Automatic Plant Irrigation System using Arduino UNO and Soil Sensor

UIT2412 DIGITAL SYSTEMS AND MICROPROCESSOR LAB

A Mini Project Report

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Introduction

The Automatic Plant Irrigation System is designed to facilitate efficient watering of plants without manual intervention. Utilizing an Arduino UNO microcontroller and a soil moisture sensor, this system ensures that plants receive the optimal amount of water based on the moisture levels in the soil. This project integrates hardware and software to monitor soil moisture in real-time and activate a water pump when necessary, conserving water and promoting healthier plant growth. By automating the irrigation process, this system not only saves time and effort for gardeners and farmers but also enhances the overall efficiency of water usage. It is particularly beneficial in areas with limited water resources or for individuals who may not have the time to manually water their plants regularly. Ultimately, this system supports sustainable gardening practices and contributes to healthier, more vibrant plant life.

Importance

- **Water Conservation:** With growing concerns over water scarcity, efficient water management in agriculture and gardening is crucial. This system conserves water by delivering the right amount of water only when needed.
- **Labor Reduction:** Reduces the need for manual watering, making it ideal for busy individuals or those with large gardens or agricultural fields.
- **Plant Health:** Consistent and adequate watering ensures better plant health and growth, preventing issues like overwatering or underwatering.
- **Cost Efficiency:** By reducing water usage and minimizing the need for manual labor, the system can lead to significant cost savings over time.
- **Scalability:** The system can be scaled up or down, making it suitable for small home gardens as well as large agricultural operations.

- **Energy Efficiency:** Automated systems can be powered by renewable energy sources like solar panels, reducing the overall energy footprint.

Application

- **Agricultural Fields:** Useful for farmers to ensure their crops receive consistent watering.
- **Greenhouses:** Ideal for maintaining the required moisture levels for various plants.
- **Urban Landscaping:** Can be used in city parks and office landscapes to maintain plant health with minimal maintenance.
- **Vertical Farms:** Supports the unique irrigation needs of vertical farming setups, promoting efficient use of space and resources.
- **Community Gardens:** Helps manage shared garden spaces efficiently, ensuring all plants receive adequate care.
- **Public Parks:** Enhances the maintenance of public green spaces, keeping them lush and inviting for visitors.
- **Remote Monitoring:** Allows for the integration of remote monitoring and control, enabling users to manage irrigation from anywhere via mobile or web applications.
- **Educational Institutions:** Can be used in schools and universities to teach students about sustainable agriculture and technology integration in farming.

Objective of the Report

The objective of this report is to provide a comprehensive understanding of the design, implementation, and functionality of the Automatic Plant Irrigation System using Arduino UNO and a soil moisture sensor. The report aims to:

1. **Detail the System Components:** Describe the hardware and software components used.
2. **Explain the Working Principle:** Outline how the system operates to automate the irrigation process.
3. **Present the Circuit Diagram and Design:** Show the step-by-step process of setting up the system.
4. **Algorithm and Program code:** Show the algorithm and program used in this Project.
5. **Identify Future Enhancements:** Suggest potential improvements and future developments for the system.

1) Detail the System Components:

Hardware requirements:

1. Arduino UNO
2. Soil Moisture Sensor
3. 5V Relay Module
4. Water Pump Motor
5. Jumper Wires
6. HW Battery 9V
7. Wires
8. Water Tube

Software requirements:

1. Arduino IDE

2) Explain the Working Principle:

- **Reading Soil Moisture Levels:**

The soil moisture sensor is connected to pin 6 of the Arduino. The sensor sends a digital signal (HIGH or LOW) to indicate the soil moisture level. The digitalRead(6) function reads this signal and stores it in the variable water.

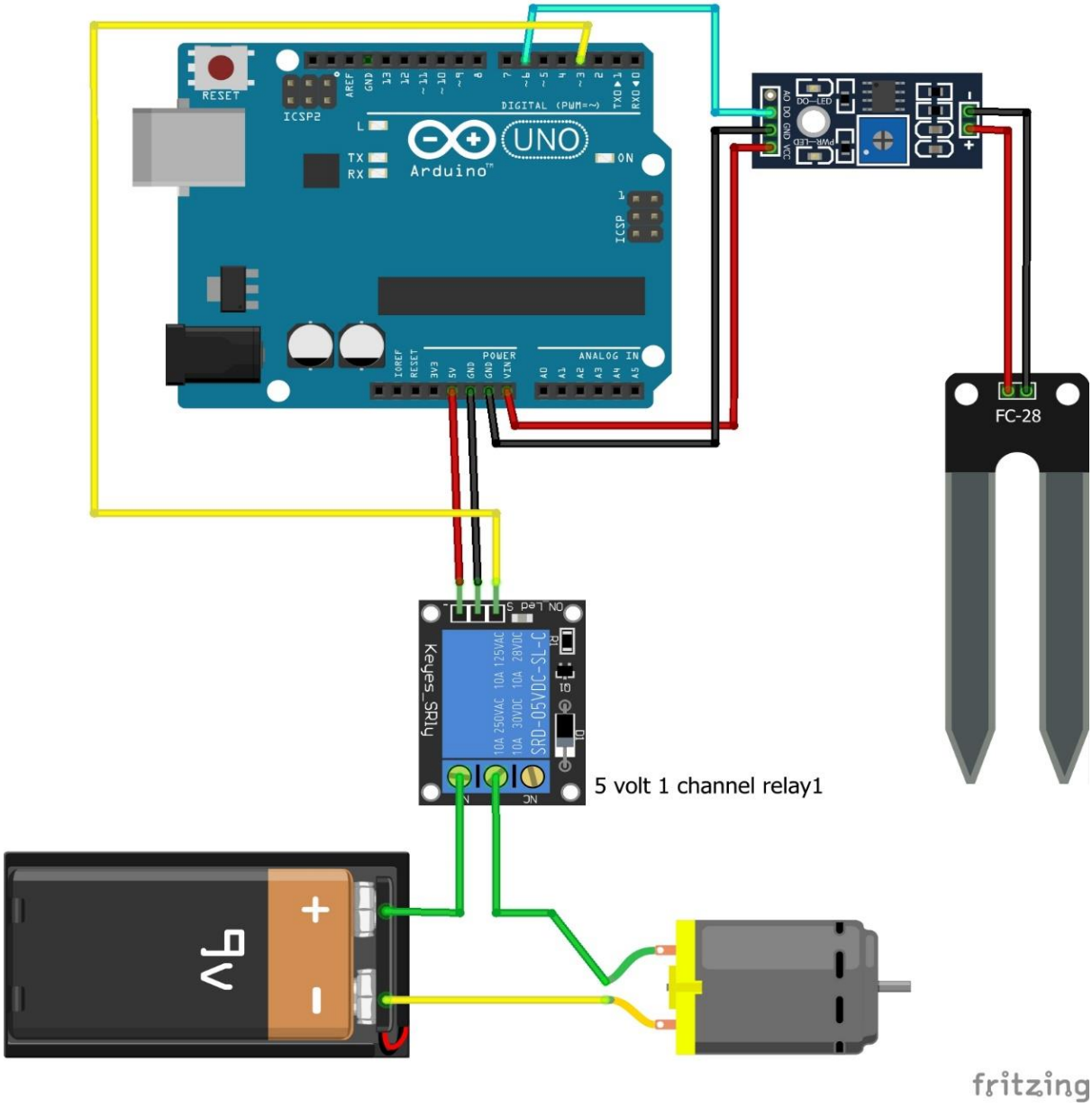
- **Controlling the Water Pump:**

Based on the value of water, the Arduino decides whether to activate or deactivate the water pump. If water is HIGH (indicating sufficient moisture), the pump is turned off by setting pin 3 to LOW using digitalWrite(3, LOW). If water is LOW (indicating insufficient moisture), the pump is activated by setting pin 3 to HIGH using digitalWrite(3, HIGH).

- **Automated Irrigation Cycle:**

This process continuously repeats every 400 milliseconds (delay(400)), ensuring real-time monitoring and control of soil moisture levels. When the soil is dry, the pump is turned on to water the plants, and when the soil is sufficiently moist, the pump is turned off to conserve water.

3) Circuit Diagram:



4) Algorithm for Automatic Plant Irrigation System:

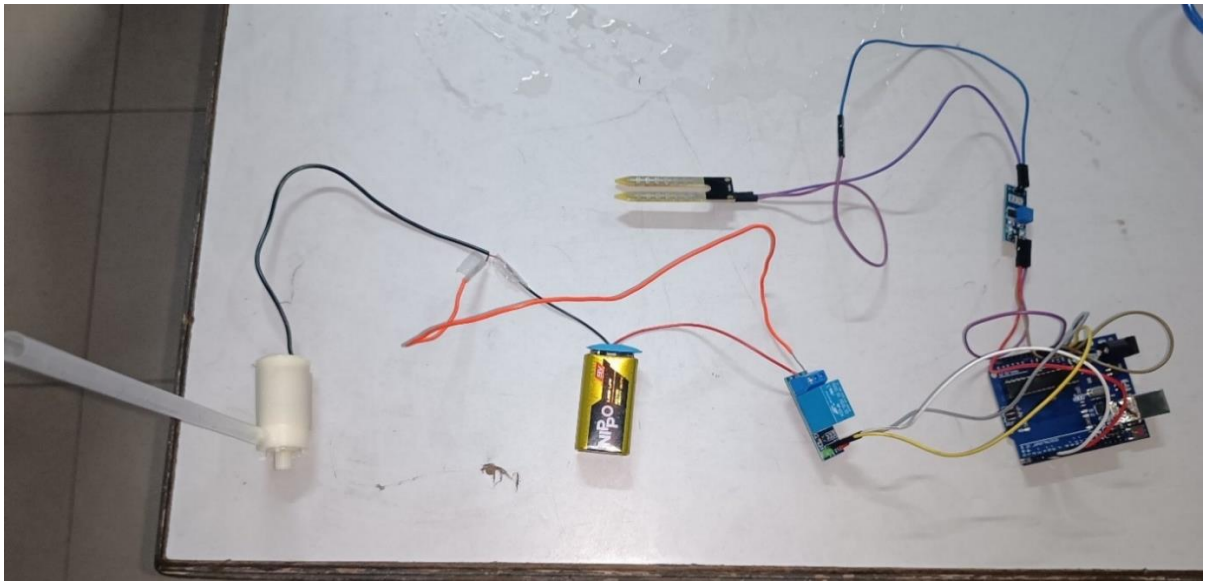
1. **Initialize Variables and Pins:**
   - Declare an integer variable water to store the sensor reading.
   - In the setup function, configure pin 3 as an output pin to control the relay board.
   - Configure pin 6 as an input pin to receive signals from the soil moisture sensor.
2. **Start Infinite Loop:**
   - Enter the loop function which will run continuously.

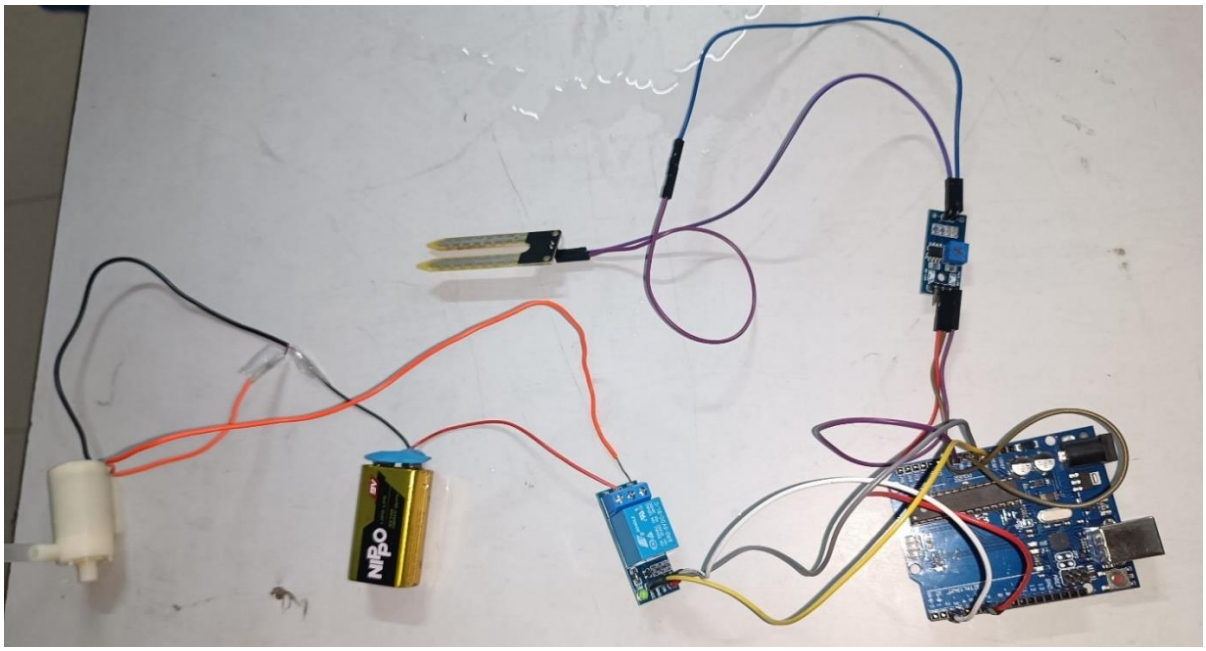
3. **Read Soil Moisture Sensor:**
    - Read the digital signal from the soil moisture sensor connected to pin 6.
    - Store the sensor reading in the variable water.
4. **Check Soil Moisture Level:**
    - If water is HIGH (indicating sufficient moisture):
        - Set pin 3 to LOW to turn off the relay, stopping the water pump.
    - If water is LOW (indicating insufficient moisture):
        - Set pin 3 to HIGH to activate the relay, turning on the water pump.
5. **Delay:**
    - Wait for 400 milliseconds before repeating the loop to allow for sensor stabilization and prevent rapid switching.

5) Program:

```
int water; //random variable

void setup()
{
  pinMode(3,OUTPUT);        //output pin for relay board, this will sent signal to
the relay
  pinMode(6,INPUT);         //input pin coming from soil sensor
}

void loop()
{
  water = digitalRead(6);   // reading the coming signal from the soil sensor

  if(water == HIGH)         // if water level is full then cut the relay
  {
  digitalWrite(3,LOW);      // low is to cut the relay
  }
  else
  {
  digitalWrite(3,HIGH);     //high to continue proving signal and water supply
  }
   delay(400);
}
```

6) Snapshot of project:





7) Future Scope

The Automatic Plant Irrigation System can be enhanced and expanded in several ways:

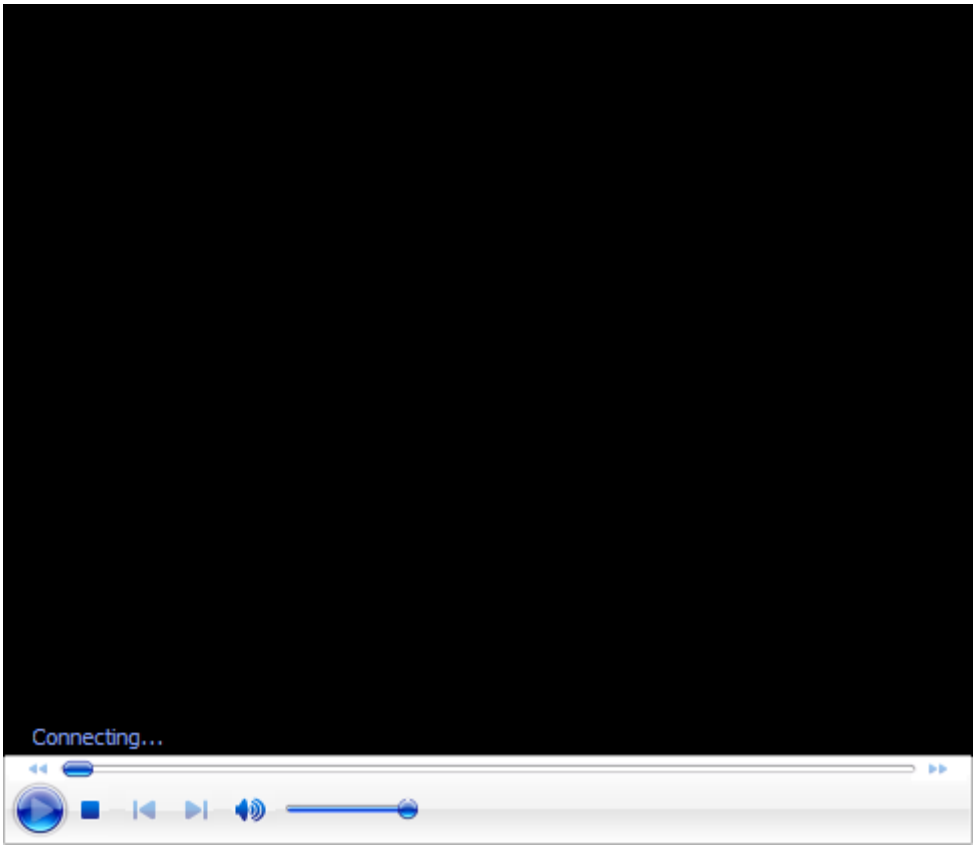
- **Wireless Monitoring and Control:** Integrate Wi-Fi or Bluetooth modules to monitor and control the system remotely via a smartphone app.

- **Multiple Sensors:** Use multiple soil moisture sensors for large gardens or fields to ensure uniform watering.
- **Weather Integration:** Incorporate weather forecasting to adjust watering schedules based on predicted rainfall.
- **Nutrient Monitoring:** Integrate additional sensors to monitor soil nutrient levels and automate fertilization.
- **Solar Power:** Utilize solar panels to power the system, making it more sustainable and suitable for remote areas.

8) Project Demo Video Link

1)..\..\Downloads\Automatic_Plant_Watering_System\mpmc_pro_3.mp4

2)Project Demo Video



9) Conclusion:

The Automatic Plant Irrigation System using Arduino UNO and a soil moisture sensor offers a cost-effective solution for maintaining optimal soil moisture levels in agriculture and gardening. Integrating the Arduino UNO, soil moisture sensor, relay module, and water pump, the system automates irrigation through precise monitoring and control. This promotes healthier plant growth while conserving water, crucial for regions facing water scarcity. Scalable and customizable, the system suits diverse applications from home gardens to large farms and urban landscapes. Future enhancements like remote monitoring, weather integration, and additional sensors promise to further enhance its utility and efficiency. In essence, this system demonstrates microcontroller technology's role in addressing agricultural challenges, emphasizing efficiency, sustainability, and plant health improvement. As technology evolves, such automated systems will play a pivotal role in modern farming and urban greening solutions.

10) References Link:

- https://www.geeksforgeeks.org/soil-moisture-measurement-using-arduino-and-soil-moisture-sensor/
- https://www.youtube.com/watch?v=iwkE_HWU-6M
- https://circuitdigest.com/microcontroller-projects/iot-based-smart-irrigation-system-using-esp8266-and-soil-moisture-sensor