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Digital Planting Pot for Smart Irrigation

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ABSTRACT

Watering plants during the correct time is very important due to scientific reasons. Both underwatering, as well as overwatering, can lead to the growth of unhealthy plants or in extreme cases, the death of the plant/tree. These issues which are the case with most self-gardeners and plant lovers can be solved using the smart irrigation technique. The main purpose of this innovation is to assist plant lovers to continue their passion to grow plants at home with ease. Smart irrigation system helps in monitoring the moisture level which majorly affects plant growth besides other factors such as sunlight, fertility of the soil, etc. The digital planting pot has been designed in a way that it effectively incorporates the idea of smart irrigation. Arduino Uno R3 has been used as the main chip in this project along with a few other components like a soil moisture sensor, relay, and water pump. This project requires coding to synchronize all the components, and function properly. A required test has been carried out to review the functioning of the mechanism. The project was tested by once using the soil with enough moisture in the pot and then the soil with the least moisture. Both times, it worked exactly how it was supposed to function. When the soil with the least moisture was tested, there was a clear indication of a low level of moisture and accordingly, the water pump got triggered to water the plant, and when the soil with enough moisture was tested, there was again the clear indication of the correct level of moisture and the water pump was inactive. All the readings which were displayed on the LCD were checked back and forth during the project. The outcomes were the same as expected. Hence, it shows that every component in this project is actively functioning and the whole project is effectively designed.

Keywords: *Arduino Board; Soil moisture sensor; Irrigation system; Digital planting pot; Water pump; Automation in smart irrigation; Soil fertility.*

1. INTRODUCTION

This paper aims to provide hassle-free plant watering assistance for all those folks who love to grow plants at home but are unable to devote the required attention to the watering needs of the different plants, either due to a lack of sufficient knowledge about the water requirement of plants or busy schedules. The digital planting pot solves this problem for the target users. There is a soil moisture sensor that helps in computing the moisture level in the plant soil precisely. Later, the data is passed onto the microcontroller which then processes the given data, and finally, the output is displayed on the LCD. Moreover, the coding has been done in a manner that the water pump starts functioning as soon as the moisture level is detected by the sensor. This innovative technology aims to reduce the stress of plant owners while keeping the plant healthy.

1.1. Scope of the Study

The smart irrigation system is a way of optimizing the water requirements in plant soil in an automated manner. The scope of the paper is primarily to build an effective and efficient plant watering system. The most important advantage of this device is that it does not indicate the current soil moisture level but automates the irrigation process when the moisture level is excessively low, by sending the signal to the water pump. This newly designed smart irrigation device runs on a microcontroller and the moisture sensor is placed in the soil. The sensor senses the water level continuously and gives the information to the Arduino through which we get readings on the LCD.

1.2. Working Principle

(1) The working principle of this paper is completely based on the microcontroller. It helps the plant owners to grow their plants without the daily stress of watering the plant on time.

(2) The soil sensor is placed inside the soil which detects the moisture levels in the soil and sends signals to the Arduino Board. Later depending on the moisture level of the soil, Arduino board triggers or stops the water pump.

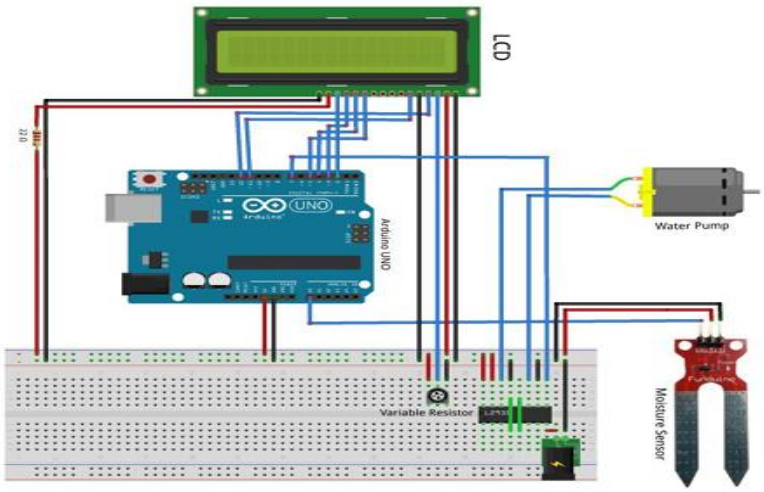

Figure 1. Connections and components

2. MATERIALS

Below mentioned are the names of the components used in the composition of the smart irrigation model.

2.1. Arduino Uno Board

It is the microcontroller and hence the brain of the whole circuit. It has been programmed to receive, process, and send signals to all the components in the circuit.

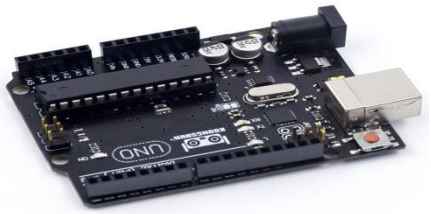

Figure 2. Arduino Uno Board

2.2. 16-Pin Display

This is an LCD that displays the output/results of the circuit.

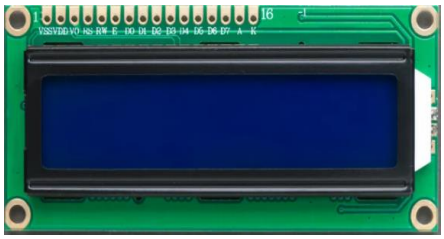

Figure 3. 16-Pin Display

2.3. Breadboard

It is nothing but a connection board that helped us establish the connection.

2.4. Soil Moisture Sensor

This sensor helps to return the value of soil moisture in exact units.

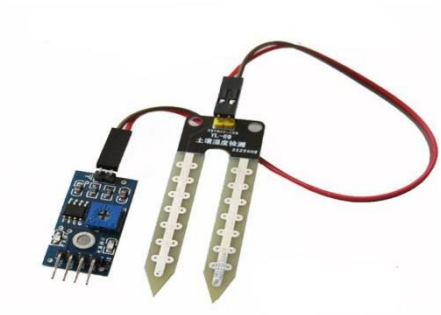

Figure 4. Soil Moisture Sensor

2.5. Dupont Cable

Male to Female, these cables help us transmit data between component.

2.6. USB Cable

Using this USB, we transmit the code into the Arduino board, and also the same port is used to power the whole circuit.

2.7. Water Pump

This is the necessary component that helps to pull the water from storage and sprinkle it into the soil.

Figure 5. Water Pump

2.8. Potentiometer

It is also known as a variable resistor and it is used in our circuit to change the contrast of our LCD screen.

2.9. 5V Relay

It is a programmed switch that is ordinarily utilized in a programmed control circuit to control a high-current utilizing a low-current sign.

2.10. Planting Pot

This is the main device that forms the key part of our paper of paper. All the tests were performed to test the effectiveness of our innovatively designed digital planting pot.

Figure 6. Planting Pot

3. PROCEDURE

We all know that all the components would work together in coordination only once they are synced so that they can share data. This synchronization and data sharing has been made possible with the interconnection. We have connected all the components in a way that they can coordinate together and produce desired results. The data is generated from the soil moisture sensor and sent to the Arduino board which is programmed specifically for this paper to process the sensor signals. Hence, if the soil moisture is low, it will send a real-time signal to the Arduino which will further send a signal to the water pump that will shower water on the soil. If the moisture level of the soil is medium or high, the Arduino board will handle the signal in such a manner that it will not send any signal to the water pump which will keep the water pump on halt.

4. RESULTS AND DISCUSSIONS

4.1. When the moisture/water level is low

During this test, the moisture sensor is kept in the plant soil whose moisture level is low and it can be seen that the sensor detects the moisture level quickly and triggers the water pump while displaying the whole process on LCD in real time.

4.2. When the water level is medium

During this test, the moisture sensor is kept in the plant soil whose moisture level is medium which means the soil is a great condition. Hence the data is shown as it is on LCD and no further actions are taken.

4.3. When the water level is High

Under this situation when the sensor is placed in soil containing a high level of moisture, LCDs a high value of soil moisture which makes the plant user aware of the excess moisture condition. The plant user can responsively take action to remove the excess water so that the plant is not affected otherwise.

4.4. Advantages and Disadvantages

Advantages	Disadvantages
Cost-effective solution for those who grow plants in their homes.	The mechanism is not easily understood by every person. One must be properly familiar

	with its operation to use this device.
Time-Saving and hassle-free plant watering device	In case of technical issues, the restoration process can be time consuming
The correct procedure for watering can be followed	Initial installation of the system at home can be a bit

5. CONCLUSION AND FUTURE WORKS

The paper has been designed with a great level of accuracy and efficacy. It is showing the level of soil moisture rightly and the water pump is turned on whenever the soil moisture level is low. In each scenario, we have tested the outcomes and they have been correct. Figures have been presented above to show that the paper is working properly. In the future, a temperature sensor and a wireless soil moisture sensor can be implemented in the planting pot so that the owner can monitor the health and status from anywhere in his/her comfort.

6. APPENDIX

The whole paper runs on the Arduino board and to make Arduino work as per expectation, the board must be well coded covering all the aspects in every possible situation. Arduino IDE software is used to implement the code into the board.

6.1. Code

```
#include <LiquidCrystal.h>
LiquidCrystal lcd(8, 6, 5, 4, 3,2);
void setup() {
  Serial.begin(9600);
   lcd.begin(16, 2);
  lcd.clear();
  pinMode(2, OUTPUT);
  digitalWrite(2, HIGH);
  delay(1000);
  lcd.setCursor(0, 0);
  lcd.print("IRRIGATION");
  lcd.setCursor(0, 1);
  lcd.print("SYSTEM IS ON ");
    lcd.print("");
    delay(3000);
  lcd.clear();
}
 void loop() {
```

```
 int value = analogRead(A0);
 Serial.println(value);
 if (value > 550) {
  digitalWrite(2, LOW);
  lcd.setCursor(0, 0);
  lcd.print("Water Pump is ON ");
 } else {
  digitalWrite(2, HIGH);
  lcd.setCursor(0, 0);
  lcd.print("Water Pump is OFF");
 }
  if (value < 300) {
  lcd.setCursor(0, 1);
  lcd.print("Moisture : HIGH");
 } else if (value > 300 && value < 550) {
  lcd.setCursor(0, 1);
  lcd.print("Moisture : MID ");
 } else if (value > 550) {
  lcd.setCursor(0, 1);
  lcd.print("Moisture : LOW ");
 }
}
```

Declarations

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Competing Interests Statement

The authors declare no competing financial, professional, or personal interests.

Consent for publication

The authors declare that they consented to the publication of this research work.

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