AUTOMATED IRRIGATION CONTROL SYSTEM BASED ON ENVIRONMENTAL SENSING

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Aim:

To design and implement an automated irrigation control system that efficiently manages water delivery to crops by sensing environmental factors such as soil moisture, temperature, and humidity, using the ESP8266 microcontroller for real-time monitoring, control, and remote management.

Tools / Hardware Required:

- ESP8266 microcontroller
- Soil moisture sensor
- DHT22 temperature and humidity sensor
- Water level sensor
- Motor pump
- Relay module (2 channel)
- Power supply
- OLED display
- LED
- Connecting wires

Theory:

This Irrigation Control System has the following functions:

1. ESP8266 – Central controller with Wi-Fi, low power, 3.3V logic.

2. Soil Moisture Sensor – Measures soil water content (0–100%) to trigger irrigation

3. DHT22 – Reads temperature (-40°C to +80°C) & humidity (0–100% RH)

4. Relay Module – Switches pumps/valves safely, controlled by ESP8266.

5. Water Level Sensor – Detects tank levels (low/medium/high) to prevent dry-run.

6. Power Supply – Provides stable 5V/3.3V for system components.

7. Motor Pump – Pumps water from tank to field, controlled via relay.

8. OLED Display – Shows real-time soil, climate, and pump status (I2C).

9. LED Indicators – Visual alerts for power, irrigation, or faults.

10. Breadboard – Temporary testing platform.

11. Connecting Wires – Ensure power and signal links between modules.

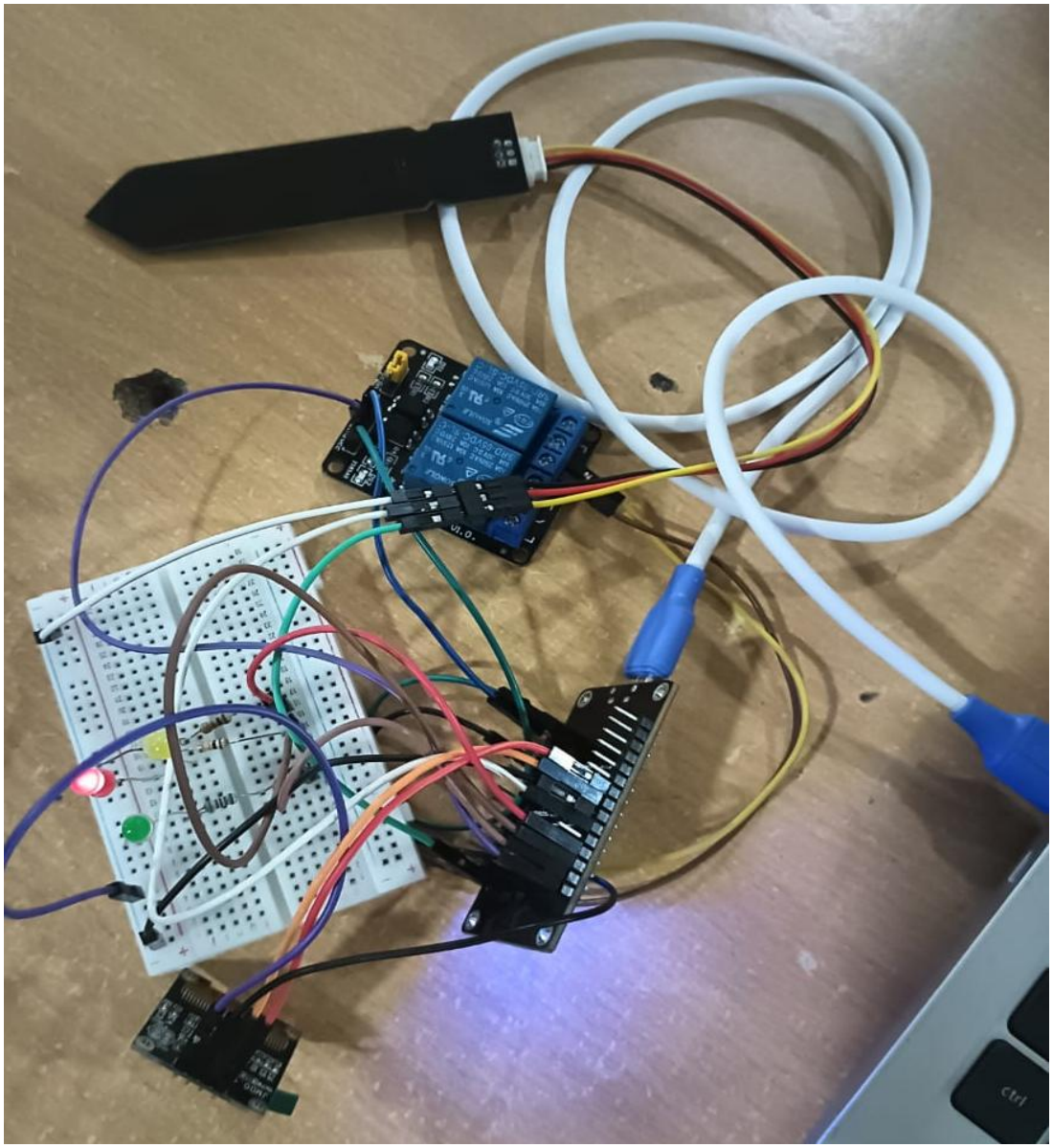
Pin Connections:

Pin Name	GPIO Number	Function
D0	GPIO16	Can be used for sensor input
D1	GPIO5	I2C SCL (optional for sensors)
D2	GPIO4	I2C SDA (optional for sensors)
A0	ADC0 (Pin)	Analog input (e.g., soil sensor)
D5	GPIO14	Relay control output
D6	GPIO12	Relay control output or sensor
D7	GPIO13	General purpose I/O
3V3	Power	3.3V power supply
GND	Power Ground	Ground reference

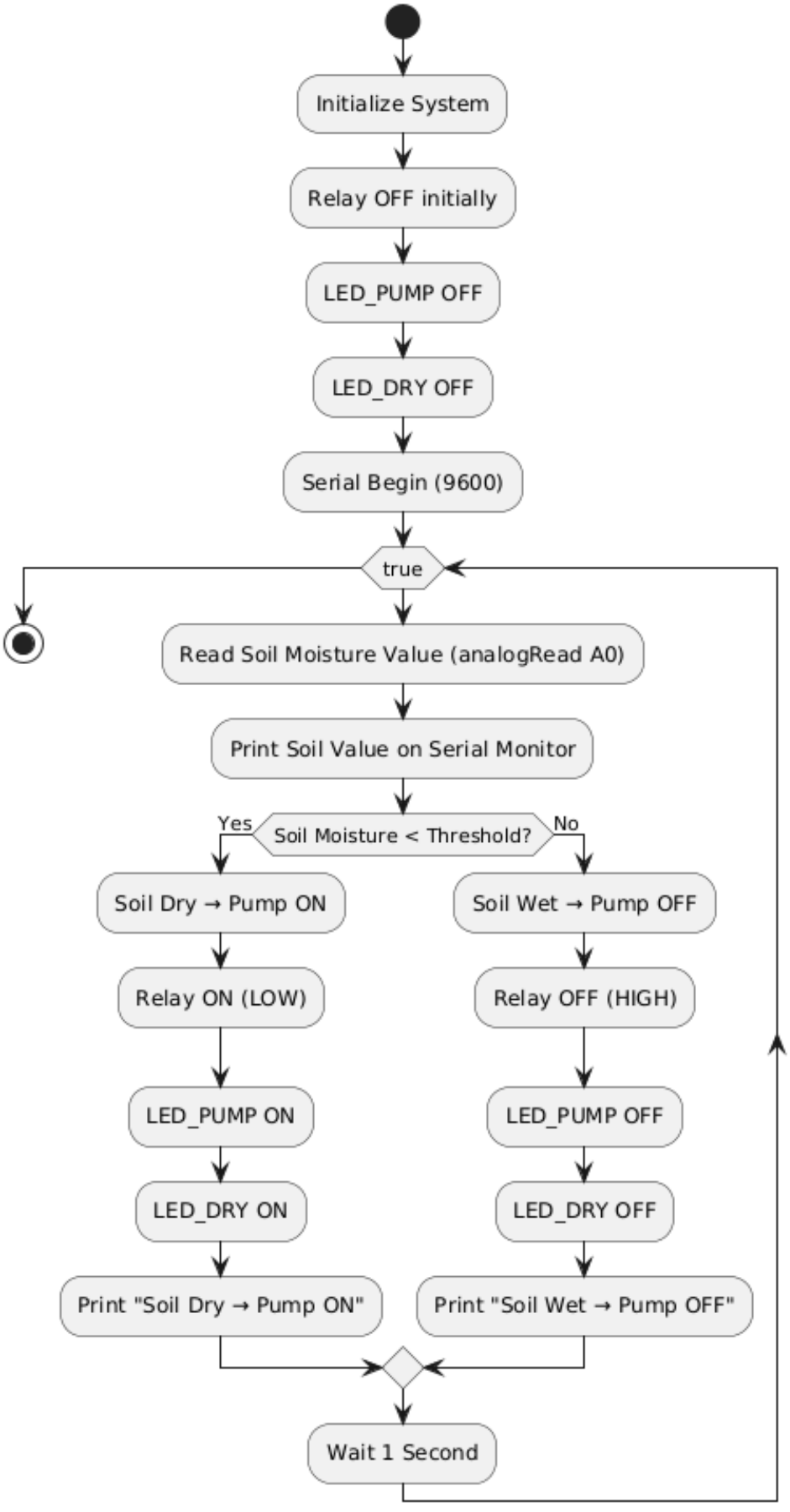
Procedure:

- Soil Moisture Sensor analog output to ESP8266 A0 pin.
- DHT22 data pin connected to GPIO D4 (GPIO2).
- Relay module input connected to GPIO D5 or D6 through transistor driver circuit.
- Relay common connected to pump or valve power line.
- Water level sensor to GPIO D7 (optional).
- ESP8266 powered with 3.3V regulated supply.
- Check that the buzzer turns ON when sudden motion is deected.
- Common GND for all the components.

Circuit:



Flowchart:


Initialize System
Relay OFF initially
LED_PUMP OFF
LED_DRY OFF
Serial Begin (9600)
true
Read Soil Moisture Value (analogRead A0)
Print Soil Value on Serial Monitor
Yes
Soil Moisture < Threshold?
No
Soil Dry → Pump ON
Relay ON (LOW)
LED_PUMP ON
LED_DRY ON
Print "Soil Dry → Pump ON"
Soil Wet → Pump OFF
Relay OFF (HIGH)
LED_PUMP OFF
LED_DRY OFF
Print "Soil Wet → Pump OFF"
Wait 1 Second

Program:

```
#define SOIL_PIN A0
#define RELAY_PIN 5
#define LED_PUMP 4
#define LED_DRY 0

int threshold = 600;

void setup() {
  pinMode(RELAY_PIN, OUTPUT);
  pinMode(LED_PUMP, OUTPUT);
  pinMode(LED_DRY, OUTPUT);

  // Relay OFF initially
  digitalWrite(RELAY_PIN, HIGH);
  digitalWrite(LED_PUMP, LOW);
  digitalWrite(LED_DRY, LOW);

  Serial.begin(9600);
  Serial.println("Automated Irrigation System Started");
}

void loop() {
  int soilValue = analogRead(SOIL_PIN);
  Serial.print("Soil Moisture Value: ");
  Serial.println(soilValue);

  if (soilValue < threshold) {
    // Soil dry → Pump ON
    digitalWrite(RELAY_PIN, LOW);   // Relay active (active LOW module)
    digitalWrite(LED_PUMP, HIGH);
    digitalWrite(LED_DRY, HIGH);
    Serial.println("Soil Dry → Pump ON");
  } else {
    // Soil wet → Pump OFF
    digitalWrite(RELAY_PIN, HIGH);
    digitalWrite(LED_PUMP, LOW);
    digitalWrite(LED_DRY, LOW);
    Serial.println("Soil Wet → Pump OFF");
  }

  delay(1000);
}
```

Result:

The Automated Irrigation System was successfully developed and tested. The system accurately monitored soil moisture levels using the sensor and controlled the water pump through the relay mechanism. When the soil moisture dropped below the threshold, the pump was automatically turned ON, and when the soil was sufficiently wet, the pump was turned OFF. Indicator LEDs provided real-time status of the soil condition and pump activity. This resulted in effective water conservation, reduced manual intervention, and improved efficiency in irrigation management.