CSE360 Lab Project
Project Name: Plant Watering System Based on Soil Moisture, Sunlight & Water Overflow Using Arduino Uno R3
Section: 4
Group: 7

Submitted by:

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Submitted to: Shakir Rouf, Faculty; Sumaiya Tanjil Khan, Faculty

Introduction:

In this project, we intend to build an automated plant watering system according to the presence of sunlight and soil moisture. To detect the presence of sunlight and moisture in soil, a Light Dependent Resistor (LDR) and Soil Moisture Sensor will be used. The system will read the moisture value of the soil using a soil moisture sensor and will also read the output voltage value from the LDR. Then, according to that, a motor will be turned on or off through a relay switch to water the plant. Alongside that, an ultrasonic sensor and a buzzer will be used to alert the user if there is some sort of water overflow or water clot due to an error in the system or due to nature. Also, relevant information about the whole system regarding the sensors and the motor will be indicated by a 16X2 I2C LCD Display. The whole automated system will be controlled by an Arduino Uno R3 microcontroller.

Application Area:

Indoor Gardening & Nursery: Keeping plants inside houses or nursery healthy and flourishing is made easier by automating watering schedules.

Greenhouses: Precise irrigation management in regulated environments promotes the best crop development conditions.

Urban Farming: Support sustainable food production in constrained settings by helping urban farmers manage water delivery to crops.

Office Spaces: Enhance workplace aesthetics with hassle-free plant maintenance to create a more comfortable and effective environment in office spaces.

Drought-prone Areas: Support vegetation even under difficult circumstances by conserving water by effectively hydrating plants in areas experiencing water scarcity.

Technology & Tools:

a. Arduino IDE
b. Tinkercad
c. Arduino Uno R3(ATmega328)
d. 1 Channel 5V Relay Board Module
e. 5V Submersible Micro Pump
f. Transparent Pipe for Pump
g. 20 mm LDR(Light Dependent Resistor)
h. YL-69 Soil Moisture Sensor
i. HC-SR04 Ultrasonic Sonar Sensor
j. 5V Passive Buzzer
k. 16x2 Standard LCD Module Display with Soldered I2C Adapter Board
l. Jumper Wires(Male-to-Female & Male-to-Male)
m. MB102 Large Breadboard
n. Resistors(470 Ohm & 1 KOhm)
o. Soil

Programming Language:
To control and automate the whole system, a variant of C++ has been used as the programming language which is conventionally implemented through the Arduino IDE.

Working Mechanism of Sensors:

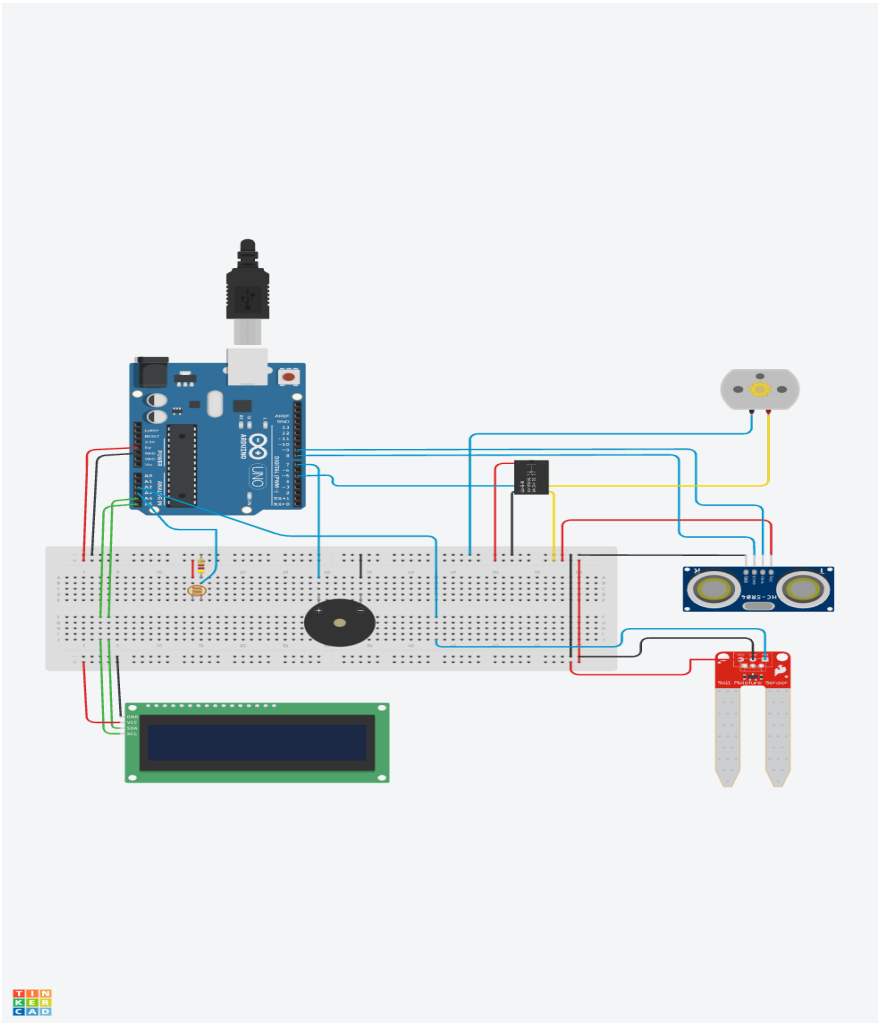
1. Ultrasonic Sensor: The ultrasonic sensor emits ultrasonic sound waves and measures the time it takes for the wave pulse to bounce back after hitting an object. In our plant watering system, these sound waves will travel through the air and hit the surface of the soil or water. The echoes of the sound waves bouncing back will then be detected by the sensor. By measuring the time it takes for the echo pulse to return, the sensor will calculate the distance between itself and the soil or water surface. This distance can give us an idea of the water level in the soil. We will set 2 specific thresholds that correspond to the desired water level. When the ultrasonic sensor detects that the distance has crossed the threshold or the distance is the same for quite some time, the Arduino will turn on the buzzer that we installed and alert the user of overflowing or clotting.

2. Photoresistor: A photoresistor, also known as a light-dependent resistor (LDR), changes its resistance based on the intensity of light it receives. When the sensor detects more light, its resistance decreases, causing the output voltage to increase. Conversely, if it detects less or no light, the opposite occurs. In our system, we will use this sensor to measure the amount of light available to the plant. We can assess whether the plant is getting adequate light or not and based on that, we can decide when to water the plant since watering under less to no sunlight is harmful for a plant.

3. Soil Moisture Sensor: The soil moisture sensor measures the moisture content of the soil by measuring the electrical conductivity between two or more probes inserted into the soil. Dry soil has higher resistance, while wet soil has lower resistance. By reading the resistance value, the sensor can provide an indication of whether the soil is dry or wet. In our system, based on this information, we can determine when to water the plant and when not to.

Connection with ICs: 5V pin of the Arduino is connected to the positive series of the breadboard and GND pin of the Arduino is connected to the negative series of the breadboard. Analog pins A4 and A5 are respectively connected to the SDA and SCL pins of the LCD. They're working as output pins. Analog pins A2 and A3 are working as input pins. A2 is connected to the SIG pin of the Soil Moisture Sensor. The signal that is released from the Soil Moisture Sensor is received at the A2 pin whereas the output voltage of the LDR is received as at the A3 pin. Digital pin 7, which is an output pin, is connected to the positive end of the buzzer and the negative end of the buzzer is connected to ground. Digital pin 5, which is an output pin, is connected to the relay switch to control it and the relay switch is connected to the motor where both the switch and the motor have been given 5V supply and GND. Furthermore, Digital pins 8 and 9 are connected to the Ultrasonic sensor. Between them, pin number 8 is an input pin whereas pin number 9 is an output pin. Pin 9 is connected to the TRIG pin of the ultrasonic sensor. From pin 9 when high value is passed, TRIG pin is high and a high ultrasonic pulse is released from the Transmitter, which is later reflected back to the Receiver, and through the ECHO pin of the Ultrasonic sensor, a signal is sent to the Digital pin 8 as input through which the time period of the pulse is generated. The rest of the pins of the Ultrasonic sensor : GND and VCC, are connected to the ground and power supply respectively.

Diagram:



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Data flow from sensors through ICs to I/O devices:

In our project, we have implemented 3 sensors - 20 mm Light Dependent Resistor, YL-69 Soil Moisture sensor and HC-SR04 Ultrasonic Sonar sensor. The data flow from sensors through Arduino to I/O devices - Water Motor, Buzzer and LCD can be explained as follows:

1. 20 mm Light dependent resistor:

This sensor is used to measure the presence of sunlight by varying resistance. We implemented it in our circuit to measure if there is presence of sunlight or not. The plant watering system will work based on the presence of sunlight as the plants will be watered if there is presence of sunlight. The mechanism in the sensor works in a way that the resistance of the sensor changes when the amount of light hits the sensor. When there is an adequate amount of sunlight present, the resistance decreases. To the contrary, the resistance increases when there is a shortage of sunlight.

From the variation in resistance, the output voltage is sent to arduino through the connected analog pin of the microcontroller. An extra resistor is used alongside the LDR to receive the output voltage. Based on the received data, the microcontroller decides through the programmed code whether to send signals to turn on the motor or not using a relay switch. It would also send signals to the LCD display that would show the current state of the sunlight intensity and the state of the motor.

2. YL-69 Soil Moisture sensor:

This sensor is implemented in our project to determine the level of moisture present in the soil. The soil moisture sensor also works in such a mechanism that when the water content is high in the soil, the resistance between the probes would be low. On the other hand, if the moisture is low, the resistance between the probes would become high.

This sensor reads data from the soil that represents how damp or dry the soil is and sends it through the analog pins of the microcontroller. Arduino converts the data and makes decisions based on that and sends signals to the motor through the relay switch to turn it on for watering in case of dry soil or off if the soil turns out to be damp. It would also send signals to the LCD display that would show the current state of the moisture in soil and the state of the motor.

3. HC-SR04 Ultrasonic Sonar sensor:

Ultrasonic sonar sensor is used for measuring distance and in this project we implemented it for measuring the water level distance in case there is any sort of mishap or natural calamity that might cause imbalance in the water level. Working principle of this sensor is such that it emits ultrasonic frequencies and converts the reflected pulse into electronic signals, then calculates the distance based on the received time period.

This sensor has two components: transmitter and receiver. The transmitter will emit ultrasonic waves when it is triggered and it reads the reflected pulse through the receiver. Then, from the time period, the distance will be measured which will indicate the water level and this data will be sent to the Arduino for decision making. Based on the water level, the arduino will send a signal to the buzzer and the LCD display. According to the received signal, the buzzer will be turned on if there is a water overflow or clot. It will remain turned off if there is no mishap in the water level. Along with this, the LCD would also display the water level information according to the received data from the microcontroller.

Estimated Cost Analysis:

Components	**Estimated Price(BDT)**
Arduino Uno R3(ATmega328)	1100
1 Channel 5V Relay Board Module	99
5V Submersible Micro Pump	145
Transparent Pipe for Pump	45
20 mm LDR(Light Dependent Resistor)	78
YL-69 Soil Moisture Sensor	120
HC-SR04 Ultrasonic Sonar Sensor	93
5V Passive Buzzer	15
16x2 Standard LCD Module Display with Soldered I2C Adapter Board	340
Jumper Wires(Male-to-Female & Male-to-Male)	200
MB102 Large Breadboard	159
Resistors(470 Ohm & 1 KOhm)	10
Soil	-
Other Indirectly Associated Components	100
Total(Estimated):	2504

Responsibilities of Each Member:

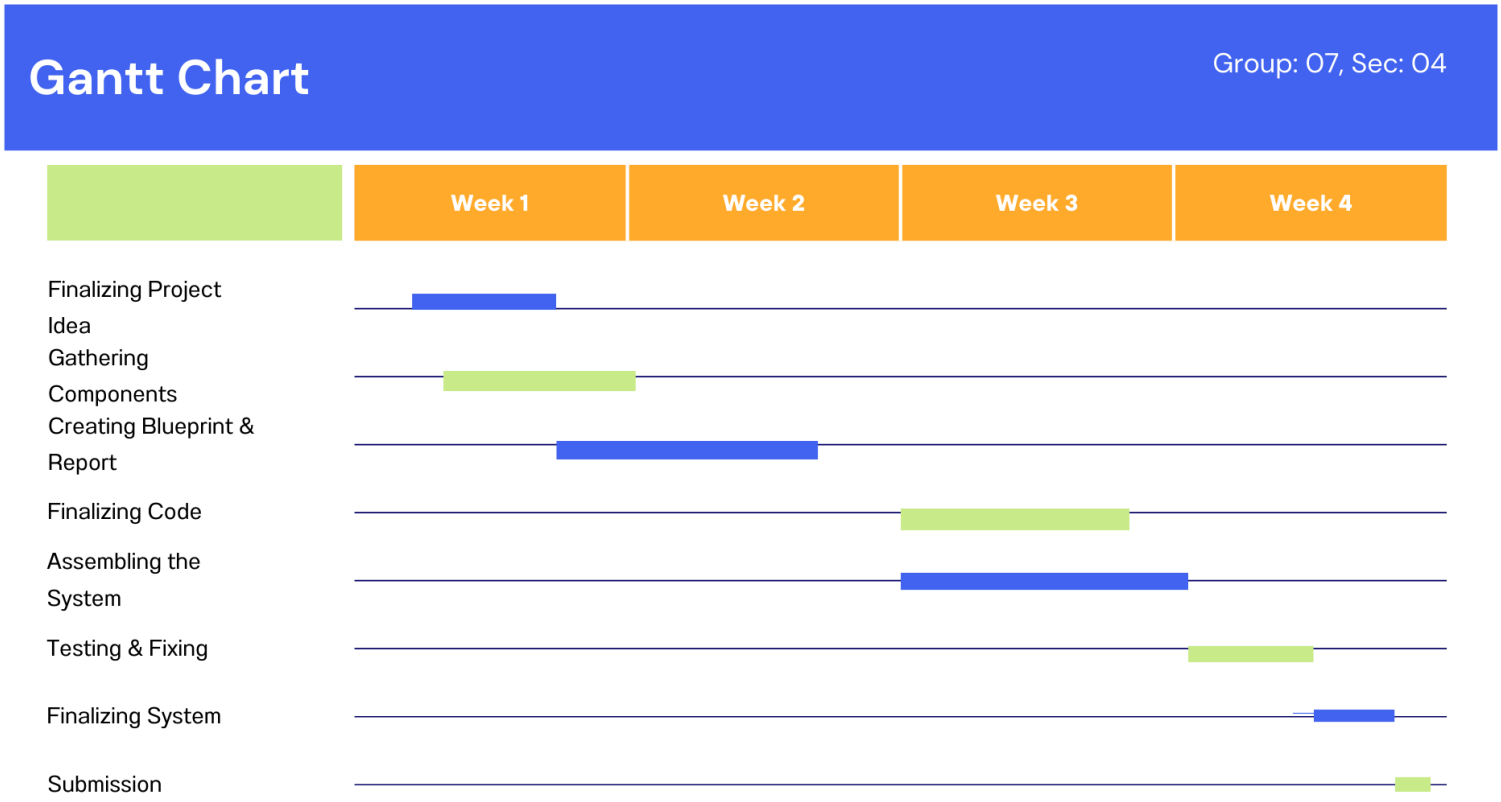
1. Tanusree Das Aishi:
    - Report: Data flow from sensors through ICs to I/O devices, Conclusion
    - Blueprint Generation
    - Coding
    - Assembling System

2. Nisharga Nirjan:
    - Report: Programming Language, Estimated Cost Analysis, Gantt Chart
    - Blueprint Generation
    - Coding
    - Assembling System

3. Rida Asmat Mila:
    - Report: Introduction, Connection with ICs
    - Blueprint Generation
    - Coding
    - Assembling System

4. Rageeb Mohammad Ridwan:
    - Report: Application Area, Working Mechanism of Sensors
    - Blueprint Generation
    - Coding
    - Assembling System

Workplan:



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Conclusion:

In conclusion, the Plant Watering System is an overall automated solution for plant care. The utilization of 3 types of sensor - Light dependent resistor, Soil moisture sensor and Ultrasonic sonar sensor makes the system intelligent and an efficient solution for plant care. This project would not only be beneficial for making the plant care process automated and hassle free, it would also help for reserving the resources as well as ensuring the proper use of water resources. We believe that this project will make an impact for the agriculture and house-gardening sector towards making the plant care process more effective and easy.

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