sensor is inserted into the soil/growing medium where the moisture is to be measured. Three moisture statuses—wet, moist, and dry—are determined based on the sensor's analog values. The measurement data from the soil moisture sensor are then transmitted to the Arduino microcontroller, which processes the data and displays the results as a percentage. A block diagram of the growing medium detection design flow used in this study is shown in the Figure 1.

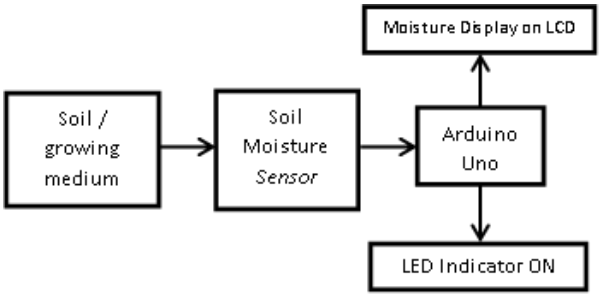

Figure 1. Block Diagram of the Growing Medium Detection Design

The testing was conducted through the following steps:

LCD Display Testing

The soil moisture sensor was placed in the growing medium, and the moisture level was measured. The percentage of moisture was displayed on the LCD. This test ensured that the LCD displayed the moisture values.

LED Indicator Testing

The LEDs were tested to ensure they correctly indicated the moisture status of the growing medium. The soil moisture sensor was placed in growing media with different moisture levels (dry, moist, wet), and the corresponding LED (red, yellow, green) was observed to light up.

Moisture Responsiveness Testing

The growing medium in the polybag was initially dry. Water was added gradually, and the changes in moisture were measured using the sensor. The changes in moisture percentage were displayed on the LCD, and the LED indicators were observed to ensure they correctly indicated the changes.

Energy Efficiency and Mobility Testing

The device was operated using a rechargeable battery to test its energy efficiency and mobility. Testing was conducted in various locations with polybag-grown media to ensure the device's portability and efficiency.

Data obtained from the LCD display testing, LED indicator testing, and moisture responsiveness testing then were analyzed to evaluate the performance of the moisture detection system.

4. RESULTS AND DISCUSSIONS

In this study, the constructed moisture detection system for the growing medium includes an Arduino Uno microcontroller, a soil moisture sensor, an LCD, three LEDs, a power switch, and batteries. The design of the moisture detection tool developed in this study is showed in Figure 6.

Figure 2. Top View of the Growing Medium Moisture Detection Design

The probe of the soil moisture sensor is inserted into the soil or growing medium to measure its moisture content. The sensor's analog value is then used to determine the moisture status as wet, moist, or dry. The moisture percentage is displayed on the LCD, while the LEDs on the device indicate the moisture level: a red LED for dry soil, a yellow LED for moist soil, and a green LED for wet soil. The tool in this study is powered by a rechargeable batteries, making it more efficient and portable for detecting moisture levels in various growing media. Initial display of growing medium moisture detection tool built in this study is showed in Figure 3.

Figure 3. Initial Display of Growing Medium Moisture Detection Tool

LCD and LEDs Indicator Testing

Initial testing was conducted to observe the performance of the LCD screen when the sensor detected the moisture level of the soil or growing medium. The LCD functions to display data in the form of numbers, letters, or characters. When the soil moisture sensor reads the moisture level of the soil or growing medium, the LCD will show the percentage of moisture along with its moisture status. The LEDs provide indications of the detected

moisture status by the sensor. In this study, the green LED indicates a wet status, the yellow LED indicates a moist status, and the red LED indicates a dry status. The test results demonstrate that the LCD and LED indicators in this system function well in displaying information and indicating the moisture level and status of the soil or growing medium. The display of LCD and LEDs indicators in this study can be seen in the Figure 4 below.

Figure 4. LCD and LEDs Indicator Performance

Moisture Responsiveness Detection Testing

Further testing aimed to evaluate the tool's ability to detect changes in the moisture level of the growing medium after adding a certain amount of water. The testing was conducted on soil or growing medium in polybags initially with a dry moisture level status, followed by the sensor detecting changes in moisture after water addition. The measured moisture values are displayed as percentages[10]. The results of the percentage moisture change testing are shown in Figure 6. Condition 1 represents the initial condition before watering, followed by an increase in moisture value after the first watering at condition 2, and further increase after the second watering at condition 3. The testing results indicate that this moisture monitoring detection can detect changes in the moisture level of the growing medium after watering.

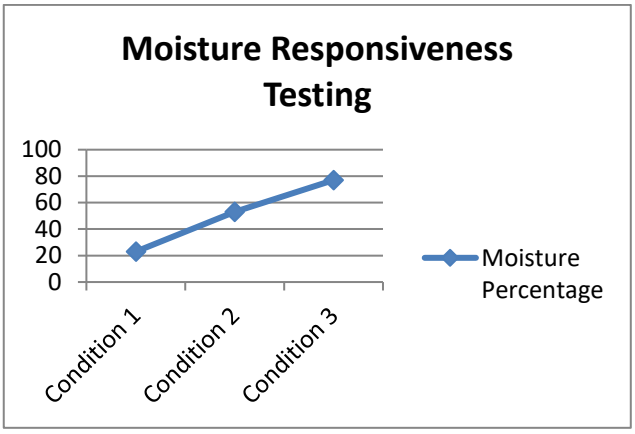

Figure 5. Moisture Responsiveness Detection Testing

Energy Efficiency and Device Mobility

Another important aspect of the device in this study is its use of rechargeable batteries, making it efficient and portable for measuring moisture levels in various locations. The use of rechargeable batteries enables the device to operate for extended periods without frequent power source replacements. The device's mobility provides users with flexibility to conduct moisture measurements in different locations without depending on external power sources. Below is a picture showing the side view of the device, highlighting the ease of recharging its battery.

Figure 6. Side View of the Device for Battery Recharging Setup

An essential aspect of this tool is its use of rechargeable batteries, making it more efficient and portable for measuring moisture levels in different locations. The device is also lightweight and easy to carry, enhancing its practicality for field use. Additionally, it can be recharged using a standard phone charger, which is readily available in the market. This feature ensures ease of recharging and extends the usability of the device without the need for specialized chargers.

Figure 7. The Soil Moisture Detection Device In Use with Polybag-Grown Media.

From the testing was conducted with polybag-grown media in this study, the device successfully detected moisture changes and displayed the information on the LCD screen. The LED indicators also provided clear visual feedback on the moisture status.

5. CONCLUSION

The soil moisture monitoring tool developed in this study demonstrates effective performance across several key areas. The LCD works well in displaying the moisture level and status of the soil or growing medium in percentage form. The LED indicators effectively display the moisture status, with green for wet, yellow for moist, and red for dry soil, offering clear visual feedback. The system detects changes in moisture levels after watering, showcasing its capability to monitor and respond to varying moisture conditions. Additionally, utilizing rechargeable batteries makes the device energy-efficient and portable, allowing for extended operation and easy mobility in various locations. Future research can further enhance and adapt the system to meet specific needs and applications.

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