**MAULANA AZAD NATIONAL INSTITUTE OF TECHNOLOGY**

**BHOPAL**



**DEPARTMENT OF COMPUTER SCIENCE AND**

**ENGINEERING**

**PROJECT ON**

## SMART AGRICULTURE SYSTEM

## BASED ON IOT

SUBMITTED IN PARTIAL FULFILLMENT FOR THE DEGREE OF BACHELOR OF TECHNOLOGY

**SUBMITTED BY: UNDER THE GUIDANCE OF:**

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This is to certify that Omprakash kushwah, **Shubhanshu Prajapati, Ruchita Gupta** and **Shati Biswas** students of B.Tech 4rd Year (Computer Science & Engineering)have successfully completed their project “**SMART AGRICULTURE SYSTEM BASED ON IOT**” in partial fulfillment of their major project in Computer Science & Engineering.

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**DECLARATION**

We, hereby, declare that the following report which is being presented in the Major Project Documentation entitled “SMART AGRICULTURE SYSTEM BASED ON IOT” is the partial fulfillment of the requirements of the fourth year (8th semester) Major Project in the field of Computer Science and Engineering. It is an authentic documentation of our own original work carried out under the able guidance of Dr Dhirendra Pratap Singh. The work has been carried out entirely at Maulana Azad National Institute of Technology, Bhopal. The following project and its report, in part or whole, has not been presented or submitted by us for any purpose in any other institute or organization.

We, hereby, declare that the facts mentioned above are true to the best of our knowledge. In case of any unlikely discrepancy that may possibly occur, we will be the ones to take responsibility.

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**ABSTRACT**

Agriculture sector is evolving with the advent of the information and communication technology. Efforts are being made to enhance the productivity and reduce losses by using the state of the art technology and equipment. As most of the farmers are unaware of the technology and latest practices, many expert systems have been developed in the world to facilitate the farmers.

Use of technology in different areas to get numerous benefits is itself a valuable research. Use of Sensor network in the area of agriculture is not new. But due to the different weather, soil, water and land conditions, diverse models, methods of analysis and solutions are needed on which different communities of researchers are working and proposing several solutions.

In this project, we are using Internet of Things (IoT). It means that all the collected data will be sent to Microcontroller board which then sends that data to server. This monitoring can be done through any devices like Mobile, Tab, Laptops and PCs. The highlighting features of this project include smart irrigation with smart control and intelligent decision making based on accurate real time field data and this can be easily operated by the farmers too.

**INTRODUCTION AND LITERATURE SURVEY**

**2.1 INTRODUCTION**

Internet of Things (IoT) is a broad term that describes the interconnection of different daily life objects through the internet. In the concept of IoT every object is connected with each other through a unique identifier so that it can transfer data over the network without a human to the human interaction. IoT has referred as a network of everyday objects having ubiquitous computing. The ubiquity of the objects has increased by integrating every object with embedded system for interaction. It connects human and devices through a highly distributed network. The aim of IoT is to connect every person and every object through the internet. In IoT, every object is accessible through the internet. Every object in the IoT has the following three capabilities: awareness, representation, and interaction.

This is the project from the motivation of the farmers working in the farm lands and who are solely dependent on the rains and bore wells for irrigation of their land. In recent times, the farmers have been using irrigation technique through the manual control in which the farmers irrigate the land at regular intervals by turning the water-pump ON/OFF when required. They may have to travel so far for SWITCHING ON/OFF the motor. They may be suffering from hot Sun, rain and night time too. After reaching their farm, they may find that there is no power and hence, get quite disappointed with it.

**2.2 LITERATURE SURVEY**

* In irrigation field, soil moisture sensor, temperature sensors are placed in root of plant and microcontroller handles the sensor information and transmits data. One algorithm was developed to measure threshold values of temperature sensor and soil moisture sensor that was programmed into a microcontroller to control water quantity.
* A model of automatic irrigation system which is based on microcontroller and solar power was used only for source of power supply. Various sensor are placed in paddy field. Sensors sense water level continuously and give the information to farmer through cellular phone. Farmer controls the motor using cellular phone without going in field. If the water level reaches at danger level, automatically motor will be off without conformation of farmer.

**METHODOLOGY & WORK DESCRIPTION**

**3.1** **Internet of Things (IoT)**

The ‘**Internet of Things’** is the interconnection of uniquely identifiable embedded

computing devices within the existing Internet infrastructure.

The “Internet of Things” connects devices and vehicles using electronic sensors and the

Internet.

The IoT allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer based systems and resulting in improved efficiency, accuracy and economic benefit, when IoT is augmented with sensors and actuators, the technology becomes an instance of the more general class of cyber physical systems, which also encompasses technologies such as smart grids, smart homes, intelligent transportation and smart cities.

Each thing is uniquely identifiable through its embedded computing system but is able to interoperate within the existing Internet infrastructure.

So, Internet of Things or IoT is an architecture that comprises specialized hardware boards, Software systems, web APIs, protocols which together creates a seamless environment which allows smart embedded devices to be connected to internet such that sensory data can be accessed and control system can be triggered over internet.



Internet of Things (IoT) Basic Architecture

**3.2 IoT Platforms**

IoT development can be divided into two parallel technologies: Wearable and

Embedded. Developers can build apps for custom Wearable devices like Peeble, Samsung Gear or can often create their own platform using Embedded solution and then can develop app for that platform.

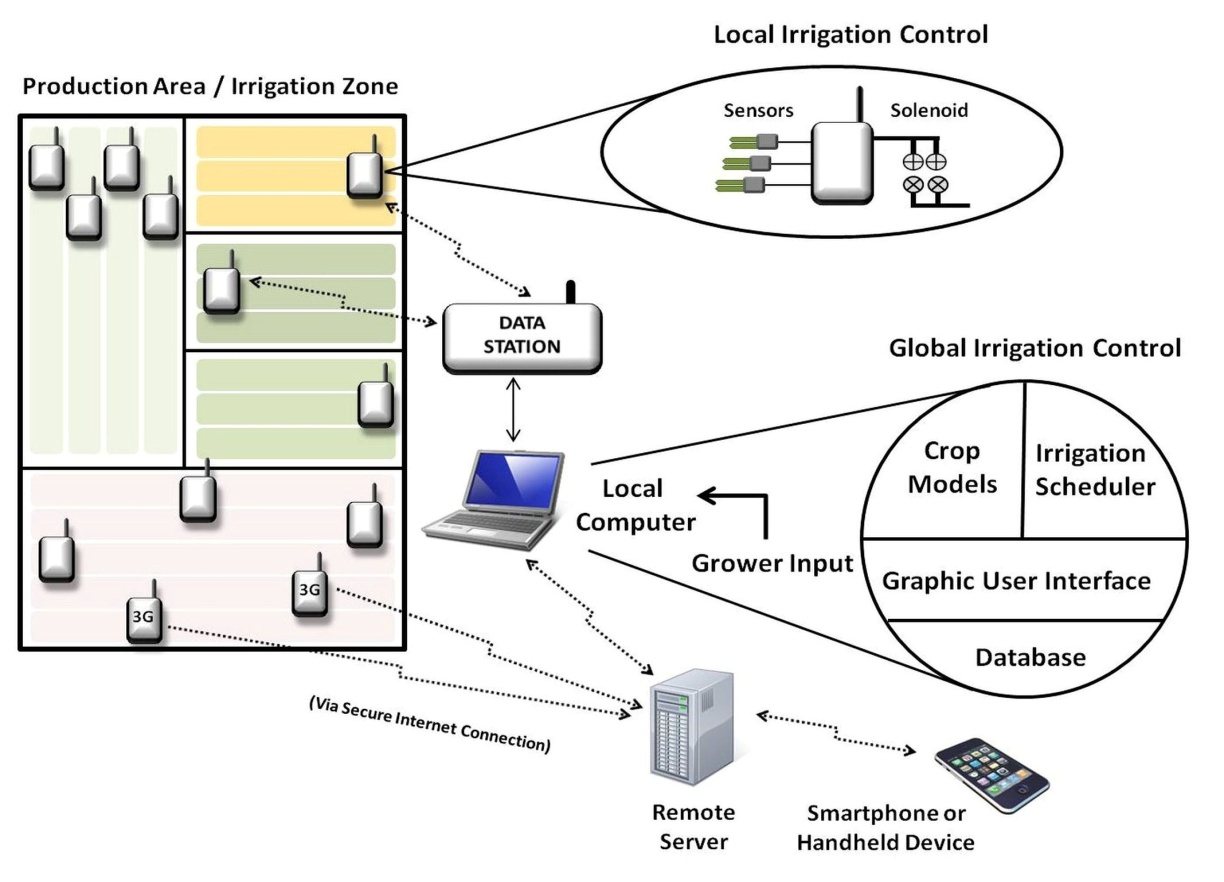
**3.3 Library used**

The SoftwareSerial library has been developed to allow serial communication on other digital pins of the Arduino, using software to replicate the functionality (hence the name "SoftwareSerial"). It is possible to have multiple software serial ports with speeds up to 115200 bps.

**3.4 Implementation using IoT**

The analysis can be done for the following parameters:

* IoT View
* Temperature analysis
* Soil Moisture level analysis
* Humidity level analysis
* Light Intensity level analysis



Graphical Representation of the Smart Agriculture System

**INTRODUCTION OF HARDWARES**

**4.1 Arduino**

Arduino is an open source physical computing platform based on simple input/output board and a development environment that implements the Processing language. Arduino can be used to develop standalone interactive objects or can be connected to software on your computer. This is the new Arduino Uno R3 made in Italy with box. In addition to all the features of the previous board, the Uno now uses an ATmega16U2 instead of the 8U2 found on the Uno (or the FTDI found on previous generations). This allows for faster transfer rates and more memory. No drivers needed for Linux or Mac (uno file for Windows is needed and included in the Arduino IDE), and the ability to have the Uno show up as a keyboard, mouse, joystick, etc. The Uno R3 also adds SDA and SCL pins next to the AREF. In addition, there are two new pins placed near the RESET pin. One is the IOREF that allow the shields to adapt to the voltage provided from the board. The other is a not connected and is reserved for future purposes. The Uno R3 works with all existing shields but can adapt to new shields which use these additional pins. The open-source IDE can be downloaded for free (currently for Mac OS X, Windows, and Linux).

**4.1.1 Introduction to Arduino Boards**

Arduino is an architecture that combines Atmel microcontroller family with standard

hardware into a board with inbuilt boot loader for plug and play embedded programming. Arduino Software comes with an IDE that helps writing, debugging and burning program into Arduino. The IDE also comes with a Serial Communication window through which can easily get the serial data from the board.



Arduino Uno

**4.1.2 Arduino Uno Technical Specifications**

|  |  |
| --- | --- |
| Microcontroller  Operating Voltage | AT mega 328 |
| Input Voltage (recommended) | 7-12 V |
| Input Voltage (limit) | 12 V |
| Digital I/O Pins | 14 |
| PWM Digital I/O Pins | 6 |
| Analog Input Pins | 6 |
| DC Current per I/O Pin | 2A |
| DC Current for 3.3V Pin | 2A |
| Flash Memory | 32 KB |
| Clock Speed | 16 MHz |
| Weight | 100 g |

**4.2 GSM Module**

A**GSM module is a chip or circuit that will be used to establish communication** between a mobile device or a computing machine and a **GSM system. GSM (Global System for Mobile Communications, originally Groupe Spécial Mobile)**, is a standard developed by the European Telecommunications Standards Institute (ETSI).

A GSM modem is a class of wireless modem, designed for communication over the GSM network. It requires a **SIM (Subscriber Identity Module)** card just like mobile phones to activate communication with the network.

**4.2.1 Functions of GSM**

With the help of GSM Module, we can do the following tasks:

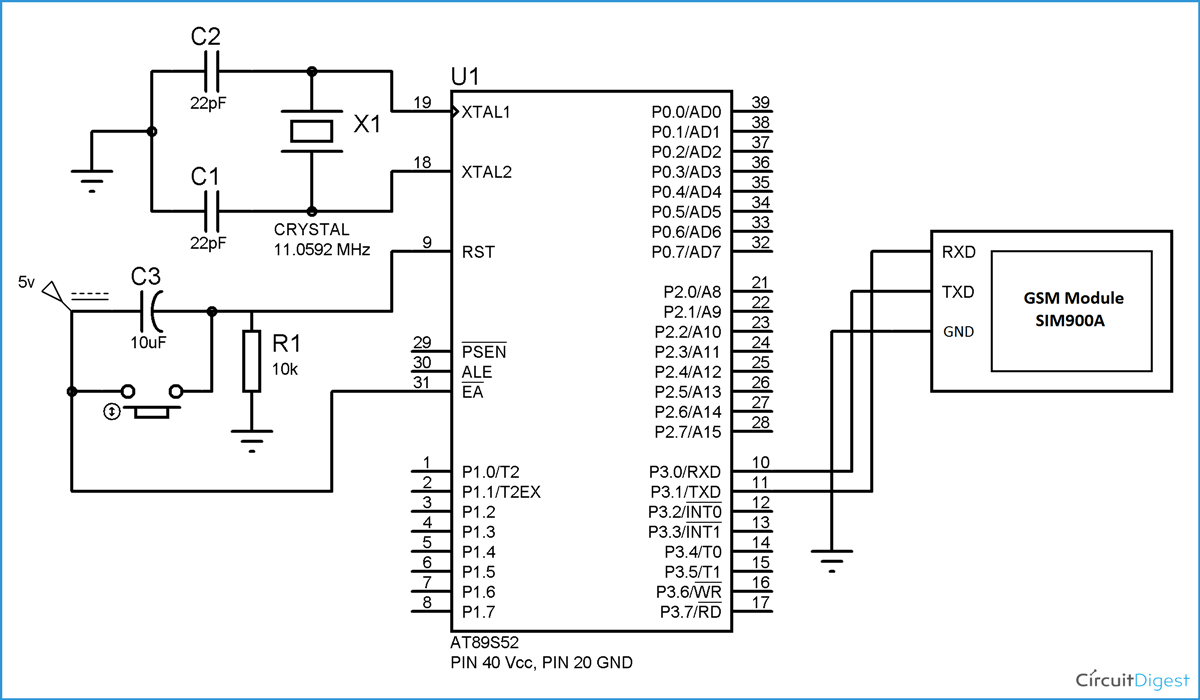
* Make, receive or reject voice calls
* Send, receive or delete SMS messages in the SIM Card
* Add, read and search the contacts in the SIM Card
* Send and receive data to / from the GSM.

The processor or controller to which the GSM/GPRS Module is connected to, is responsible for sending the AT Commands to the module. In response, the GSM Module performs command specific tasks like answering a phone call, send an SMS Message, etc.



GSM Module

**4.2.2 SCHEMATIC DIAGRAM**



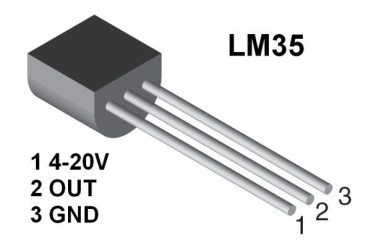
**4.3 SOIL MOISTURE SENSOR**

The soil moisture sensor can read the amount of moisture present in the soil surrounding it. It is a low tech sensor, but ideal for monitoring an urban garden, or your pet plant's water level. This is a must have tool for a connected garden. This sensor uses the two probes to pass current through the soil, and then it reads that resistance to get the moisture level. More water makes the soil conduct electricity more easily (less resistance), while dry soil conducts electricity poorly (more resistance).

It will be helpful to remind you to water your indoor plants or to monitor the soil moisture in your garden. It is used to sense the moisture in field and transfer it to microcontroller in order to take controlling action of switching water pump ON/OFF.

**4.4 TEMPERATURE SENSOR**

The LM35 is precision IC temperature sensor. Output voltage of LM35 is directly proportional to temperature in degree Celsius. It is very low cost sensor. Low cost is assured by trimming and calibration at the water level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. The operating temperature range for LM35 is −55˚ to +150˚C. The output voltage is given to the microcontroller which is multiplied by the conversion factor in order to give the value of actual temperature. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1°C in still air.

****

The LM35 does not need any exterior calibration and maintains an exactness of +/-0.4°C at room temperature and +/-0.8°C over a range of 0°C to +100°C.

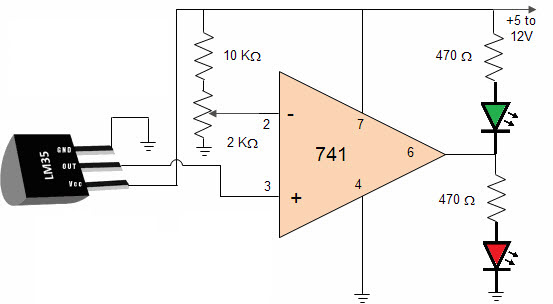
Size of LM-35:

1. Width : 7 mm
2. Height : 7 mm
3. Depth : 4 mm
4. Weight : 20 g

#### PIN CONFIGURATION OF LM 35

|  |  |  |
| --- | --- | --- |
| **Pin Number** | **Pin Name** | **Description** |
| 1 | Vcc | Input voltage is +5V for typical applications |
| 2 | Analog Out | There will be the increase in 10mV for raise of every 1°C.  Can range from -1V (-55°C) to 6V (150°C). |
| 3 | Ground | Connected to ground terminal of the circuit. |

**LM 35 CIRCUIT DIAGRAM**

****

This LM35 temperature sensor circuit amplifies the difference between its input terminals. The advantages of temperature sensor include It has no effect on the medium, more accurate, has an easily conditioned output and responds instantly**.**

**IMPLEMENTATION AND CODING**

**4.1 Arduino Code**

#include <SoftwareSerial.h>

SoftwareSerial ports(2,3);//rx,tx

int temperature(){

float temp=0;

temp=analogRead(A0);

temp=temp\*0.48828125;

//Serial.print("Temparature ");

//Serial.print(temp);

//Serial.print("\*C");

//Serial.println();

delay(1000);

return (int)temp;

}

int soilsensor(){

int soil= analogRead(A4);

//Serial.print("Moisture ");

//Serial.print(soil);

//Serial.println();

delay(1000);

return soil;

}

void setup() {

// put your setup code here, to run once:

Serial.begin(9600);

ports.begin(9600);

ports.println("AT+CGMI;\r\n");// network

delay(5000);

while (ports.available()) // forward data to monitor

Serial.write(ports.read());

ports.println("AT+CSQ;\r\n");// network strength

delay(5000);

while (ports.available()) // forward data to monitor

Serial.write(ports.read());

ports.println("AT+CREG?;\r\n");// registered sim card

delay(5000);

while (ports.available()) //forward data to monitor

Serial.write(ports.read());

ports.println("AT+CGATT=1;\r\n");// attach to gprs

delay(5000);

while (ports.available()) // forward data to monitor

Serial.write(ports.read());

ports.println("AT+SAPBR=3,1,\"Contype\",\"GPRS\";\r\n");// open gprs context

delay(5000);

while (ports.available()) // forward data to monitor

Serial.write(ports.read());

ports.println("AT+SAPBR=3,1,\"APN\",\"internet\";\r\n");// apn of internet provider

delay(5000);

while (ports.available()) // forward data to monitor

Serial.write(ports.read());

ports.println("AT+SAPBR=1,1;\r\n");// permissions to read

delay(5000);

while (ports.available()) // forward data to monitor

Serial.write(ports.read());

ports.println("AT+SAPBR=2,1;\r\n");// permission to write

delay(5000);

while (ports.available()) // forward data to monitor

Serial.write(ports.read());

}

void loop() {

// put your main code here, to run repeatedly:

int t=temperature();

delay(50);

int humi=soilsensor();

delay(50);

ports.println("AT+HTTPINIT;\r\n");// http service request

delay(20000);

while (ports.available()) // forward data to monitor

Serial.write(ports.read());

ports.println("AT+HTTPPARA=\"CID\",1;\r\n");// argument to write in server

delay(10000);

while (ports.available()) // forward data to monitor

Serial.write(ports.read());

ports.print("AT+HTTPPARA=\"URL\",\"http://agriculture19.000webhostapp.com/index.php?t=");// server address

ports.print(t);

ports.print("&h=");

ports.print(humi);

ports.print("\"\r\n");

delay(10000);

while (ports.available()) // forward data to monitor

Serial.write(ports.read());

ports.println("AT+HTTPACTION=0;\r\n");// http post action

delay(10000);

while (ports.available()) //forward data to monitor

Serial.write(ports.read());

ports.println("AT+HTTPREAD;\r\n");// read

delay(20000);

while (ports.available()) // forward data to monitor

Serial.write(ports.read());

ports.println("AT+HTTPTERM;\r\n");// http session termination

delay(5000);

while (ports.available()) // forward data to monitor

Serial.write(ports.read());

}

**4.2 Server Code**

<?php

$servername = "localhost";

$username = "id5229892\_root";

$password = "\*\*\*\*\*\*\*\*\*\*\*\*";

$database = "id5229892\_data";

echo "SMART AGRICULTURE SYSTEM";

echo "<br>";

echo "<br>";

//$temp = $\_GET["t"];

//echo $temp;

//$humi = $\_GET["h"];

// Create connection

$conn = mysqli\_connect($servername, $username, $password, $database);

// Check connection

if (!$conn) {

die("Connection failed: " . mysqli\_connect\_error());

}

$temp1=0;

$hum1=0;

if(isset($\_GET["t"]) && isset($\_GET["h"])){

$temp1=$\_GET["t"];

$hum1=$\_GET["h"];

if($temp1>0 && $hum1>0){

$motor ="off";

$reason="None";

if($temp1>50){

$reason="Temperature Alert";

$motor="on";

}

if($hum1>800 ||$hum1<200){

$reason="Humidity Alert";

$motor="on";

}

$tempf=($temp1\*1.8)+32;

$sql = "INSERT INTO Sensor (Moisture,Tempc,Tempf,Motor,Alert) VALUES ('$hum1','$temp1','$tempf','$motor','$reason')";

if ($conn->query($sql) === TRUE) {

echo "New record created successfully";

} else {

echo "Error: " . $sql . "<br>" . $conn->error;

}

echo "<br>";

}

}

echo str\_repeat("&nbsp;", 2);

echo "Date";

echo str\_repeat("&nbsp;", 12);

echo "Time";

echo str\_repeat("&nbsp;", 30);

echo "Moisture";

echo str\_repeat("&nbsp;", 5);

echo "Temperature(\*C)";

echo str\_repeat("&nbsp;", 5);

echo "Temperature(\*F)";

echo str\_repeat("&nbsp;", 5);

echo "Motor";

echo str\_repeat("&nbsp;", 5);

echo "Alert";

echo "<br>";

echo "<br>";

$sql = "SELECT \* from Sensor";

$result = $conn->query($sql);

if ($result->num\_rows > 0) {

// output data of each row

while($row = $result->fetch\_assoc()) {

echo $row["TIMESTAMP"] ;

echo str\_repeat("&nbsp;", 20);

echo $row["MOISTURE"]."\t";

echo str\_repeat("&nbsp;", 20);

echo $row["TEMPC"]."\t";

echo str\_repeat("&nbsp;", 30);

echo $row["TEMPF"]."\t";

echo str\_repeat("&nbsp;", 15);

echo $row["MOTOR"]."\t";

echo str\_repeat("&nbsp;", 10);

echo $row["ALERT"]."\t";

echo "<br>";

}

} else {

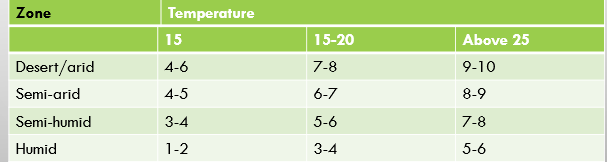
echo "0 results";

}

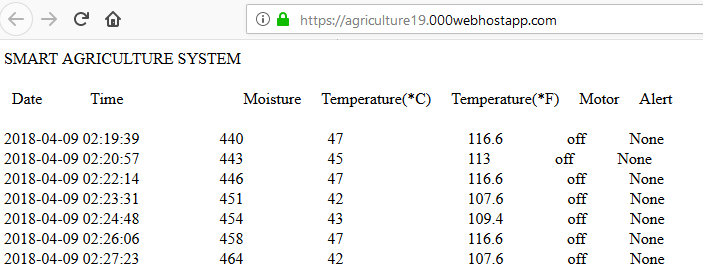
?>

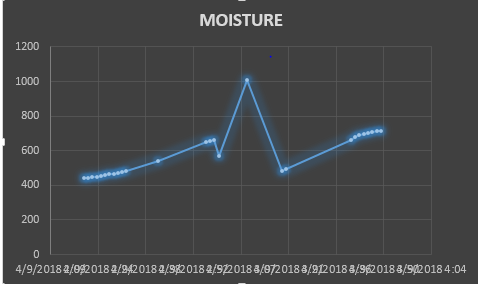
**EXPERIMENTAL SETUP AND RESULTS**

**AVERAGE DAILY WATER NEED**



Monitoring





* LM35 temperature sensor and soil moisture sensor reads the environment temperature and moisture in surrounding respectively.
* LM35 temperature reading is in voltage level hence its value is converted to temperature in \*Celsius using temp=temp\*0.48828125
* 1 centigrade means 10 millivolts change
* 1024 steps in 0-5 V
* Temp=adc\*5/(1024\*10\*10^-3) i.e. temp=temp\*0.48828125
* Arduino sends the data to the webpage ( log files) for monitoring purpose. GSM module is used for the internet connectivity ,calls , message.
* Arduino code uses AT(Attention) Commands for sending commands to GSM Module
* GSM module sends all the data to the webpage by –
* Opening the http session
* Sending data transfer request to server
* Sending data to website
* Terminating http session

**5.1 Initial Setups in Arduino IDE Software**

Step 1: Install the Arduino 1.6.7 IDE.

**5.2How module works?**

* Wi-Fi module has to connect the internet by an internet service provider like mobile hotspot, Wi-Fi router.
* Firstly module checks status of water level indicator, if water is present then it proceeds otherwise it terminates.
* If water is present, then it checks status of soil moisture sensor 1,
* If Region 1 is wet, motor will be off.
* If Region 1 is dry, valve 1 will open and motor will be on for 10 seconds.
* If Region 1 is humid, valve 1 will open and motor will be on for 5 seconds.
* During this, valve 2 will remain closed.
* Once again module checks status of water level indicator, if water is present then it proceeds otherwise it terminates.
* If water is present, then it checks status of soil moisture sensor 2,
* If Region 2 is wet, motor will be off.
* If Region 2 is dry, valve 2 will open and motor will be on for 10 seconds.
* If Region 2 is humid, valve 2 will open and motor will be on for 5 seconds.
* During this, valve 1 will remain closed.
* System is usually OFF state.
* It is possible to get STATUS of the field.
* It is possible to make System ON whenever. Once System is ON, it will check the status and supply the water one time only. Then again System is OFF.
* It is possible to make System OFF. But usually System is always will OFF condition.

**FUTURE SCOPE**

* Internet of Things applications in agriculture include farm vehicle tracking, livestock monitoring, storage monitoring, and much more. For example:
* Livestock sensors can notify ranchers when animals have roamed from the

herd so that ranch hands can round them up.

* Soil sensors can alert farmers to irregular conditions like high acidity,

giving the farmer time to reconcile the issue and produce better crops.

* Self-driving tractors can be controlled remotely, providing significant

savings in labor costs.

* **Disease Detection and Diagnosis:** Photos taken of suspect plants can be forwarded to experts for analysis.
* **Fertilizer Calculator**: Soil sensors and leaf color can determine what nutrients are needed.
* **Soil Study**: Capturing soil images, as well as pH and chemical data from sensors, allows farmers to monitor and adjust to changing soil conditions.
* **Water Study**: Determining Leaf Area Index from photos and brightness logging can help farmers determine water needs.
* **Crop Harvest Readiness**: Camera photos with UV and white lights accurately predict ripeness.

**CONCLUSION**

This system works in a manner in which it ﬁrstly does data collection from the farm via the help of sensors, then it sends the data to the server side from where and on which further actions can be taken. The ﬁnal output of this system is displayed after getting processed by the server side and then displayed onto the mobile phone. Thus, on the basis of literature survey and by analyzing the existing system, we have come to a conclusion that the proposed system will not only aid the farmers but will also help them to digitize their farming practice and in turn help them to yield the best from that soil without being dependent on the climatic conditions.

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