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Recent Advancements in Irrigation System of Poly House Farming

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Abstract: Automatic plant irrigation system is created by assembling the electronic items like Arduino, GSM, transistors, receiver/ transmitters, sensors, etc. With the input of desired programme set by coding software. Arduino functions as a master brain of the system as it is capable of interpreting the programmes and data fed. Moisture sensors/ rain sensors sense the moisture content of the field and rain if any, the data is sent to Arduino via transmitters/receiver which intern analyse the data and switch on/off the motor based on the dryness/ wetness of the field. Our system is capable of sending SMS to user's mobile phones if field remains dry and if pumps isn't working. The system is also designed such a way that even an illiterate farmer can recognise the status of field watering via light signal.

Keywords: AutomaticIrrigation system, Poly House Farming, Arduino.

1. Introduction

Irrigation is the process to provide reasonable amounts of water to plants and crops at fixed intervals or as per their requirement. Generally ‘irrigation’ term seems to be associated with mass cultivation of crops where watering is done with the help of irrigation channel, but actually, all plants and crops smaller or large scale cultivation requires water and the system to make water available is termed as irrigation. Irrigation plays a major role to grow horticultural crops, control landscapes and reforest degraded lands in bare regions and location with less average rainfall. Irrigation is helpful in many other ways which include crop production, protection from deforestation, cut off weed growth in grain fields, etc.

A routine task of watering the plants and crops is the most crucial cultural practice and the most back-breaking task. Irrespective of different weathers (hot, cold, dry or rainy) the right amount of water must reach the crops. So, it would be an active initiative to use **automatic plant watering system** which would provide water as and when required by the plants. However an essential condition of this project is: “when and how much to water”. To reduce human effort to water on agricultural land, a concept of automatic plant watering system is adopted.

An automatic irrigation system has overcome the manual effort in and around the station or field. Automation of the irrigation system became necessary based on the modern approach towards ease

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of doing work with higher efficiency. The entire irrigation system of drip, water sprinkler, and other parts get automated with the support of sensors and other mechanical and electronic appliances. This arrangement would help to observe the level of moisture and temperature of soil and accordingly decide upon the time and quantity of water required by the plants. This project is associated with several subsystems like power supply, Soil moisture sensor, relays, LCD, solenoid valve and Arduino GSM shield.

This system is designed and programmed in a manner that sensor keeps sensing moisture of soil at fixed intervals of period and sensor detect the moisture less than the stated value of different plants and crops. Whenever required water is supplied to them as per their need till it reaches to the defined value.

System reports the current status and send a message to water the plants and to add water to the tank. All the notifications are generated using Arduino GSM shield. The automation irrigation mechanism was intended to turn the switch of pumping motor ON and OFF automatically.

The benefit of applying such techniques is to decrease human interference and increase the efficiency of irrigation methods. It can be applied in different types of soil and it can be configured according to the type of irrigation it is being applied to.

To achieve this we have broken the system into two halves. One is the transmitter, which sends the soil moisture data to the receiver for further operation and another half is the receiver, which receives the transmitted data sent by the transmitter and controls the function of the pump. The transmitter consists of an 8-bit Atmega328p microcontroller which makes the control decisions in the transmission end. It is connected to a soil moisture sensor and a 433 MHz RF transmitter. The transmitter setup is placed in the field. When the soil moisture reaches the minimum threshold limit, the sensors send the data through the RF transmitter to the receiver.

The receiver also has an 8-bit Atmega328p microcontroller which is the main decision maker of the receiver block. The 433 RF receiver receives the data signals from the transmitter and feeds to the Arduino Nano board. The Arduino Nano board is further connected to a GSM SIM900 board through UART communication protocol. The Arduino board is also connected to rain sensor, water level sensor and a dc pump. When the receiver receives the transmitted data and the moisture level of the soil is below the threshold limit, the level is checked. If there is enough water in the tank and soil moisture content is low then the water pump automatically operates. If in case there is some error and the water pump does not operate when its operation is initiated or the water sensors does not sense any flow of water after 30 seconds from the pump, the user gets a message of the error. The user also gets the message for rain and water level of the tank.

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A LCD display is employed to display the various messages, warnings and data for different functions and operations. A LED light based indicating is system is also employed in the system for differently abled persons or for individuals who is unable to understand the displayed messages. It is a simple indicating system with green and red LED light which glows to indicate the programmed status of the system accordingly.

The objective is to analyse the moisture in the soil around the crops/plants using moisture sensor. The Pumps for watering will be controlled using microcontrollers and other electronic accessories with programmed data based on the moisture contents of the soil and the status of the pump's 'ON/OFF' and functioning will be sent to the field owner via SMS or light signals using GSM/Wi-Fi.

The automatic irrigation system is simple, efficient and much economical set. While the reliability of this system depends on many factors like geographical conditions of the field, attitudes of the end users, etc.This idea can be improved and can be made more reliable future. This system can be used effectively for irrigation purposes of cultivating of crops, vegetables, flowers, plants, etc. The system does not have any adverse disadvantages for soil and crops but has numerous advantages were saving time and labour cost being the major advantages.

2. Background

Every project has a story, it makes the project have a purpose and brings in an attachment. In the mountainous region of the Northeast the farms near the river (Proximity to water) and houses are mostly somewhere on hilltops far from the farm. The income of debt borne farmers is solely dependent on their harvest and they do not have the time to have a passive source of income or even sell their harvest themselves and they have to sell their harvest cheaply to businessmen.

Farmers wake up early 4-5 am and move towards their farm to monitor the watering, crops since it generally takes 1 hour to reach the farm and even they have responsibility to take care of their livestock. Sometimes to their agony, they would have wasted their time when they reach the farm and realize that everything is fine on the farm. Sometimes the opposite happens when the canal drowns the field up.

Through our project, we want to empower the farmers by making their lives a bit easier. The farmers would receive messages on every activity on the field and receive a call if the activity is severe. They would get an idea of when to go to the farm and when not. At least, if we help them by saving 4-5 hours of their day it will be a lot to those farmers who could even start a shop or their own grocery or vegetable store so that they are self-sustained.

The automatic irrigation system works on the principle of LoRa, which stands for Long Range digital wireless data communication technology. LoRa is a long-range wireless communication

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protocol which is used in our system to perform wireless communication between the transmitter and the receiver. The automatic irrigation system is unlike other irrigation systems as it is a wireless model and it does not require a wired connection between the transmitter and receiver modules. It is beneficial in the regions where the irrigated land is far away from the residential area and where it is difficult to setup a wired connection. It is a common problem in hilly areas or other such difficult topography. It makes the irrigation process more convenient and introduces an easy setup process. An automated irrigation system is best suited were large areas are irrigated. As per the survey it has observed various automatic irrigation systems. This project also describes how this project differs from other systems.

The existing irrigating systems such as "Applied engineering in agriculture", "Data acquisition system and irrigation controller" and "Automation in Micro-Irrigation", it apply subsurface drip irrigation method. It adopted time-based systems with two drip tapes which holds irrigation time clock controllers. The time of complete process is calculated according to the quantity of water required and its average rate of flow. A timer handles the process of start and stop. It automatically set the watering process at regular intervals [1].

The papers "Feedback Control for Surface Irrigation Management" and "Control and Automation in Citrus Micro-irrigation Systems", apply open loop system in which the operator decide the timing for the event of irrigation. The controller is scheduled for supplying water to the fields. This system either use irrigation duration or a specified volume for control purpose. The clock is set to start the irrigation process. The irrigation process stops according to pre-set time or when a specified volume of water pass through a flow meter. The operator also control the amount of water supplied and the time for irrigation process to take place. The drawback of this system is failure to respond automatically to different weather conditions. Moreover, it depends upon periodic resetting to attain great level of performance [2], [3].

3. Methodology

The project on "Automatic Plant Irrigation System" is designed to construct an automated irrigation process which on detecting the moisture of soil turn the pumping motor switch to ON and OFF. In farming, the means of irrigation has an important role. The reduction in water level due to continuous eradication of water from earth lead a lot of land to come in the zones of non-irrigated land. The contribution to apply this approach is to decline individual intervention without disturbing proper irrigation. Here we are using soil moisture sensor which will detect the moisture of soil, rain sensor which will sense the rain and according to that it will ON or OFF the pump, if moisture sensor send the less amount of moisture in soil then it will give command to

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ON the motor and we will also receive the message regarding that on our mobile phone, if any type of error comes in pump and pump doesn't work then also we will receive a message on our mobile phone that our pump is not working.

3.1 Components

There are many components used in this project and we are going to explain basic and required one.

Arduino Nano

Arduino consists of both hardware programmed circuit (a microcontroller) and software (integrated development environment) which executes on a computer and code can be uploaded on physical board. It works or uses the simplified version of c++ which is easier for a programmer to understand and to write down and it provides the function of the microcontroller in the more sufficient way.

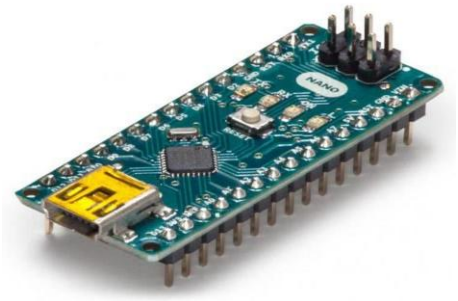
Working Principle behindArduino

It's hardware and software was designed for the hacker's artist and for someone who is interested to interact with the environment or with objects, Arduino interacts with everything such as buttons smartphone internet tv camera and much more.it acts as the microcontroller to allsystem which receives the command in the form of code form the user and converts it into binary and gives those commands the system [4].

Arduino Nano

Arduino Nano is cast in a manner that it became easy to understand and easy for beginners to start with a microcontroller, it is especially a breadboard which is very easy to handle the connection.usally the microcontroller used in Arduino Nano is Atmega328 which is same used in the Arduino UNO.

A Nano board consist of 14 digital pins along with 8 analog pins. These digital pins are used as interface for sensors which are used as input or output pins, it operates at a voltage of 0V and 5Vfor digital analogue pins respectively.



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Vol-22-Issue-17-September-2019

Figure 1:Arduino Nano

Table 1: Specifications of Arduino Nano

Microcontroller	ATmega328P (8bits AVR family)
Operating Voltage	5V
Recommended Input Voltage for Vin pin	7-12V
Analogue Input pins	6(A0-A5)
Digital IO pins	14(6 provide PWM output)
DC current on IO pins	40mA
DC current on 3.3V pin	50mA
Flash memory	32KB(2KB for boot loader)
SRAM	2KB
EEPROM	1KB
Frequency (clock speed)	16MHz
Communication	IIC, SPI, USART

Transmitter module and Receiver module

A transmitter module is a compact PCB sub assembly. It has capability to transmita radio wave and modulate that wave to transfer data. It is equipped on a microcontroller to provide data to the module for transmission. The functions of the transmitter are to generate an RF carrier wave, to amplify the carrier wave, to amplify the modulated signal, to couple the modulated signal to an antenna and to radiate the signal into the atmosphere. A receiver module receives the modulated RF signal and further demodulates it.

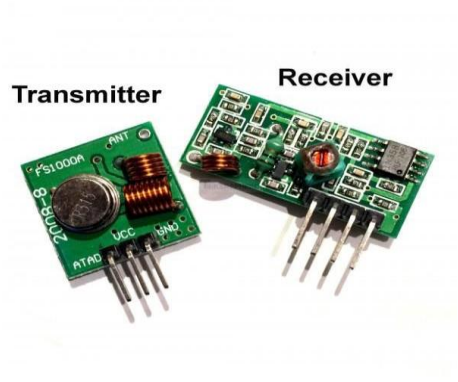

Figure 2: Transmitter and Receiver

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Vol-22-Issue-17-September-2019

Water level sensors

Water level meter use sensor probes to marklevel of water in a water storage tank. They send signal to set off an alarm in the control panel. This apparatus is arranged to check the level of tank so that liquids and granular materials do not overflow.

Rain Sensor

It is a tool for detecting rain. It is used forthe degree of rainfall. The module features are designed in a way that rain and control boardsare placed separate for convenience. It is mounted with power indicators i.e. LED a potentiometer to adjust sensitivity. The analogsignals are used to detect the amount of rain drops. It is further connectedwith 5V power supply. The LED will be turned on whenthere is no rain drops on induction board. DO output will be high.However, when it rains DO output become less and the switch of indicators will get turned on. The device which sense the rain drops and respond accordingly is a rain sensor. During rainfall it turnoff the irrigation system. It alsocontains expansion disks for absorbing water, which get enlarged during rainfall. The electrical switches get depressed after incorporating adequate amount of rain drops. Due to which the regular irrigation starts working however automatic irrigation system get turned off. The expanded disks again get shrink when dry conditions occur.

Soil Moisture Sensor

IT is used to calculate the volumetric water constituents in the soil. It is basically used to perform certain experiments related to soil science, environmental science, horticulture and biology. It uses capacitance for measuring water quantity in soil. This rugged sensor is inserted into the soil to perform test regarding presence of moisture in soil.

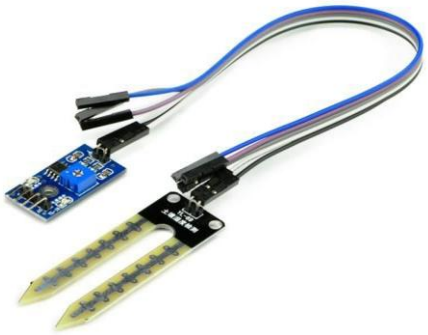

Figure 3: Moisture Sensor

GSM SIM 900 Module

The GSM SIM-900 Module is a low power consumption device which generate GSM/GPRS/850/900/1800/1900MHZ voice, SMS, Data and fax. It is a perfect quad-band

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Vol-22-Issue-17-September-2019

GSM/GPRS key in a SMT module which are generally fixed in software application.It is capable to access the internet as well as for oral communication. It as a slim and compact design so as to fit easily inside mobile phones. From inside it is handled by AMR926EJ-S processor, which handles data communication. A/D converter, SPI bus, a PWM, RTC, andI^2C, are modules attached with it.

Figure 4:GSM SIM 900 Module

Direct Current Pump

This device is to move fluids. The mechanical action is applied on pump to displace the volume 12V DC power is supplied.It can be run by using direct current (DC) from battery to move the fluid in different direction or according to our requirement.

Figure 5: DC Pump.

Transistor

The TIP-122 transistor is used because this transistor have good current collector capacity, and we can also switch between high current load easily which is required in our project.

LED

This is an equipmentmade up of silicon. When an electric current passby the LED, it radiate photons. The bulbs produce light when a metal filament is heated, until it get white hot. It has low power consumption, smaller size, easy operating and improved robustness.

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Working

In the project, you can see from the block diagram is broken into two halves.The Transmitter side and the receiver side.

Transmitter side: It consists of an 8-bit Atmega328p microcontroller which makes all the decisions. It is connected to a soil moisture sensor and a 433Mhz RF transmitter. This setup is placed in the field.

The soil moisture sensor gives analog value to 10-bit Analog input of Arduino. Arduino gets 0-1023 value for the moisture in the soil. If there is presence of moisture is detected the value Arduino reads is less and closer to Zero and if the soil is dry the value read by Arduino is closer to 1023.

We have set a threshold that if the value read by Arduino is greater than 50 then it will send the sensor data through the 433Mhz RF transmitter. The transmitter sends packets of data serial through a one wire interface.

Receiver Side: It has an 8-bit Atmega328p microcontroller which is the main decision maker of the Receiver block. The 433MhzRf receives the infodirected by transmitter and feeds it to the Arduinonano board. Arduino board is further connected to a GSM SIM900 board through UART communication Protocol. The Arduino board is also connected to a Rain Sensor, Water Level Sensor, Water sensor and a dc Pump.

When the Soil moisture value is less the receiver gets the message from the transmitter upon getting the message, the water level in the tank is checked. If there is enough water in the tank and soil moisture is low then the water pump automatically operates. If in case the water pump doesn't run. The water sensor starts itself and waits for 30 seconds for the pump to operate when the Watering state is called. If the water sensor further after 30 seconds also doesn't sense any out flowing water from the pump, the user gets message that the pump could be damaged. Also the user gets the message for rain, water level low of the tank.

There is also message displayed on the LCD for every activity. If the Pump is working fine then a Green Led glows and if it is not g then a Red LED glows.

Figure 6 and 7 shows the block diagram of the working of the project.

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Vol-22-Issue-17-September-2019

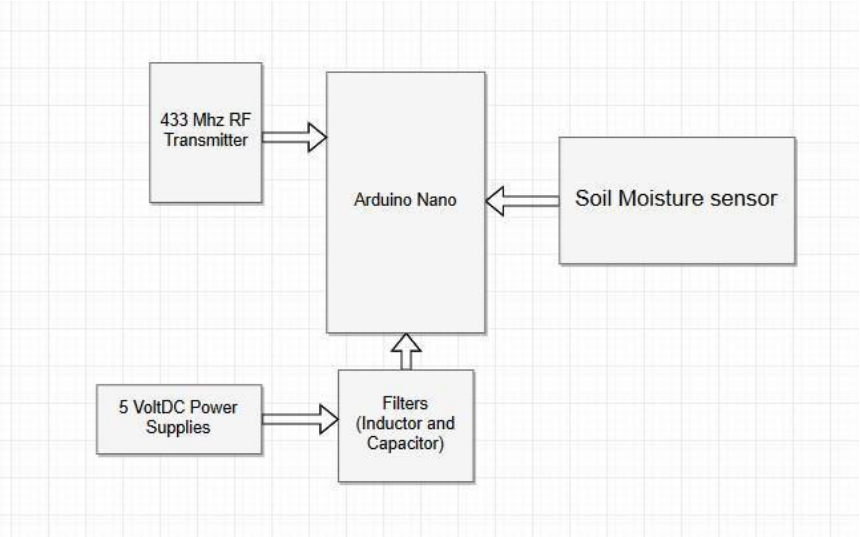

Figure 6: Transmitter Side:

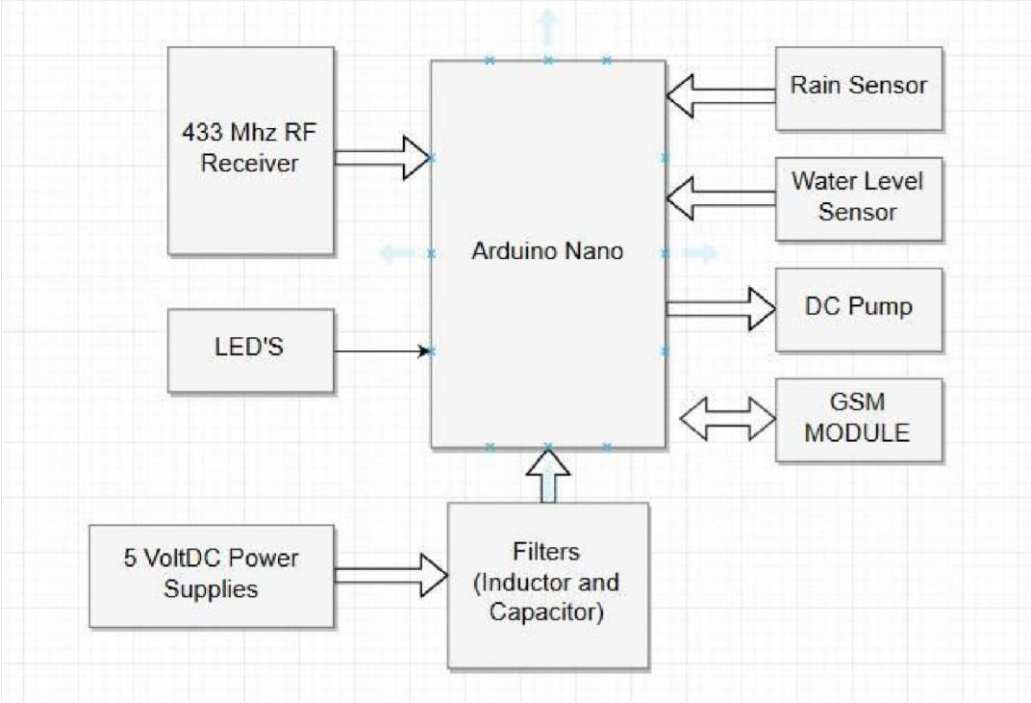

Figure 7: Receiver Side.

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Vol-22-Issue-17-September-2019

Coding
Reciver end

```
#include<SPI.h>
#include<SoftwareSerial.h>
#include<LiquidCrystal.h>
SoftwareSerialmySerial(18,17);//A3,A4 constintrs = 4, en = 5, d4 = 6, d5 = 7, d6 = 8, d7 = 9; LiquidCrystallcd(rs, en, d4, d5, d6, d7); uint8_tbuf[3]; uint8_tbuflen = sizeof(buf);
#definewaterSensePin A0
#definetankLevelPin A1
#definerainPin A2
#definemotorPin A5
#definerainThreshold30
#definestateReset0
#definestateSoil1
#definestateRain2
#definestateWatering3 int
S1=stateReset; RH_ASK rf_driver;
voidsetup()
{
rf_driver.init(); lcd.begin(16, 2);
mySerial.begin(9600);
Serial.begin(9600);
lcd.setCursor(0, 1);
}
Voidloop()
{
int rain=analogRead(rainPin);
rain=map(rain,0,1023,0,100); constrain(rain,0,100);
switch(S1)
{
casestateReset:
if (rf_driver.recv(buf, &buflen))
{
messageSoil();
S1=stateWatering; }
if(rain<rainThreshold)
{
S1=stateRain;
}
break; casestateRain: lcd.clear();
lcd.setCursor(0,1); delay(100);
lcd.print("Rain"); messageRain();
delay(1000); S1=stateReset;
break; casestateWatering:
lcd.clear(); lcd.setCursor(0,1);
digitalWrite(motorPin,HIGH);
```


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Vol-22-Issue-17-September-2019

```
        delay(2000);
        if(analogRead(waterSensePin)>5)
    if(analogRead(tankLevelPin)>10)
        {
    motorSick();
        }
        else
            {
        tankEmpty();
     }      }
        lcd.print("Waterng");
        delay(10000);
            S1=stateReset;
        break;
        }
        }
        VoidmessageRain()
          {
mySerial.println("AT+CMGF=1");    //To set GSM in Text Mode
        Serial.println("AT+CMGF=1");    // To set GSM in Text Mode
        delay(1000);  //1 second delay
    Serial.println("AT+CMGS=\"+919876543210\"\r");
        mySerial.println("AT+CMGS=\"+919876543210\"\r");          delay(1000);
    mySerial.println("Hello its Raining");// SMS text
        Serial.println("hello");// SMS text
        delay(100);
        mySerial.println((char)26);// ASCII code for CTRL+Z
    delay(1000);
      }
    VoidmotorSick()
      {
    mySerial.println("AT+CMGF=1");        //To set GSM in Text Mode
        Serial.println("AT+CMGF=1");    // To set GSM in Text Mode    delay(1000);
    // 1 second delay
    Serial.println("AT+CMGS=\"+919876543210\"\r");
        mySerial.println("AT+CMGS=\"+919876543210\"\r");
    delay(1000);
        mySerial.println("Hello maybe the motor is sick");// SMS text
        Serial.println("hello");// SMS text
        delay(100);
        mySerial.println((char)26);// ASCII code of CTRL+Z
delay(1000);        }
voidtankEmpty()             {
mySerial.println("AT+CMGF=1");            // To set GSM in Text Mode
        Serial.println("AT+CMGF=1");    // To set GSM in Text Mode    delay(1000);
// 1 second delay
    Serial.println("AT+CMGS=\"+919876543210\"\r");
    mySerial.println("AT+CMGS=\"+919876543210\"\r"); // (1000);
```


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Vol-22-Issue-17-September-2019

```
    mySerial.println("No water in Tank");// SMS text
    Serial.println("hello");// SMS text
        delay(100);
        mySerial.println((char)26);// ASCII code of CTRL+Z
delay(1000);        }
voidmessageSoil()           {
mySerial.println("AT+CMGF=1");            // To set GSM in Text Mode
        Serial.println("AT+CMGF=1");   // To set GSM in Text Mode   delay(1000);
// 1 second delay
    Serial.println("AT+CMGS=\"+919876543210\"\r"); // Replace x with mobile
    number
        mySerial.println("AT+CMGS=\"+91 919876543210\"\r"); //
    Replace x with mobile number            delay(1000);
mySerial.println("Time to water");// SMS text
        Serial.println("hello");// SMS text
        delay(100);
        mySerial.println((char)26);// ASCII code of CTRL+Z
delay(1000);        }
        voidcall()
          {
        Serial.println("Call via GSM Modem");       mySerial.begin(9600);//setting
of baudrate
    delay(1000);
    mySerial.println("ATD6297357195;");
    UART protocol;
        Serial.println("Call ATD6297357195");
delay(1000);
          }
```

Transmitter

```
        #include<RH_ASK.h>
        #include<stdlib.h>
        #include<SPI.h>   RH_ASK
        rf_driver;
                charsoilValue[20];
                #definesoil        A0
                intsoilRead;
                voidsetup()
        {
        // Initialize ASK Object      rf_driver.init();
        }
        voidloop()
        {
soilRead=analogRead(soil);
        soilRead=map(soilRead,0,1023,0,100);
        constrain(soilRead,0,90);
        itoa(soilRead,soilValue,10);          if(soilRead>40)
          {
```


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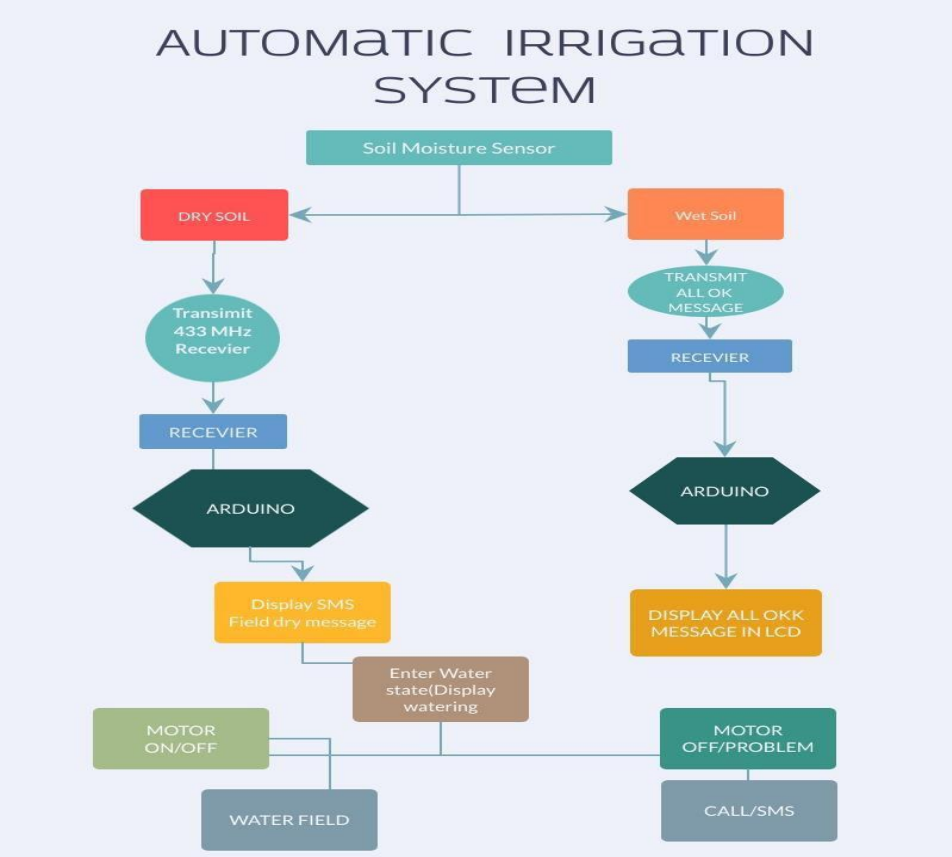
Vol-22-Issue-17-September-2019

```
rf_driver.send((uint8_t *)soilValue, strlen(soilValue));
        rf_driver.waitPacketSent();
        delay(1000);
          }
        }
```

Figure 8 shows theFlowchart of the actual working of the system which is closed loop process. This process will give the feedback of the system to the owner if there is any failure.

Figure 8: Flowchart of the process.



Conclusion

This System has several advantages. Itrequire less manpower. It release water when the humidity level reach to specify condition.It also lead to water conservation because of direct water transfer to roots and also maintains moisture in the soil. Therefore it is very efficient

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and appropriate according to change in weather and climate. The use of advanced technology and motor sensors made it possible to construct an automatic irrigation system. The features can be updated further using new technologies.

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