Microcontroller Based Plant Hydrator Using Weather Prediction and Soil Analysis

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***Abstract* - Whatever the weather, either too dry or hot or wet, we want to control the amount of water that reaches the plants. Here this project is an Arduino based project which can be used to water the plants based on the weather characteristics. This system can sense whether the soil is wet or not and measure the temperature around the plants. After all the measuring, the system will predict whether the plants need water and if needed then how much.**

***Keywords* - Arduino, soil moisture, temperature sensor, relay, motor, 20x4 LCD, sounder.**

I. INTRODUCTION

It is very important to know how much water the plant needs. And these needs vary based on whether and how much the soil is moisture. Shortage of water is a big problem nowadays as the level of groundwater is declining. In this situation wastage of water is a big issue to prevent. Sometimes farmers forget to turn off the water supplier. And they sometimes forget to water the plants which causes damage to plants. So, the water should be used properly. The aim of this project is to overcome the problem. This project is based on an Arduino microprocessor. To measure the moisture level of soil, a soil moisture sensor is used. After measuring moisture, a signal will be sent. To measure the temperature of the weather a temperature sensor is used. To handle the distribution of larger power based on low power, relay is used. And many other proper instruments are used with Arduino to measure moisture of soil and weather correctly. The target of our system is to develop a plant hydration system which measures the moisture of soil and temperature of weather. Then it automatically turns on or off the water supply.

II. RELATED WORKS

In this kind of work, there are some systems which are conjoined by some sensing device which can sense the dry condition of the field and pass the state to the automation system. They also used a control algorithm for controlling the flow of water. But in that system, there was some lack of ability to measure the soil moisture and temperature of the weather. In this project, including measuring the soil moisture and temperature, also used technology to detect the weather completely. So that the acceptance of this project will be higher. Here, used LED lights and sounders here. This feature makes this project more reliable and different from others previous

work. I've completed the project with limited resources. By using limited resources, I've been able to minimize the cost compared to others.

III. METHODOLOGY

Microcontroller-based plant hydrator using weather prediction and soil analysis system using Arduino microcontroller UNO R3 is programmed such that it gives the interrupt signals to the motor via the motor driver module. A0 pin of the Arduino board is connected to the Soil sensor which senses the moisture content present in the soil. Whenever the soil moisture content value goes down, the sensor senses the moisture level change, giving a signal to the microcontroller so that the pump (motor) can be activated. A temperature sensor LM35 is also used to sense the temperature. In this code, will give some conditions for the pump on-off. If the soil moisture is more than 77%, the motor will turn off. Otherwise check the temperature. If the temperature is less than 35C, the motor will turn on. Otherwise, the motor will turn off. This concept can be used for automatic plant watering systems. The circuit comprises an Arduino UNO board, a soil moisture sensor, a temperature sensor, a 12V motor pump, and a 12V Relay to run the water pump. A 5V to 9V wall wart or plugin adapter or solar panel needs to power the Arduino board; here we use a separate 12V battery that is required for the pump motor. A blue light will come on as soon as the motor is turned on. And in case of any emergency, it will make a sound to get notification.

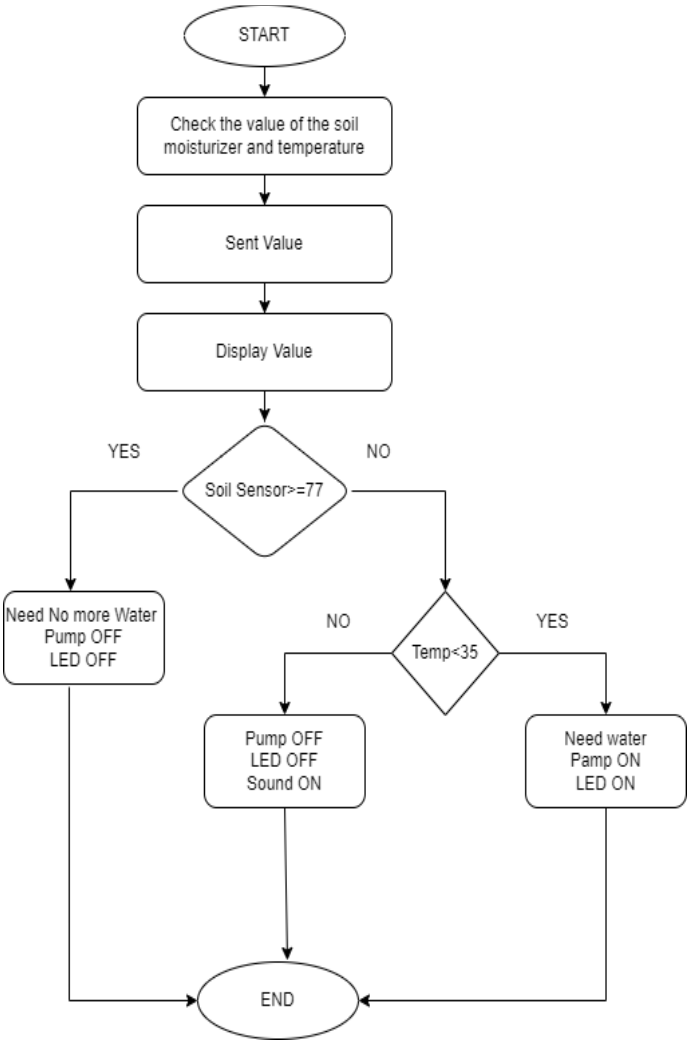

Figure-Flow Chart

IV. REQUIREMENTS

Arduino UNO R3:

Arduino board is an open-source platform that is used for building electronics projects. Arduino is a programmable circuit board in which I can write a program based on the project. The Arduino program will be uploaded with IDE (Integrated Development Environment) software that runs a computer, it is used to write and upload computer code (a HEX file) to the Arduino physical board.

Arduino language is merely a set of C/C++ functions that can be called from the code.

Coil:

A coil is an electrical conductor that consists of a series of conductive wires wrapped around a ferromagnetic core. Electric coils are one of the simplest forms of electronic components and provide inductance in an electrical circuit, an electrical characteristic that opposes the flow of current. In proteus I use a 1210-271K coil.

Capacitor:

The capacitor is a component that has the ability or capacity to store energy in the form of an electrical charge producing a potential difference (Static Voltage) across its plates, much like a small rechargeable battery. They save charge. There are many types of capacitors available, among them here use CAP TANTALUM 1000uF of 6.3V.

DC Voltage Source (Battery):

A DC voltage source consists of two or more cells that convert chemical, nuclear, solar, or thermal energy into electrical energy. Here use a 12V DC power supply to turn on the motor.

NPN Transistor:

Here we used Silicon NPN Low Power Bipolar Transistor which may be a common NPN bipolar semiconductor device or bipolar junction transistors (BJT) used for general purpose low-power amplifying or switching applications. It is designed for low to medium current, low amplifying current, low power, medium voltage, and might operate at moderately high speeds.

Soil Sensor:

Soil Moisture Sensors measure the amount of moisture in the soil. Since the direct hydrometric measuring of free-soil wetness needs removing, drying, and coefficient of a sample, soil wetness sensors live the meter water content indirectly by victimization another property of the soil, like electrical phenomenon, nonconductor constant, or interaction with neutrons, as a proxy for the wetness content. Here, I've converted the signal value from (19 to 1019) to (1 to 100) percent.

Temperature Sensor:

The LM35 temperature sensor can be used to measure temperature with an electrical output proportional to the temperature (in °C). The LM35 is an Integrated Circuit Temperature Sensor. In order to calculate the Celsius reading from the analog value, Here, use the following formula to calculate the temperature in Celsius:

$t$empCel= $(5.0 * 1000 * temp) \div (1024 * 10)$

Where,

temp = value of the serial port.

tempCel = calculated temperature value in Celsius [1]

20x4 Alphanumeric LCD:

LCD (Liquid Crystal Display) screen is an electronic display module. It has a wide range of applications. A 20x4 LCD display is a very basic module and is very commonly used in various devices and circuits.

Motor:

A motor is used to artificially supply water for a particular task. It can be electronically controlled by interfacing it with a microcontroller. It can be triggered ON/OFF by sending signals as required. Pumping means the process of artificially supplying water. In this project, a 12V DC motor is used for water pumping.

Sounder:

Piezoelectric sounders are sound components which generate sound suitable for use as input signals (including multi-tone, melody and so forth) without built-in oscillator circuits. It can be used in a wide range of applications. They come in SMD type, which is suitable for small, high-density mount and pin type. It can be used for general purposes

Potentiometer:

A potentiometer is also known as a pot. It is defined as a 3 terminal variable resistor where the resistance is manually changed to control the flow of electric current. A potentiometer acts as an adjustable voltage divider. It has 3 pins one with VGG one with GROUND another with a Soil sensor. Here, pot is 10K ohm.

Relay:

Relay is an electrically operated switch. Relays are used wherever it's necessary to regulate a circuit by a separate low-power signal, or wherever many circuits should be controlled by one signal. Here use an animated relay model here.

Resistor:

The resistor is an electrical device that may be a passive two-terminal electrical part that implements resistance as a circuit component. In electronic circuits, resistors unit of measurement accustomed to reducing current flow, alter signal levels, divide voltages, bias active components, and terminate transmission lines, among completely different uses. In our project, use one analog resistor.

V. RESULT ANALYSIS

The output of the project after implementation is shown below:

When the soil moisture is more than 77%, the motor will be off, and the LED lights will be off also.

If soil moisture level is 80%, then the diagram is-

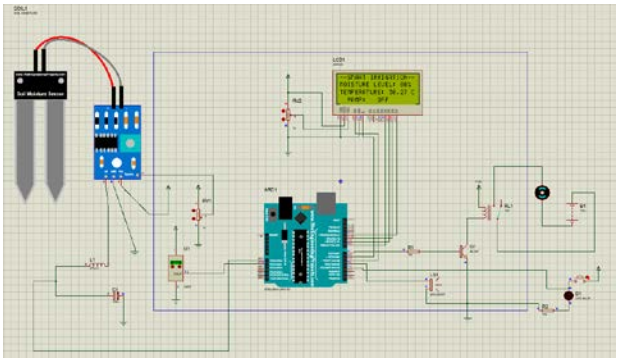

fig:1

When the soil moisture is less than 77% and the temperature is less than 35C, both the motor and the LED lights will be on.

If soil moisture level is 70% and temperature is 30.27C, then the diagram is-

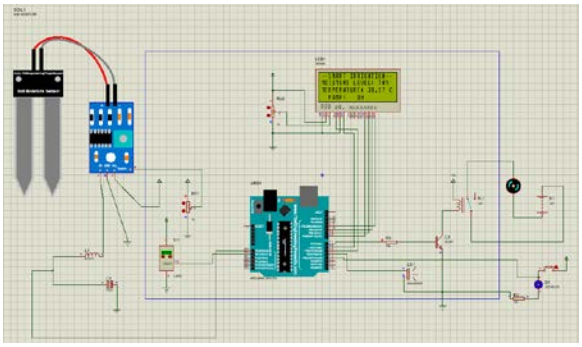

fig:2

When the soil moisture is less than 77% and the temperature is greater than 35C, both the motor and the LED light will be off, but the sounder is on.

If soil moisture level is 70% and the temperature is 40.04C, then the diagram is-

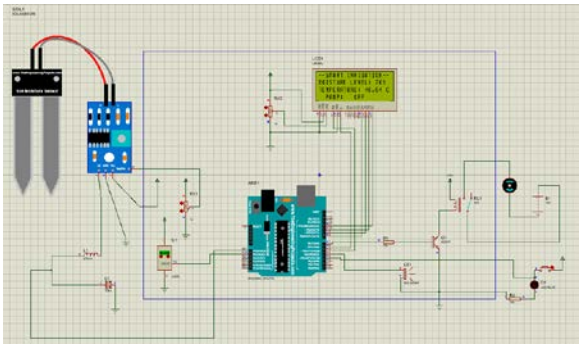

fig:3

VI. ADVANTAGES

This work has some advantages like-

Automation: No manual labor is required here for an automatic system.

Time effective: Being automated saves a lot of time [1].

Cost-effective: Automatic irrigation systems provide water to the lawn exactly where and when it is needed, which cuts down utility bills significantly, and offsets the initial cost of setup.

Efficient: Perhaps the most appealing benefit of an automatic irrigation system is that it conserves water. Say goodbye to dry patches and thoroughly watered sidewalks or driveways. Automatic systems provide precise coverage, eliminating concerns of over or underwatering your lawn.

The wastage of water will be decreased also. A sound system is available here for emergencies.

VII. FUTURE WORK

There are many scopes for further work while working with our module. Such as-

1) **IOT:**

With any android phone, I can control and monitor the pump automatically. Automated hydrator system using WSN and GPRS Module having the main goal is to optimize the use of water for agriculture crops. This system is composed of a distributed wireless sensor network with soil moisture and temperature sensor in WSN. Gateway units are used to transfer data from sensor unit to base station, send commands to the actuator for irrigation control and manage data of sensor unit. GSM is a network that supports both cellular and data. GSM can be added to the module so that I can control it from remote areas [2].

2) **Incorporation of Artificial Intelligence:**

We know that weather and soil characteristics are not the same for all places. As a result, we have thought of implementing artificial intelligence to adapt our products to the surrounding atmosphere.

3) Time scheduling:

I can add clocks to set the time. So that I can control the module when I feel that I need to water the soil. So, the module automatically starts watering the soil at a fixed time and stops giving water at a fixed time.

4) Weather predictor:

By adding a weather predictors system which can automatically collect information about how much time we should put water in plants.

VIII. CONCLUSION

The goal of this project is to use the maximum benefits of water without wasting it in the agricultural field. In this system I've used a moisture sensor which will measure the moisture of soil and measure the temperature in weather by using an Arduino microcontroller. Then it decides whether the plants need water or not. On this basis the system turned off or on the water supplier. The whole process completes without the help of humans. Long ago farmers had to check the soil's moisture and predict whether crops needed water or not. But with this system farmers can monitor the moisture without wasting time. This system also turns off the water supplier when it needs to stop so there is no wastage of water. In this project, there is also a huge chance in the structure for future expansion. It allows everyone to make use of standard and valuable frameworks in their respective field [3], [4].

REFERENCES

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CODE:

```
#include<LiquidCrystal.h>
LiquidCrystal  lcd(5,6,8,9,10,11);
// RS,E,D4,D5,D6,D7

int SensorPin = A0;
int tempSensorPin = A1;
int relay = 7;
int ledLight = 3;
int sound = 4;
float temp;

void setup() {
  pinMode(relay, OUTPUT);
  digitalWrite(relay, LOW);

  pinMode(sound, OUTPUT);
  digitalWrite(sound, LOW);

  pinMode(ledLight, OUTPUT);
  digitalWrite(ledLight, LOW);
  lcd.begin(20,4);
}

void loop() {
  int SensorValue = analogRead(SensorPin);
  SensorValue = map(SensorValue, 1019, 19,
0, 100);
float temp = analogRead(tempSensorPin);
temp = temp*5000/(1024*10);

lcd.setCursor(0,0);
lcd.print("--SMART IRRIGATION--");
lcd.setCursor(0,1);
lcd.print("MOISTURE LEVEL:");
lcd.setCursor(0,2);
lcd.print("TEMPERATURE: ");
lcd.setCursor(2,3);
lcd.print("PAMP: ");

if(SensorValue >= 77)
{
   lcd.setCursor(16, 1);
   lcd.print(SensorValue);
   lcd.print("%");
   lcd.setCursor(13, 2);
   lcd.print(temp);
   lcd.print(" C");
   lcd.setCursor(10, 3);
   lcd.print("OFF");

   digitalWrite(relay, LOW);
   digitalWrite(ledLight, LOW);
   digitalWrite(sound, LOW);
}

  else if(SensorValue < 77 && temp < 35)
  {
```

```
  lcd.setCursor(16, 1);
  lcd.print(SensorValue);
  lcd.print("%");
  lcd.setCursor(13, 2);
  lcd.print(temp);
  lcd.print(" C");
  lcd.setCursor(10, 3);
  lcd.print("ON");

  digitalWrite(relay, HIGH);
  digitalWrite(ledLight, HIGH);
  digitalWrite(sound, LOW);
 }

 else if(temp >= 35 && SensorValue < 77 )
 {
  lcd.setCursor(16, 1);
  lcd.print(SensorValue);
  lcd.print("%");
  lcd.setCursor(13, 2);
  lcd.print(temp);
  lcd.print(" C");
  lcd.setCursor(10, 3);
  lcd.print("OFF");

  digitalWrite(relay, LOW);
  digitalWrite(ledLight, LOW);
  digitalWrite(sound, HIGH);
 }
delay(5000);
  lcd.clear();
}
```