360 Final Theory Project

Title: Automated Irrigation with Smart Water-Level monitoring system

Section: 03

Submitted By:

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Introduction

Modern gardening is the process of applying water artificially to a field in order to ensure the success of agricultural production. Irrigation has long been an important aspect of agriculture. For nearly 5,000 (five thousand) years, agriculture has been practiced. Globally. In the field of science, Irrigation has progressed at a rapid pace. Mechanization. Irrigation has become more popular in recent years. Because of this, efficiency has become increasingly crucial. Depletion of groundwater. As a result, proper irrigation planning is essential. Flood irrigation is used in Bangladesh. The simplicity of the procedure was a major factor in its selection. However, water is used in this procedure. In evapotranspiration, around 50% to 60% of the water is lost. percolation, infiltration and extra water consumption due to dead storage weeds. To make irrigation better an intelligent irrigation system has a high level of efficiency. In recent days, smart irrigation has been a prominent topic of debate among academics. The irrigation system consists of a smart climate monitoring system, soil conditions, evaporation, plant water usage, and an automatic irrigation program. Watering plans and automatic running periods are automatically beautified by intelligent irrigation systems to match the landscape's individual needs. The controls increase the efficiency of outdoor water use dramatically. Many automated systems are required to replace or reduce human labor in everyday tasks. Due to population expansion, agricultural land in Bangladesh is dwindling. Every year, over 0.2 million people are added to the total population, while agricultural land is predicted to be reduced by 0.08 million hectares. As a result, we need to boost food production every year, but we don't have enough land to do so. The best solution to this challenge is smart technology. It is feasible to boost the effectiveness of each irrigation site while saving money by employing clever technologies. Roof gardening and greenhouse plants are the most common methods for cultivating exotic fruits, flowers, and vegetables in Bangladesh's mild environment. In these situations, a control-based system is particularly effective. Automatic irrigation systems save both time and money, and this technology is becoming increasingly popular around the world. The operation of a large-scale water system structure with fewer manual intercessions is referred to as automation. To increase the cost-benefit ratio, a representation of the full managed water system is one that simplifies the single distribution. The mechanization of the structure of a small-scale water system necessitates knowledge of the water system's planning. Plant irrigation systems that are automated, reduce the overflow of water and keep the plants healthy. Our economy is mostly focused on agriculture, with isotropic climatic conditions and full utilization of agricultural resources. The lack of rain and scarcity of water from the terrestrial tank are the primary causes. It is critical to make proper use of resources. As a result, a system to manage this action automatically is necessary. This document is based on a project that consists of an integrated system that includes an Arduino UNO, a soil moisture sensor and a water level sensor for the water tank. The elements of this system that receive and process sensor data are processed and controlled by the Arduino UNO. The sensor will be placed on the ground and used to determine how dry the soil is. The sprinkler will start and irrigation will begin if the drying speed is equal to or greater than the set figure. The sprinkler will automatically stop when it reaches a saturated state. Where the plants grow in water and all of the works are regulated by various sensors. Everything can be regulated and worked in a natural manner in the current reality. However, there are still a few critical segments of our country where computerization has not been received or employed for unquestionable purposes, which may be owing to one of the reasons why one of these reasons is being spent. Agriculture is one of these fields. Following just-in-time development, agriculture became one of the most important vocations for males. Irrigation also plays a significant role in this growth. The goal of this research is to create and deploy an autonomous irrigation system with a microcontroller to improve irrigation efficiency while saving farmers time and energy.

Application Area

As the Internet becomes more widely used all over the world, it is also becoming more prevalent in agriculture and the agricultural environment, where people are struggling with water evaporation. Also it can be implemented in the home or yard lawn. The agricultural industrialization hypothesis primarily provides a new operational idea and mode for wisdom garden agricultural production. Because the development and operation of wisdom gardens is based on agricultural production, the planning and design of wisdom gardens should be combined with agricultural industrialization theory for industrial planning in order to provide an industrial foundation for the modern gardens' long-term development.

Besides, it is already being used in golf grounds and other sports grounds manually such as hockey, cricket, football etc. Natural turf fields are much more complex than a traditional lawn where the water can be absorbed over time and pass water when the soil is too dry. The base and aeration of the soil needs to be just right to ensure that the grass grows a thick thatch to support the heavy foot traffic and gameplay. When irrigating these types of athletic surfaces, it needs to reach the root level for healthy nutrient absorption that does not flood the top surface. Standing water is never safe for athletes.

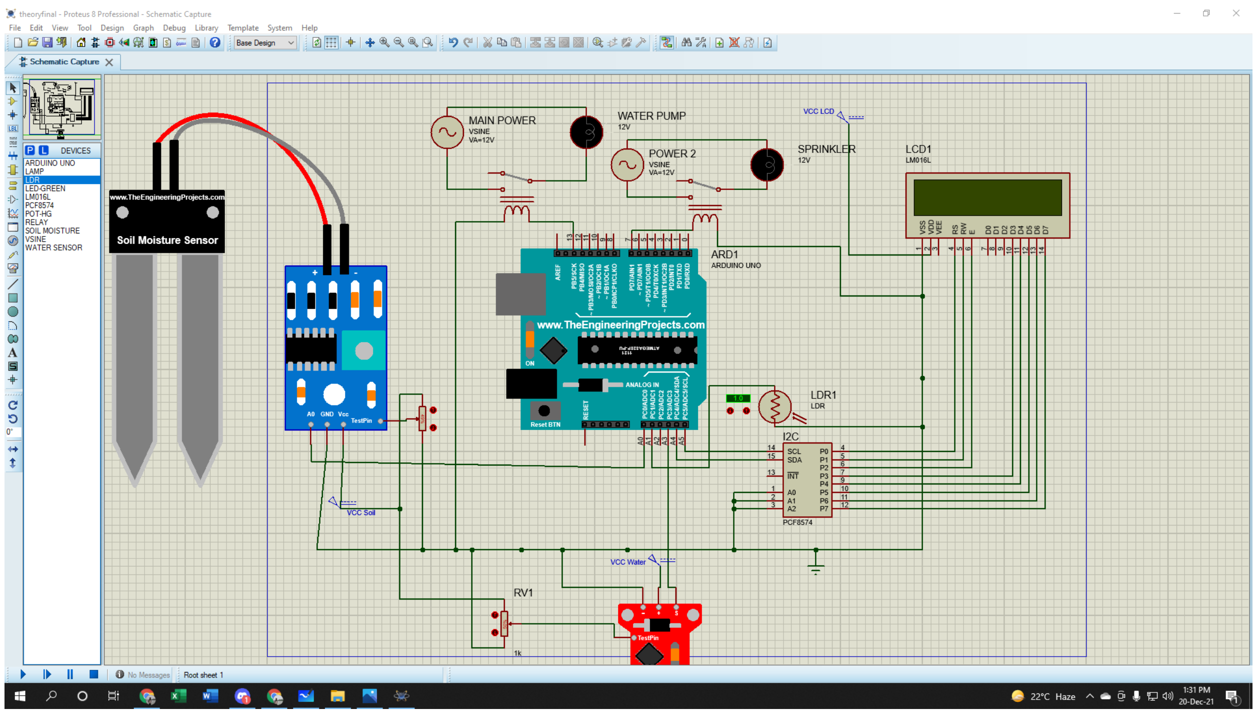
Technology and tools

1. LDR
2. Water Level Sensor
3. Soil Moisture Sensor
4. Arduino Uno R3
5. 16x2 LCD display (I/O Device)
6. Water Pump (I/O Device)
7. Sprinkler (I/O Device)

Programming Language

Arduino, which is based on C++

Connection with the ICs



Soil Sensor:

The soil sensor has 3 pins. They are A0, VCC and GND.

The A0 pin is connected to the A0 pin of the arduino, VCC and GND are connected with DC 5v power source and Ground

Water level sensor:

The water level sensor also has 3 pins: S, “+” and “-”. S is the data pin and is connected to the A3 pin of the arduino. The “+” and “-” pins are connected with DC 5v power source and Ground respectively.

LDR Sensor:

The LDR sensor has 2 pins. 1 pin is connected to the A1 pin of the arduino and another one is connected to the ground.

16*2 LCD Display+I2C:

- **Connection between LCD and I2C:**

The LCD display has 14 pins in total but we have used 10 of them. VDD and VSS are connected with VCC and Ground respectively. We have connected RS, RW, E, and D3 to D7 with I2C pin P0 to P7. VEE, D0-D3 pins of the LCD have been ignored.

- **Connection between I2C and Arduino:**

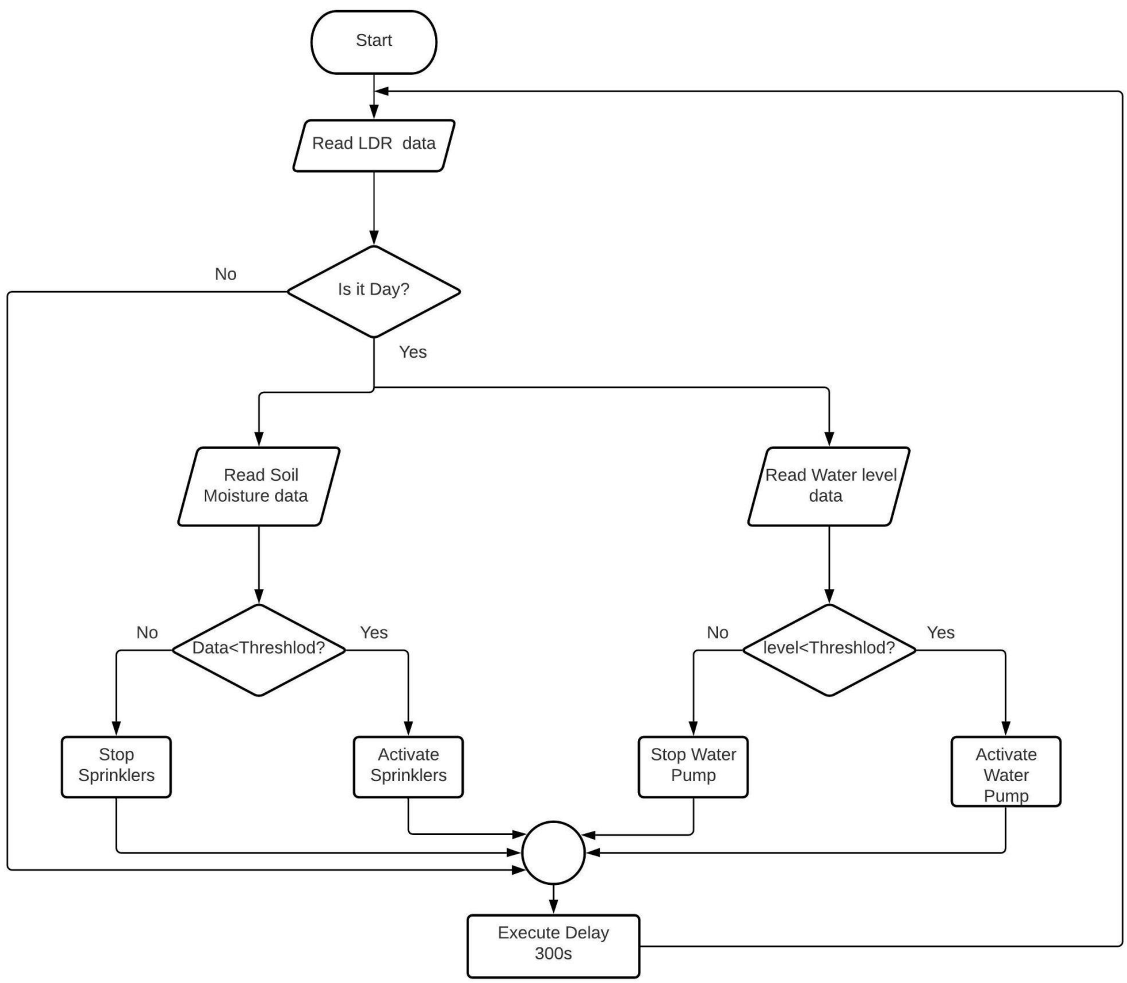
The SCL and SDA pins of I2C are connected with the A4 and A5 pins of Arduino. A0 - A2 are connected to Ground.

Water Pump + Sprinkler:

Here the water pump and sprinkler are represented by a lamp. Arduino VCC will not be enough to power these elements so there will be a relay circuit that will connect with the lamp, the main AC current source and the arduino pin 13(for the pump) and 7(for the sprinkler).

Data flow from sensors through ICs to I/O devices

The Soil sensor will detect the moisture of the soil and send the data to arduino. The arduino will process the data and if the soil moisture level gets lower than a threshold value, it will activate the sprinklers. It will also check the water level of the water tank from which the sprinklers are getting water. If that water tank gets low the arduino will open the water pump and fill the tank according to the limit. Here is a flow chart to understand the dataflow better:



Arduino Code:

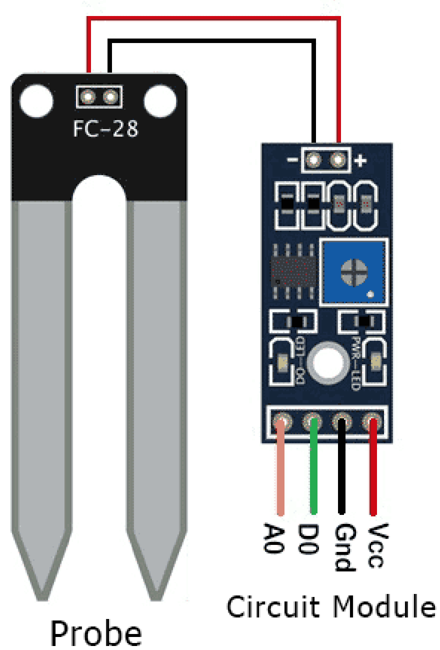
```
#include <LiquidCrystal_I2C.h>
#include <Wire.h>
LiquidCrystal_I2C lcd(0x27, 16, 2);
int relay_sprinkler = 11;
int relay_pump = 12;
int water_pin=A3;
int soil_pin = A0;
int ldr_pin = A1;
void setup() {
  pinMode(relay_sprinkler,OUTPUT);
  pinMode(relay_pump,OUTPUT);
  pinMode(water_pin,INPUT);
  pinMode(soil_pin,INPUT);
  pinMode(ldr_pin,INPUT);
  lcd.init();
  lcd.backlight();
}

void loop() {
  int ldr_data=analogRead(ldr_pin);
  if (ldr_data>200){
    //it is day
    int soil_data = analogRead(soil_pin);
    if (soil_data<400){
      digitalWrite(relay_sprinkler,HIGH);
      lcd.clear();
      lcd.setCursor(1,0);
      lcd.print("Soil needs water");
    }else{
      lcd.clear();
      lcd.setCursor(0,0);
      lcd.print("Soil moisture ok");
      digitalWrite(relay_sprinkler,LOW);
    }
    int water_data = analogRead(water_pin);
    if (water_data<250){
      lcd.setCursor(0,1);
      lcd.print("Water level low");
      digitalWrite(relay_pump, HIGH);
```

```
    }else{
      lcd.setCursor(0,1);
      lcd.print("Water level ok");
      digitalWrite(relay_pump, LOW);
    }
  }
  delay(3000);
}
```

Working Mechanism of Sensors

Soil Moisture Sensor:

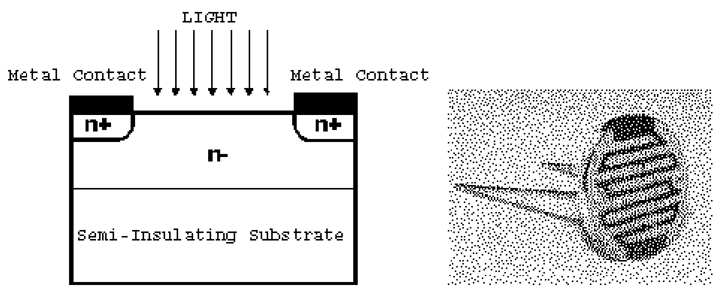
The soil moisture sensor consists of a U-shaped probe and an electronic module. The U-shaped probe acts as a potentiometer which varies the resistance. This U-shaped probe is connected with a circuit module which can be interfaced with an arduino. The module has a total of 6 pins. A0 and D0 are used for analog and digital output respectively. VCC pin is used for power connection for the sensor which ranges from 3.3v to 5v and GND is connected to the ground. Other two pins are used as input from the U-shaped probe.



Let's say the probe or the sensor is placed in the soil. If the soil has a lot of water or moisture the probe will act like a low resistance input signal otherwise it will act as high resistance. We can make a program which defines anything less than 500 analog values to be wet and 750 or above to be dry.

LDR:

LDR stands for light dependent resistance also known as photoresistor. LDR senses electromagnetic radiation and acts as a resistor accordingly. This makes the sensor light sensitive. LDR is constructed with a light-sensitive material called a photocell. The photocell is placed on insulating ceramic in a zigzag pattern in order to get desired resistance and power. The zigzag divides the metal deposited areas into two parts. Then ohmic contacts are made in both parts and made sure the resistance of those are as low as possible. Cadmium sulfide, Cadmium Selenide, Indium Antimonide are commonly used for making the photocell.

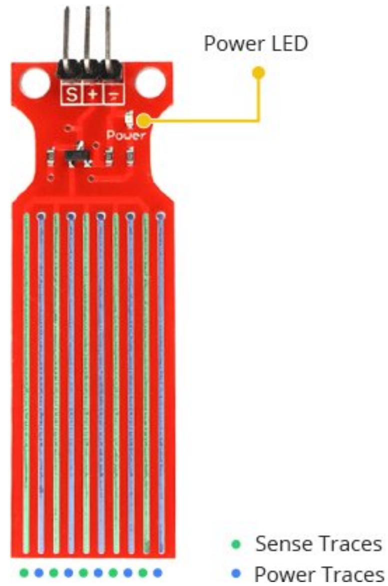


LDR

LDR functions based on photo conductivity. When light falls on the sensor the semiconductor valence bands get excited to the conduction band. The light has more energy than the band gap which makes electrons jump from the valence band to the conduction band. Thus when there is light there are more charge carrier electrons and less resistance. Reversely, when there is no light the opposite happens with high resistance. There are two pins of the LDR. When connected to VCC the ldr sensor gives analog output depending on the light intensity.

Water Level Sensor:

Water Level sensor works on the basis of sensing submerged depth of the sensor. It has a total of 10 open copper traces similar to what we see on a PCB. Five of the copper traces are of power and the other five are used for sensing. There is no connection between those traces.



When the sensor is submerged in water current conducts. The more it gets submerged the better is the current flow and lower the resistance. The water level sensor has in total 3 pins. VCC, GND and output pin. VCC takes around 3.3v to 5v. GND is connected to the ground. The output pin is connected to the arduino analog input pin. When the sensor is not in the water or completely dry there is no signal or the analog signal value is 0. When it is partially submerged the analog signal 400 is sent to the arduino. Analog signal of around 530 is sent when the sensor is fully merged.

Estimated Cost Analysis

Equipments	Cost(BDT)
LDR	6.00
Water Level Sensor	250.00
Soil Moisture Sensor	300.00
Arduino Uno R3	640.00
12v Water Pump	245.00
Relay x2	52.00
LCD Display 16X2	230.00
Sprinkler	500.00
Total	**2223.00**

Responsibilities of each member

We decided what our project would be and how we would use it together through Google Meet. Here is the work distribution among our team members:

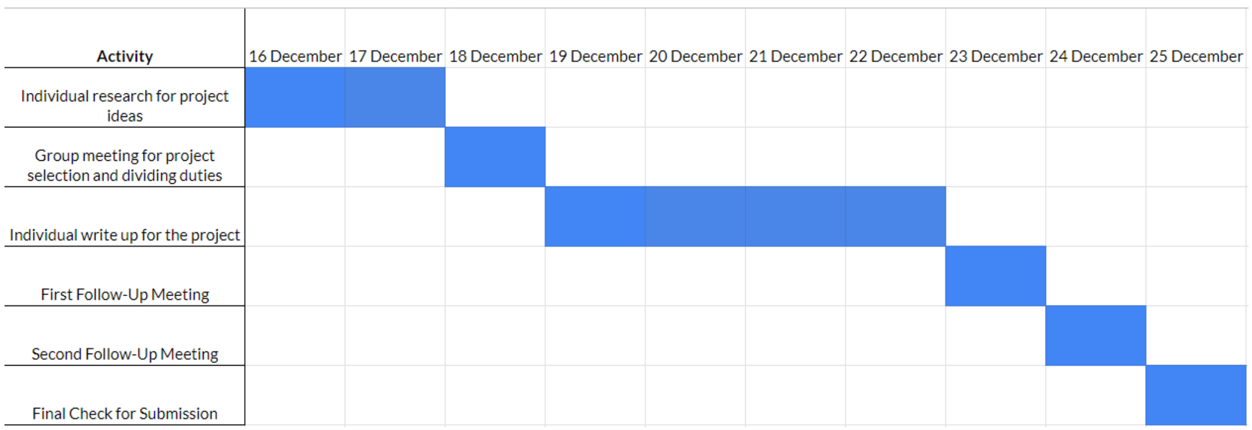
Sheikh Abdul Fahad: Introduction and Application Area

M. Tasnimul Hasan: Technology and tools, Working mechanism of Sensors and Estimated cost analysis.

Atanu Roy: Connection with ICs, Data flow from sensors through ICs to I/O devices and Arduino Code.

Kallol Saha: Programming Language, Workplan (Gantt Chart) and Conclusion.

Workplan (Gantt Chart)



Conclusion

An intelligent irrigation system based on a microcontroller was developed in this study. The microcontroller circuit is made up of only a few components and is extremely reliable. The Arduino UNO, relay, soil moisture sensor, motor, and battery were all used in this circuit.

After checking the soil dryness data on the computer, we guarantee the project's success. This system irrigates the land based on data from soil moisture sensors, preventing both excessive and insufficient irrigation. This technology functions as a potential answer to the plant's manual irrigation concerns. Flood saturation and irrigation were the goals of this clever irrigation system. Both surgeries were carried out in a pot on clayey and sandy soil. As a result, the total water required for 0.045m2 was 7.67 ml / sec for saturation, and 7.42 ml / sec for irrigation from full for the same area, with a time needed of 3.02 min. However, when water was manually applied

in the same vessel with the same overall capacity of the engine, the flow rate was found to be 8.12 ml/s and the time required was 3.23 minutes. The total water loss was 0.70 ml/s, and the time lost was 23 seconds. The sensor-based irrigation system used less water and took less time than the manual watering method, according to this study. Irrigation efficiency improved.
The sensor-based irrigation system has shown to be the most reliable and has operated independently. It improves the efficiency and convenience of the system. The study's key weakness is that it was conducted on a limited scale; more research is needed for large-scale agriculture.

References

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