Automatic Plant Watering System

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***Abstract* - Water management is a critical aspect of agriculture and plant care. Manual watering often leads to overwatering or underwatering, affecting plant health. This research presents an automated plant monitoring and watering system using an Arduino UNO, soil moisture sensor, relay module, and I2C LCD display. The system continuously monitors soil moisture levels and automatically controls a water pump based on predefined threshold values. The LCD provides real-time feedback on moisture percentage and pump status. This low-cost and efficient system reduces human effort and ensures optimal plant growth.**

I. INTRODUCTION

With increasing demand for efficient agricultural practices and smart gardening, automation plays a key role. Traditional irrigation systems lack precision and require manual intervention. This project introduces an IoT-based (semi-automated) plant watering system using Arduino UNO.
The system works on the principle of measuring soil moisture:
If soil is dry → Pump turns ON
If soil is wet → Pump turns OFF
This ensures plants receive the right amount of water, improving productivity and conserving water.

II. OBJECTIVES

- To design an automatic irrigation system using Arduino UNO
- To monitor soil moisture in real-time
- To reduce water wastage
- To display system status using LCD
- To automate pump operation

III. COMPONENTS USED

- Arduino UNO
- Soil Moisture Sensor
- Relay Module
- Water Pump
- I2C LCD Display (16x2)
- Connecting Wires
- Power Supply

IV. SYSTEM ARCHITECTURE

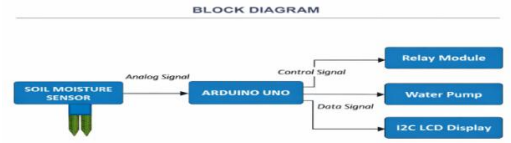
The system consists of:

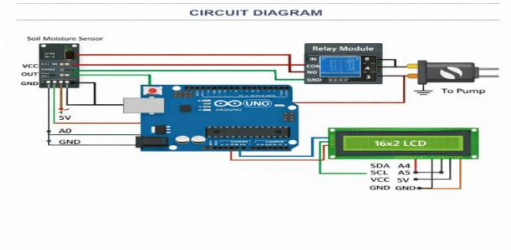
1. Input Unit → Soil Moisture Sensor
2. Processing Unit → Arduino UNO
3. Output Unit → Relay + Pump + LCD

V. CIRCUIT DIAGRAM

Connections:

Component	Arduino Pin	Description
Soil Moisture Sensor	A0	Analog input
Relay Module	D8	Controls pump
LCD SDA	A4	I2C Data
LCD SCL	A5	I2C Clock
Relay VCC	5V	Power
Relay	GND	Ground





Working:

- Sensor sends analog signal to Arduino
- Arduino converts it into percentage
- Based on threshold (40%), relay is triggered
- Pump is controlled accordingly

VI. METHODOLOGY

1. Read soil moisture value from sensor
2. Convert analog value into percentage using calibration
3. Compare value with threshold (40%)
4. Control relay:
    - Moisture < 40% → Pump ON
    - Moisture ≥ 40% → Pump OFF
5. Display results on LCD

VII. ARDUINO CODE

```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>

LiquidCrystal_I2C lcd(0x27, 16, 2);

#define MOISTURE_PIN A0
#define PUMP_PIN 8

#define AIR_VALUE 600
#define WATER_VALUE 300

void setup() {
  pinMode(PUMP_PIN, OUTPUT);
  digitalWrite(PUMP_PIN, LOW);

  lcd.begin();
  lcd.backlight();

  lcd.setCursor(0, 0);
  lcd.print("Plant Monitor");
  delay(2000);
  lcd.clear();
}

void loop() {
  int sensorValue = analogRead(MOISTURE_PIN);

  int moisturePercent = map(sensorValue,
AIR_VALUE, WATER_VALUE, 0, 100);

  if (moisturePercent < 0) moisturePercent = 0;
  if (moisturePercent > 100) moisturePercent = 100;

  lcd.setCursor(0, 0);
  lcd.print("Moisture: ");
  lcd.print(moisturePercent);
  lcd.print("% ");

 if (moisturePercent < 40) {
   digitalWrite(PUMP_PIN, HIGH);
   lcd.setCursor(0, 1);
   lcd.print("Pump: ON ");
 } else {
   digitalWrite(PUMP_PIN, LOW);
   lcd.setCursor(0, 1);
   lcd.print("Pump: OFF");
 }

 delay(1000);
}
```

VIII. RESULTS AND DISCUSSION

- Pump activates automatically when soil is dry
- LCD displays real-time data
- Water usage becomes efficient
- Reduces human intervention

IX. ADVANTAGES

- Low cost and easy to implement
- Saves water
- Reduces manual work
- Improves plant health
- Real-time monitoring

X. LIMITATIONS

- Limited to small-scale applications
- Requires calibration for accuracy
- No remote monitoring (non-IoT version)

XI. FUTURE SCOPE

- Integration with IoT (mobile app control)
- Use of solar power
- Addition of temperature and humidity sensors
- Cloud data monitoring
- AI-based irrigation system

XII. CONCLUSION

The proposed automatic plant monitoring and watering system provides an efficient solution for irrigation management. By using Arduino UNO and sensors, the system ensures optimal water usage and reduces manual effort. It is ideal for home gardening and small agricultural applications.

XIII. ACKNOWLEDGEMENT

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