Smart Plant Watering System

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Introduction

The Smart Plant Watering System was intelligently crafted in a dorm room at Fitten Residence. This system was engineered to address the common problem of maintaining optimal soil moisture for potted plants. This automated solution is a confluence of simple yet sophisticated technology, integrating electronic components and microcontroller programming to achieve a balance between technical prowess and practical application.

Project Genesis

The inception of the project involved a procurement process, ensuring all necessary components were at hand:

- An Arduino Uno, serving as the central processing unit.
- Capacitive soil moisture sensors capable of providing accurate readings of the soil's humidity.
- A submersible 80GPH water pump, perfectly sized for the scale of this endeavor.
- 5V single-channel relay modules, to interface high-power components with the Arduino’s low-power control signals.
- 1/4" ID silicone tubing, ensuring the seamless transport of water from the pump to the plant's soil.
- A set of 22 AWG test lead set and alligator clips, facilitating the initial prototyping phase.

The Built Process

Prototyping Phase: Utilizing the alligator clips and test leads, a provisional circuit was constructed. The Arduino Uno's digital outputs were linked to the relay module, which in turn connected to the water pump. The moisture sensor was interfaced with the analog inputs on the Arduino to provide real-time soil moisture data.

Programming the Microcontroller: The heart of the operation was coded with an Arduino sketch, which involved setting up the pins for the moisture sensor and relay, and writing a logic that read the moisture levels and triggered the relay (and consequently the pump) when moisture dipped below a pre-defined threshold.

The Built Process Continued

Assembly: With the code tested and functioning reliably, the system was transferred from the breadboard to a more stable base. The water pump was securely placed within a water reservoir, while the tubing extended from the pump to the plant’s soil. The moisture sensor, encased to protect from corrosion, was inserted into the soil close to the plant roots.

Testing and Calibration: Before leaving the system to run autonomously, a series of tests were performed. This involved manually adjusting the soil moisture threshold to suit the specific plant species' needs, ensuring the pump delivered the correct amount of water, and confirming the sensor provided consistent readings.

Results and Monitoring

A series of images was taken to document and illustrate the system's effectiveness. These visual narratives depict the components laid out pre-assembly, the final product at work, and images of the plant's growth over time.

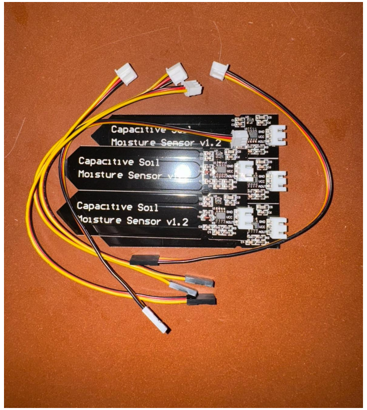
Image/video Descriptions

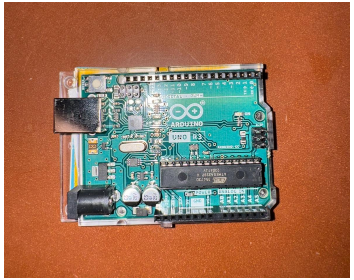
Component Layout: An image showing all the components spread out on a table, clearly labeled. It serves as a visual inventory and the starting point of our assembly process.

The Final Build at Work: A video of the plant being fed water by the system. The Arduino Uno, with its green circuit board, is connected to the relay module – a small blue component. The water pump, a compact black unit, is nestled within a container of water, and clear silicone tubing extends into the pot.

Plant Growth Over Time: A series of photos showcasing the plant before and after the implementation of the system. The progression from a limp, under-watered state to

The Components: Physical





The Components: Code

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```
// Define pin numbers
const int MOISTURE_SENSOR_PIN = A0; // Analog input pin for moisture sensor
const int WATER_PUMP_PIN = 7;       // Digital output pin for relay control

// Define the soil moisture threshold
const int MOISTURE_THRESHOLD = 300; // Threshold value to trigger watering

void setup() {
  // Set the water pump pin as output
  pinMode(WATER_PUMP_PIN, OUTPUT);

  // Start serial communication for debugging
  Serial.begin(9600);
}

void loop() {
  // Read the value from the moisture sensor
  int sensorValue = analogRead(MOISTURE_SENSOR_PIN);

  // Print the sensor value to the serial monitor
  Serial.print("Soil Moisture Level: ");
  Serial.println(sensorValue);

  // Check if the soil is dry
  if (sensorValue < MOISTURE_THRESHOLD) {
    // Soil is dry - activate the water pump
    digitalWrite(WATER_PUMP_PIN, HIGH);
    Serial.println("Pump ON");

    // Wait for 10 seconds
    delay(10000);

    // Turn off the water pump
    digitalWrite(WATER_PUMP_PIN, LOW);
    Serial.println("Pump OFF");

    // Wait for 1 hour before checking the soil moisture again
    delay(3600000);
  } else {
    // Soil is wet enough - do nothing
    Serial.println("Soil is wet enough. Pump OFF.");

    // Wait for 10 minutes before checking again
    delay(600000);
  }
}
```

Final Build At Work

Plant Growth Over Time

Reflection

The design was approached with a simplicity that belied its underlying sophistication. By adhering to the principles of modular design, each component could be tested individually before integration, which simplified troubleshooting and improved reliability. Furthermore, the system's design took into consideration energy efficiency, durability, and the safety of the electronic components when in contact with water.

The project’s success is twofold. Not only did it result in a fully functioning automated plant watering system that successfully demonstrated positive growth in the subject plant, but it also served as a valuable learning exercise in sensor integration, microcontroller programming, and the design of automated systems.

Conclusion

This Smart Plant Watering System stands as a testament to the intersection of horticulture and technology. It reflects a professional foray into the realm of practical electronics and programming, with a view to sustainability and efficiency. The system underscores the potential of integrating simple technology to create smart, scalable solutions for everyday challenges. It showcases the capability of even the most compact and straightforward systems to have a significant impact, validating the promise of smart technology in improving the quality of life.