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Automatic Irrigation System Based On Volumetric Soil Moisture Content Detection

Anirudh Itagi
Vellore Institute of Technology, VIT University, Vellore
anirudhitagi3@gmail.com

Nidhish Meherotra
Vellore Institute of Technology, VIT University, Vellore
nidhish.mehrotra2015@vit.ac.in

Utkarsh Shukla
Vellore Institute of Technology, VIT University, Vellore
utthu97@gmail.com

Dipak Singh
Vellore Institute of Technology, VIT University, Vellore
dipak.singh2015@vit.ac.in

Prof. Deepika Rani Sona
Vellore Institute of Technology, VIT University, Vellore
deepika.rs@vit.ac.in

Abstract: ***In the field of agriculture, use of the proper method of irrigation is crucial. To have it dpne with reduced human intervention and still ensure proper irrigation is a challenge. We have developed an automatic irrigation system which switches the pump motor ON/OFF on sensing the moisture content of the soil.***
The soil Moisture Sensor module is used to detect the moisture of soil and infer to the volumetric presence of moisture present in the soil and if there is water on the sensor. We would use this module and insert it into the soil and then adjust the on-board potentiometer to modify the sensitivity. The sensor would give us the output logic HIGH when the moisture is higher and LOW when it is lower than the threshold value set by the potentiometer. The Soil Moisture sensor measure the volumetric water content in the soil, indirectly by using some other property of the soil, such as electrical resistance, dielectric constant or interaction with neutrons, as a substitute for the moisture content.
We will preferably design soil moisture sensor using Arduino. An Arduino code will be used which will read the amount of moisture present in the soil and accordingly send information from the moisture sensor to the phone via the GSM module.

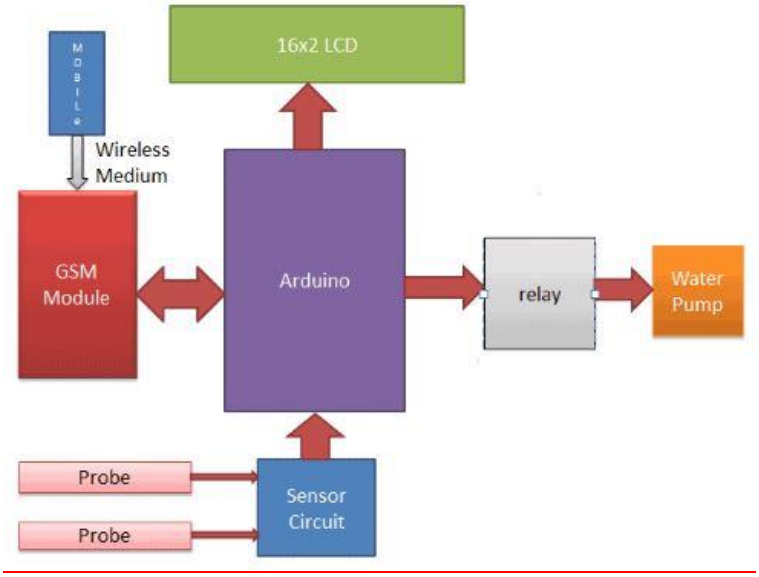
Keywords: Moisture, Irrigation, Arduino, Sensor, GSM Module.

INTRODUCTION

Constantly increasing demand of food requires the control in the quality of crops. We need a concrete and precise way for our country, India, where most of our economy is majorly based on irrigation. Due to isotropic climatic conditions in most parts of the country, we have difficulty in adjusting available soil moisture levels, due to which we are not able to fully utilize our agricultural resources. The main reason for this is the lack of rainfall and deficiency of land during crop production. Now crop growth requires a supply of water. The problem is, for the sake of crop production, enough water is being wasted, due to which the groundwater level is decreasing. Though the farmers are adopting new modern techniques like drip irrigation, a method which sprinkles the plants without much wastage of water. But still, someone has to monitor the pump motor so that there is no unnecessary wastage of water. Now, Soil Moisture is a quantity which is difficult to define because it carries different meanings in different disciplines. For instance, a farmer's concept of soil moisture differs from that of a weather forecaster. Generally, Soil Moisture is the water that is present between the spaces of the soil particles. Now, why is measuring soil moisture important? Comparing it with other elements of the water cycle, the volume of soil moisture is small. It is a key variable in monitoring the exchange of heat energy and water between the surface of land and the atmosphere through plant transpiration and evaporation. It also plays a key role in the production of precipitation and the development of weather patterns. It also has an impact on the quantity of precipitation that runs off into nearby rivers and streams.

So, the aim of our project is to design an automatic irrigation system, which measures the soil moisture content in percentage and gives an indication to the farmer in case the moisture content is low and the crop needs to be watered. If the moisture content falls below a certain level, the motor for the irrigation system is switched on with a relay. This reduces the burden of the farmers and maintains the quality of crops. [1]

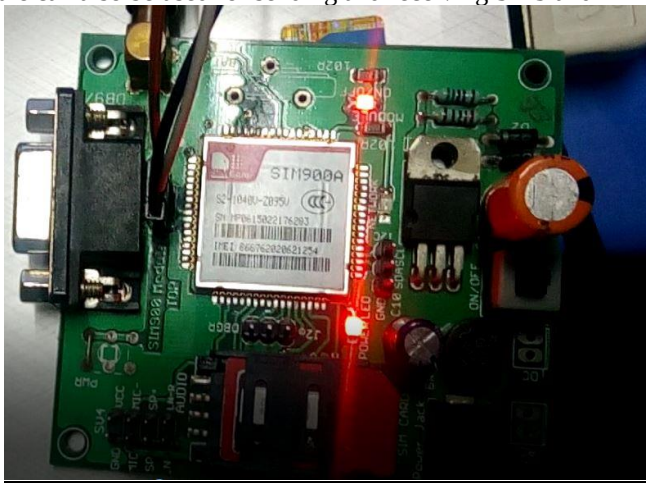
GSM Based Irrigation System



Global System for Mobile communication (GSM) is one of the most trustable wireless communication systems that can be accessed and used very easily. The price of its trans-receiver module and subscription fee of its services is very low, so it is very cost effective also. This project proposes an innovative GSM based automatic irrigation system. The interface and communication between the user and the designed system are via SMS or GSM network if the user is within a specific range of the designed system.[1]

Brief Description of Main Components Used

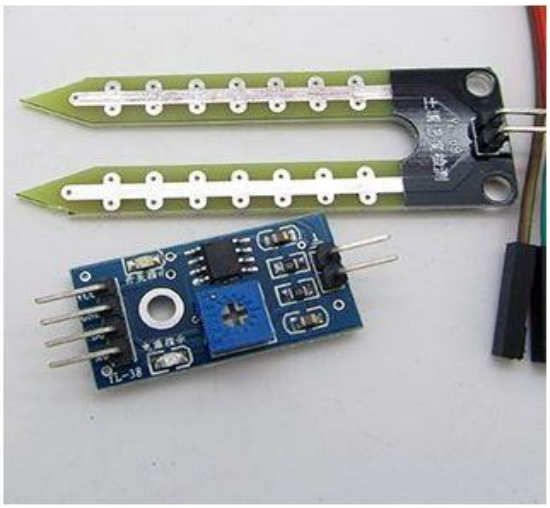
- GSM Module: It is of module which accepts a SIM card and operates over a subscription of the mobile operator. When it is connected to the controller or processor, it allows the computer to use the GSM module in order to communicate over the mobile network. This module can also be used for sending and receiving SMS and MMS messages. [2]



- Arduino: The Arduino Uno is an open-source, electronics prototyping platform, designed so that the process of using electronics in multidisciplinary subjects is simpler and more accessible to the general public at large. The hardware consists of a simple open hardware design for the Arduino board of a standard programming language based on Arduino IDE and the boot loader that runs on the board. Arduino can sense the environment by receiving input from a variety of sensors to its GPIO (General Purpose Input/Output pins) and can affect its surroundings by controlling lights, motors, and other actuators.[3]

- Relay (12 V): A relay is an electrically operated switch. Relays employ electromagnetic induction to operate a switching mechanism mechanically. Relays are used where it is necessary to isolate and control a high power circuit by a low-power signal (with complete electrical isolation between controlled circuit and controls), or where several circuits can be controlled by one signal. Relays were used extensively in telephone exchanges and early computers to perform logical operations; in modern electronic power systems, the functions are performed by digital instruments still called "Protective relays."

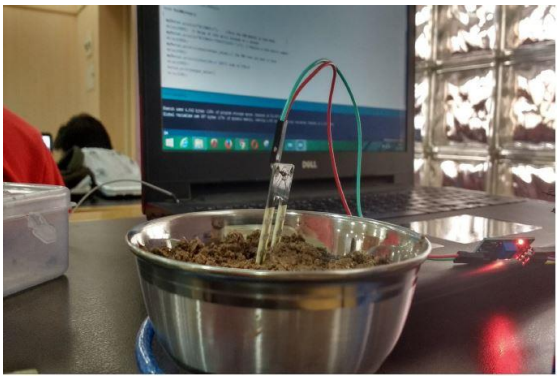
- Soil Moisture Sensor:
  Soil moisture sensors measure the volumetric water content in the soil. Since the direct, gravimetric measurement of free soil moisture requires removing, drying and weighing of a sample, soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content. The relation between the measured property and soil moisture must be calibrated and may vary depending on the environmental factors such as soil type, temperature or electric conductivity.[4][5]



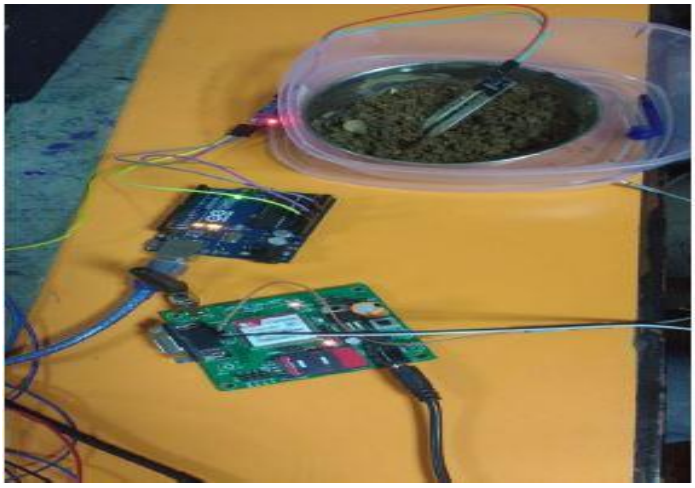
METHODOLOGY

- Working on our Model

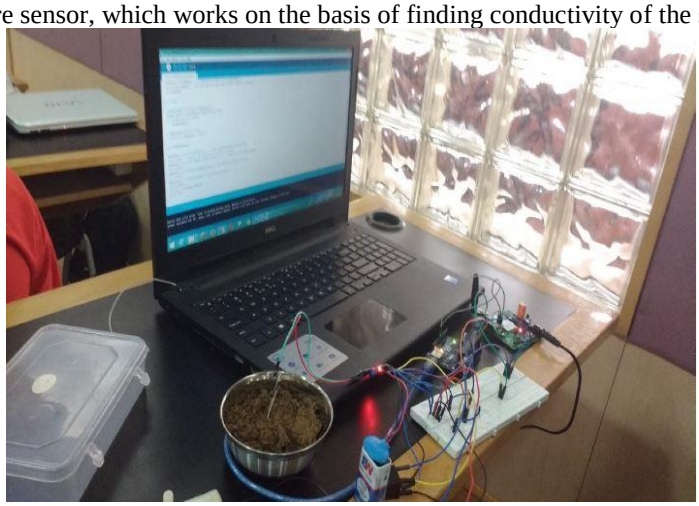
Now, the idea of our project is to implement an automatic irrigation system by sensing the moisture of the soil. The working of the circuit is as follows:



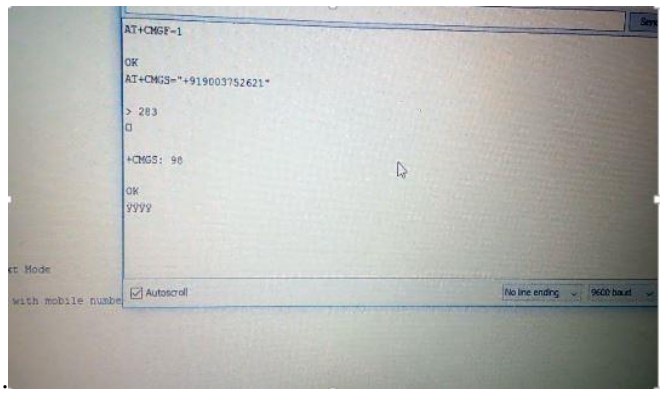
The soil moisture sensor is inserted into the soil. Depending on the quality of the sensor, it must be inserted near the roots of the plant as per the real life application. The soil moisture sensor processes the conductivity of the soil and accordingly generates an output directly proportional to the conductivity of the soil. Thus, wet soil will be more conductive than dry soil. The soil moisture sensor has a comparator in it.
We would use the Soil Moisture Sensor Module and then adjust the on-board potentiometer to modify its sensitivity.
The sensor would give us the output logic HIGH when the moisture is higher and LOW when it is lower than the threshold value set by the potentiometer. The soil moisture sensor measures the volumetric water content in the soil, indirectly by using some other property of the soil such as electrical resistance, dielectric constant or interaction with the neutrons, as a substitute for the moisture content.

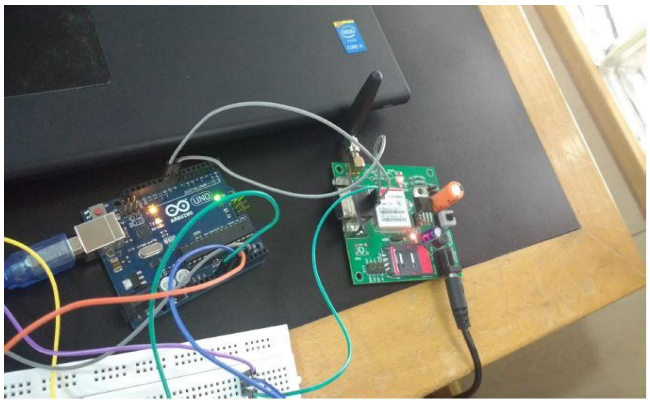


The soil moisture sensor was designed using Arduino. An Arduino code was used, which read the amount of moisture present in the soil and accordingly sent information to the moisture sensor.
Hence we use a soil moisture sensor, which works on the basis of finding conductivity of the soil.

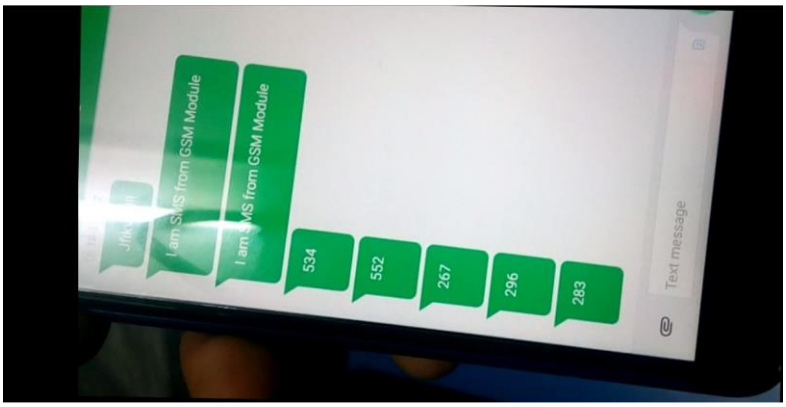


The values of conductivity are mapped on to the Arduino and it displays the moisture content on the laptop screen as a decoded value (Such as ASCII)





With the help of the GSM Module, the moisture content information will be sent to the registered mobile numbers. If the moisture content falls below a certain level, then the motor for the irrigation system is switched on with a Relay.



When the moisture of the soil reaches a threshold value, the output of the soil moisture sensor is LOW and the motor is turned OFF.
The system is also designed to warn when the moisture is very high than the threshold and the soil is too wet, which is dangerous for the plant. [3]

- Arduino Code

Code for the Soil Moisture Sensor:

```
int sensor_pin=A0;
int output_value;
void setup( )
{
Serial.begin(9600);
Serial.println("Reading from the Sensor…");
pinMode(13, OUTPUT);
pinMode(7, OUTPUT);
delay(2000);
```



```
}
void loop()
{
output_value=analogRead(sensor_pin);
output_value=map(output_value, 1023, 0, 0, 100);
Serial.print("Percentage Moisture Content :");
Serial.print(output_value);
Serial.println("%");
if(output_value<40)
{ digitalWrite(13, HIGH);
digitalWrite(7, HIGH);
delay(2000);
digitalWrite(13, LOW);
digitalWrite(7, LOW);
}
delay(5000);
}
```

Code for the GSM Module:

```
#include<SoftwareSerial.h>
SoftwareSerial mySerial(9,10);
int sensor_pin=A0;
int output_value;
void setup()
{
mySerial.begin(9600); // Setting the baud rate of GSM module
Serial.begin(9600); //Setting the baud rate of Serial Monitor(Arduino)
delay(1000);
}
void loop()
{
output_value=analogRead(sensor_pin);
output_value=map(output_value, 550, 0, 0, 100):
Serial.print(output_value);
if(Serial.available()>0)
{
Serial.read();
{
SendMessage();
}}
if (mySerial.available( )>0 )
Serial.write(mySerial.read( ) );
}
void SendMessage()
{
mySerial.println("AT+CMGF=1"); //Sets the GSM Module in Text Mode
delay(1000); //Delay of 1000 milliseconds or 1 second
mySerial.println("AT+CMGS=\"+918309169624\ "\r"); //Replace x with mobile no.
delay(1000);
mySerial.println(output_value); //The SMS text you want to send
delay(1000);
mySerial.println((char)26); //ASCII Code of CTRL+Z
delay(1000);
}
```

CONCLUSION

There is a significant need for a system that makes the agricultural process easier and burden free from the farmer's side. With the recent advancement of technology and an unending increase in population and need to support this population, it has become necessary to increase the annual crop production output of our country India, an entirely agro-centric economy. The ability to boost the production of the crops and conserve the natural resources is the main aims of incorporating such technology into the agricultural domain of the country. To save farmer's effort, water and time have been the most important consideration as well as making it user-friendly.

These systems were all remotely controlled systems which proposed a low-cost real-time information exchange via SMS and GSM network with reasonable speed. The soil moisture, humidity and various other environmental factors influencing the growth of crops are periodically sensed using the accurate sensor and those values are passed on to the controller to calculate the required amount of water and fertilizers and various other inputs during irrigation and accordingly supplied to the farmland. The result of various surveys conducted has led to a very positive approach on the impact of GSM technology in farm irrigation methods and techniques. The approaches studied had various pros and cons in the time required for operations or complexity or feasibility and user interactions. With technology advancing every day, new techniques have been implemented for further minimizing the irrigation process like using the prebuilt mobile phone or standalone application software for conduction of the irrigation process.

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