B.TECH. (CSE)

IV SEMESTER

UE22CS251B – MICROPROCESSOR AND COMPUTER ARCHITECTURE LABORATORY (MPCA)

PROJECT REPORT

Soil Analysis and irrigation system using Arduino U3 model

SUBMITTED BY:

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Abstract

The aim of this project is to design and implement a **Soil Analysis and irrigation system using Arduino Uno R3 model.** The system will monitor the soil moisture level and automatically water the plants when necessary. This project is designed to provide a solution for individuals who struggle to maintain proper watering schedules for their plants, compromising plant's health,the farmers and crop owners assisting them in watering their crops tough weather conditions in some demographics.

Introduction

Plants require consistent watering to thrive, but it can be challenging for individuals to maintain a regular watering schedule, especially for those with busy lifestyles or frequent travel commitments. To address this issue, a **Soil Analysis and irrigation system using Arduino Uno R3 model.** is proposed. This system will monitor the soil moisture level and activate a water pump when the soil becomes too dry, ensuring that the plants receive adequate hydration.

We have specifically used **Uno R3** model micro controller board due to its salient features which match our requirements for this project: -

- Containing 14 I/O pins **(6 of which used as PWM outputs)**
- 6 analog inputs
- **16MHz ceramic resonator** for generating signals of accurate frequency assisting in catching and analyzing soil moisturizes
- **USB**
- **Power Jack**
- **ICSP header**
- **Reset button**

Components Required

1. IDUINO **Uno R3** ATmega328P with USB **Cable length** 1 feet, Compatible with ATMEGA16U2 **Arduino**

2. Auslese™ 5V Relay **One Channel Module** for Raspberry Avr Pic Low Level Trigger

3. ERH INDIA Mini **Water Pump** 3-6 V DC Water Pump, 9v DC Water Pump with 1 Meter Transparent Pipe for Automatic Sanitizer Machine DIY Kit

4. Auslese™ Detection Module **Soil Moisture Sensor** (Pack of 1Pcs)

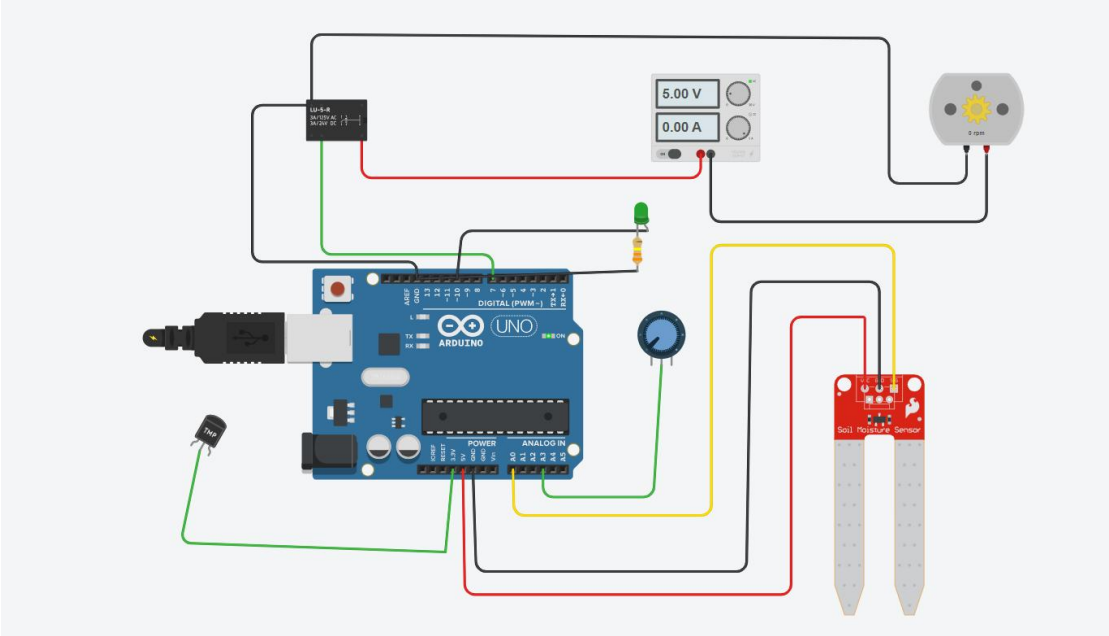
5. ApTechDeals **Jumper Wires** Male to Male, Male to Female, Female to Female/breadboard jumper wires (10+10+10)

6. Power supply (9V Battery)

7. Water reservoir

8. DHT 11 Temperature and Humidity Sensor

Circuit Diagram



Sensor Details

The Auslese™ Detection Module **Soil Moisture Sensor** is an advanced sensor designed to measure soil moisture levels accurately and efficiently. Utilizing cutting-edge technology, this sensor can provide precise readings of moisture content in soil, allowing for optimal irrigation control and water management in agricultural and horticultural applications. The features: -

- Operating Voltage - **3.7-5 V - which meets the requirement of Arduino board max. voltage**
- PCB Dimensions - 3x1.5 cm
- Soil Probe Dimensions - 6 cm
- Cable Length - 21 cm (approx)
- Dual output mode

- With power indicator (red), and digital switching output indicator (green) having LM393 comparator chip

Our 2nd Sensor is the Water Sensor **(Model: REES52 Water Level Sensor Depth of Detection Water Sensor).** This sensor is used near the water reservoir to detect the water levels in water reservoirs. This allows the system to detect when the water reservoir is running low on water, which could be then refilled. Additionally it is also used for the following features: -

- **Preventing Water Wastage**
- **Ensuring Proper Irrigation**
- **Optimizing Water Usage**
- **Enhancing System Reliability**

Our 3rd Sensor is the Temperature and Humidity Sensor **(DHT11 Temperature Sensor).** This Sensor is used in collaboration with the soil sensor and connected with the main micro controller terminals. It is mainly used for detecting **Environmental Changes.** With the help of this sensor we could get real-time data of changes in humidity levels or other environmental changes in the plants. With the availability of this information the system can use to adjust irrigation schedule preemptively, thus ensuring adequate water supply for plants. Additionally it is also used for the following features: -

- **Optimizing Irrigation Schedule**
- **Preventing Water Stress**
- **Preventing Water Overflow**
- **Enhancing Plant Health and Growth**

Methodology

System Architecture

The Overall architecture of the system is surrounded around the components mentioned in this document. **Arduino Board** serves as the CPU of the system. It reads sensor data, processes it, and controls the irrigation components accordingly. **Soil Moisture** sensor, a main sensor which measures the moisture content of the soil. It is buried in the soil near the plant roots to provide accurate moisture readings. **Temperature and Humidity Sensor** measures the ambient temperature and humidity levels, the data collected from this sensor is used to adjust irrigation schedule based on environmental conditions. **Water pump** is used to pump water from the water reservoir. **Relay Module** is used to control the water pump using the Arduino

board, as it provides isolation b/w the high voltage & low voltage components. **Water Reservoir** stores the water supply for the irrigation system.

System Operation

- The system is initialized, and sensors are calibrated to establish baseline readings.
- The Arduino continuously read the sensor data, including soil moisture, temperature and humidity.
- Based on the sensor data, the Arduino determines whether irrigation is required & calculates the duration and frequency of watering.
- If the **soil moisture** is below a predefined threshold or the environmental conditions or the environmental conditions indicate a need for watering, the Arduino activates the water pump to irrigate the plants
- Then, the **water pump** draws water from the reservoir, and delivers it to the plants through the 1m pipe attached.
- Once the desired soil moisture level is reached or the irrigation cycle is completed, the Arduino deactivates the water pump and stops water flow.

Implementation Steps

- Connect the soil moisture, temperature/humidity sensor, water sensor, and the channel relay module to the Arduino Board.
  - Connecting the respective **GND** pins of components of the **GND** pins of Arduino board.
  - Connecting the VCC point of **Soil Moisture Sensor** to the 5V of the **Arduino pin** acting as the main voltage supplier for the sensor.
  - Connecting **power output** of the Temperature sensor to the 3.3V of the **Arduino Pin,** acting as the main supplier for the sensor.
  - Then connect 1 terminal of the water pump to the 9V battery and the second terminal to a relay module.

- Lastly, to complete the circuit b/w Arduino Board and the components like connecting the **relay channel module** to the assorted **Arduino Pins.**

- Then upload the written Arduino code using Arduino IDE to read sensor data and the control the irrigation process.
- Calibrate the sensors and define the irrigation thresholds and parameters in the code.
- Test the System in different environmental conditions to ensure proper operation.

Conclusion

The automated irrigation system using Arduino and sensors offers numerous benefits, including efficient water usage, improved crop yield, and reduced labor requirements. By monitoring environmental parameters and adjusting the irrigation schedule accordingly, this system helps conserve water resources and promotes sustainable agriculture and gardening practices. Further enhancements could include the integration of additional sensors for monitoring other factors such as light intensity and soil pH, as well as the implementation of wireless communication for remote monitoring and control of the system.

Appendix 1.0 - Hardware Model

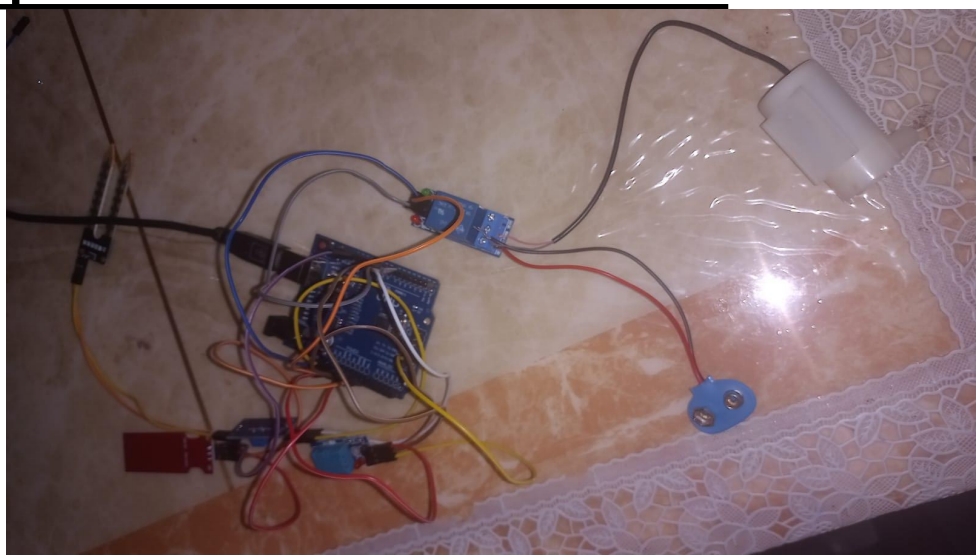


Figure 1.1 - Model

Appendix 1.1 - Bibliography

- Team, T. A. (n.d.). *Software*. Arduino. https://www.arduino.cc/en/software

- Manda, R. R. (2021, September). *20 +*. PLANT ARCHIVES | AN INTERNATIONAL JOURNAL. https://www.plantarchives.org/

- *Use an Arduino to control a Relay*. Use an Arduino to Control a Relay | Little Bird Guides. (n.d.). https://learn.littlebirdelectronics.com.au/guides/use-an-arduino-to-control-a-relay

Appendix 1.2 - Components & Sensors

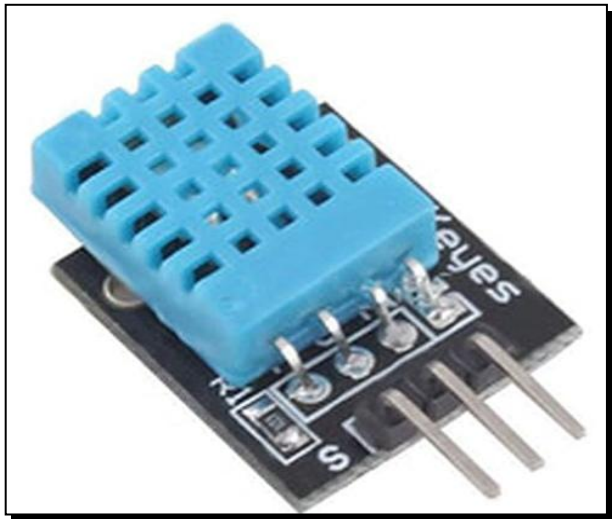


Figure 1.2 - DHT11 Temperature Sensor

Figure 1.3 - Relay Channel Module

Figure 1.4 - Jumper Wires

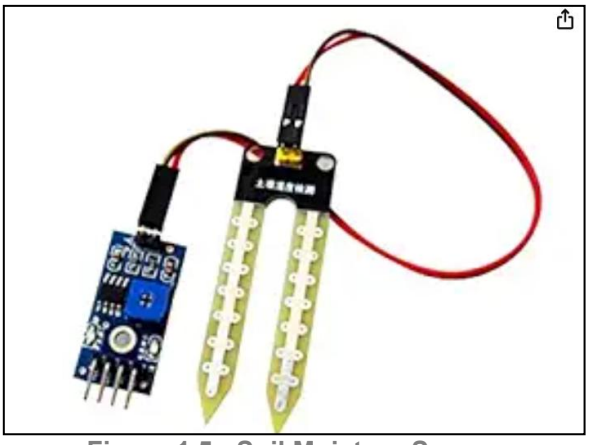


Figure 1.5 - Soil Moisture Sensor

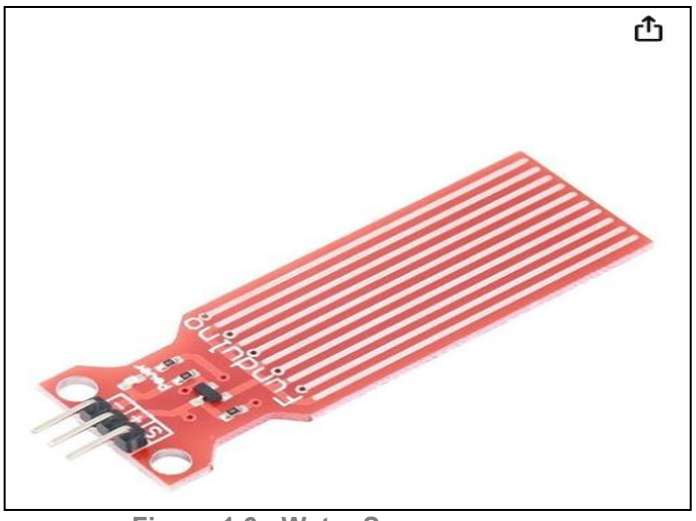


Figure 1.6 - Water Sensor