

A

RESEARCH

PROJECT REPORT FOR THE EVALUATION 3 OF PROJECT 2

**“IoT Based Smart Agriculture System”**

For the partial fulfillment of the award of the degree of 'Bachelor of Technology' in 'Computer Science and Engineering'

**GALGOTIAS UNIVERSITY, GREATER NOIDA, UP.**



SUBMITTED BY:

**ANISH SINGH**

**(1613101137)**

**B.tech 8<sup>th</sup> SEMESTER**

UNDER SUPERVISION OF:

**MR. VIVEK ANAND**

**Assistant Professor(SCSE)**

**APRIL / MAY- 2020**

## BONAFIDE CERTIFICATE

GALGOTIAS UNIVERSITY, GREATER NOIDA, UP.



This is to certify that, this project report “IOT BASED SMART AGRICULTURE SYSTEM” is the bonafide work of “ANISH SINGH(1613101137)” who carried out the project work under my supervision.

Signature of Head

Signature of Supervisor

School of Computer Science &  
Engineering

**MR. VIVEK ANAND**  
Assistant Professor(SCSE)

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## ABSTRACT

Abstract: Smart agriculture is an emerging concept, because IOT sensors are

capable of providing information about agriculture fields and then act upon based

on the user input. In this Paper, it is proposed to develop a Smart agriculture

System that uses advantages of cutting edge technologies such as Arduino, IOT

and Wireless Sensor Network. The paper aims at making use of evolving technology i.e. IOT and smart agriculture using automation. Monitoring

environmental conditions is the major factor to improve yield of the efficient

crops. The feature of this paper includes development of a system which can

monitor temperature, humidity, moisture and even the movement of animals which

may destroy the crops in agricultural field through sensors using Arduino board

and in case of any discrepancy send a SMS notification as well as a notification on

the application developed for the same to the farmer's smartphone using Wi-

Fi/3G/4G. The system has a duplex communication link based on a cellular -

Internet interface that allows for data inspection and irrigation scheduling to be

programmed through an android application. Because of its energy autonomy and

low cost, the system has the potential to be useful in water limited geographically

isolated areas.

## 1. INTRODUCTION

### Overall introduction

The Agriculture Parameters are utilizing an IOT Technology and system availability that draw in these objects to assemble and deal information. "The IOT

enables things selected recognized or potentially forced remotelycrosswise

over completed the process of existing configurationmerge of the substantial earth

into PC based frameworks, in addition to acknowledging overhauled capacity,

precision and cash interconnected favoured stance. Precisely when IOT is extended with sensors and actuators, the improvement modify into an



occasion of

the all the extra wide category of electronic physical structures, which in like

manner incorporates headways, for instance, clever grids, splendid homes, canny

moving and smart urban groups [1]. All is especially specific through its

introduced figuring configuration anyway can interoperate within the current

Internet establishment.

India has agriculture as its primary occupation. According to IBEF (India Brand

Equity Foundation), 58% of the people living in rural areas in India are dependent

on agriculture. As per the Central Statistics Office 2nd advised estimate, the

contribution of agriculture to the Gross Value Addition (India) is estimated to be

roughly around 8% which is very significant contribution. Under such a scenario,

the usage of water especially the fresh water resource by agriculture will

be enormous and according to the current market surveys it is estimated that

agriculture uses 85% of available freshwater resources worldwide, and this

percentage will continue to be dominant because of population growth and

increased food demand. This calls for planning and strategies to use water sensibly

by utilizing the advancements in science and technology. There are many systems



to achieve water savings in various crops, from basic ones to more technologically

advanced ones. One of the existing systems use thermal imaging to monitor

the plant water status and irrigation scheduling. Automation of irrigation systems

is also possible by measuring the water level in the soil and control actuators to

irrigate as and when needed instead of predefining the irrigation schedule, thus

saving and hence utilizing the water in a more sensible manner. An irrigation

controller is used to open a solenoid valve and apply watering to bedding plants

(impatiens, petunia, salvia, and vincarosea) when the volumetric water content of

thesubstrate drops below a setpoint.



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## List of Abbreviation

ACRONYM	EXPANSION
IF	Isolation Forest
IT	Information Technology
LOF	Local Outlier Factor
SP	Service Provider
IDP	Identity Provider
kNN	K Nearest Neighbor
RFA	Random Forest Algorithm
DF	Data Frame





## 2. Hardware Configuration

- Servers: We will need a local host to implement an algorithm to tackle the situation. The local server will get implemented on any browser present on the system.
- Terminals: Jupyter.
- Processor Pentium –IV and above
- RAM 128 MD SD EAM
- Monitor 800\* 600 resolution
- Hard disk 10 GB
- Processor 64 bit Intel core I3 and above
- Recent dataset uploaded by any bank
- Key board Standard 102 keys
- Mouse 3 buttons, scroll able
- Software – Windows 10,7,8.
- Prompt- Anaconda prompt.



### 3. Software Requirements

- Operating system Windows 10,7,8
- Coding Language Python
- Text editor- Jupyter
- Platform – Anaconda Prompt
- Machine Learning Algorithms

### 4. PURPOSE

Also known as precision agriculture, precision farming can be thought of as

anything that makes farming practice more controlled and accurate when it comes

to raising livestock and growing crops. In this approach of farm



management, a

key component is the use of IT and various items like sensors, control systems,

robotics, autonomous vehicles, automated hardware, variable rate technology, and

soon. This will hopefully stop the fraud because this type of fraud is staying with

us for decades and no successful solution has come through to stop it.

Technology has changed over time and agricultural drones are a very good

example of this. Today, agriculture is one of the major industries to incorporate

drones. Drones are being used in agriculture in order to enhance various

agricultural practices. The ways ground-based and aerial-based drones are being

used in agriculture are crop health assessment, irrigation, crop monitoring, crop

spraying, planting, and soil and field analysis.



## 5. Motivation and scope

Anish Singh utilized IoT and picture handling to locate the supplement and mineral insufficiencies that influence the yield development. Anish Singh and Mr. Vivek Anand have proposed a technique to picture and follow rural items in inventory network. Anishcentre around the equipment engineering, arrange design and programming process control of the exactness water system framework have proposed an approach to direct water in rural fields. Anish have proposed an approach to measure the soil moisture and temperature in rural fields.

## 6. PROBLEM WITH CURRENT SYSTEM

- ❑ Horticulture is the foundation of our Nation. In long time past days agriculturists used to figure the ripeness of soil and influenced presumptions to develop which to kind of product.



- ❑ They didn't think about the level of water and especially climate condition which horrible an agriculturist more.
- ❑ They utilize pesticides in view of a few suspicions which made lead a genuine impact to the yield if the supposition isn't right .
- ❑ The profitability relies upon the last phase of the harvest on which agriculturistdepends.
- ❑ To replace the current method there should be competitions that should be held regularly so that talent from various parts of the world could come forward and we can get something.

## 7. PROPOSEDSYSTEM

To improve the efficiency of the product there by supporting country we need to utilize the innovation which appraises the nature of harvest and giving recommendations. The Internet of things (IOT) is revamping the agribusiness engaging the farmers by the broad assortment of techniques, for instance, accuracy and conservative cultivation to go up against



challenges in the field. IOT advancement aids in social affair information on conditions like atmosphere, temperature and productivity of soil, harvest web watching. IOT utilize farmers to get related with his residence from wherever and at whatever point. Remote sensor frameworks are used for checking the farm conditions.

In this paper a Precision Agriculture has the advantage of giving continuous

criticism on various distinctive yield and site factors. As its name suggests,

Precision Agriculture is exact in both the extent of the product territory it screens

and in addition in the conveyance measures of water, compost, and so forth. This

innovation can separate a solitary plant for checking in the tens or several square

feet. The WSN framework requires a brought together control unit with UI.

Exactness Agriculture requires a novel programming model for each land territory,

the development of a smart agriculture system using sen-sors, microcontroller

within an IOT system is presented. The aim of the implementation is to

demonstrate the smart and intelligent capabilities of the microcontroller to allow

the decisions to be taken on watering the plants based on the continuous monitoring

of the environmental conditions in the field. The system is as shown in Fig.



1. It

also aims at a predefined irrigation schedule as per the farmers

convenience, uploaded into the application developed for the same.

The implementation is a photovoltaic powered automated irrigation system that

consists of a distributed wireless network of soil moisture and temperature sensors

deployed in plant root zones. These sensors continuously monitor the parameters

and send it to the Arduino board for further processing which acts as an IOT

gateway. This gateway has been given the wireless capability by installing a WiFi

module which will be updating the data to the cloud. The IOT gateway also has the

GSM capability through the module connected. This receiver unit also has a duplex

communication link based on a cellular-Internet interface, using general packet

radio service (GPRS) protocol, which is a packet-oriented mobile data service used

in 2G and 4G cellular global system for mobile communications (GSM). The data

being uploaded to the cloud allows the user to continuously view the parameters

from the comforts of his/her home or wherever on the go. The system has the

capacity to adapt based on the user input which the farmer can input through the

smart agriculture application. The farmer can select a profile based on the season

and the crop for irrigation and schedule and plan the water resource

15



utilization

sensibly as shown in Fig. 2. The volumetric water content in the soil is a primary

factor which gives a suggestion that the water is required for the crops. In the

absence of this system the farmer has to manually inspect these for all the crops by

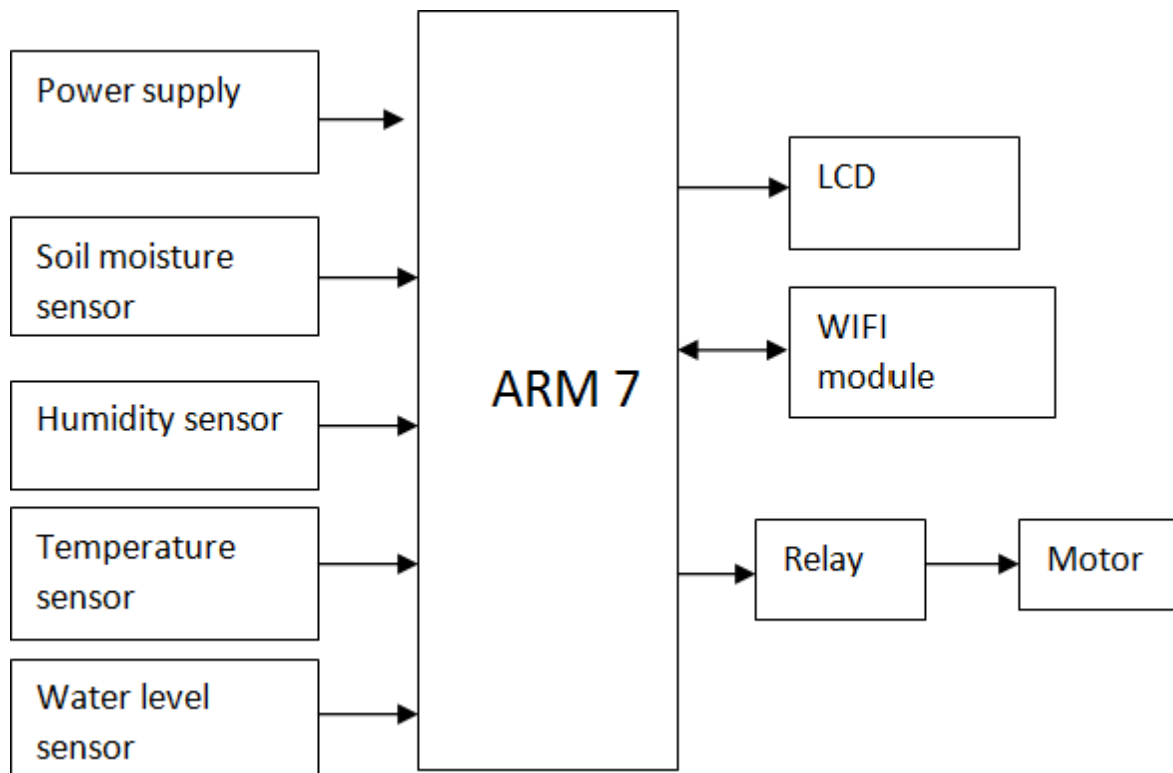


Figure 1

inspecting the soil in the fields which is tedious, time consuming and straining. This

can be taken care by the intelligent system which informs the user whenever the

water content goes below the threshold set by the farmer himself. Intrusion of

animals especially cows, monkeys, dogs etc to the fields is a very common issue

and one of the factors for disruption or disturbance to the yield. This



requires one

person to continuously guard the fields at all the times which will not be accurate

and the productivity of one person is wasted. This can be overcome by this system

which has a motion sensor to detect the presence of any animal in the fields

and send notifications to the farmer in their presence. The distance range for which

the farmer needs to detect the animals can be allowed to set by the farmer himself

in the application in the beginning

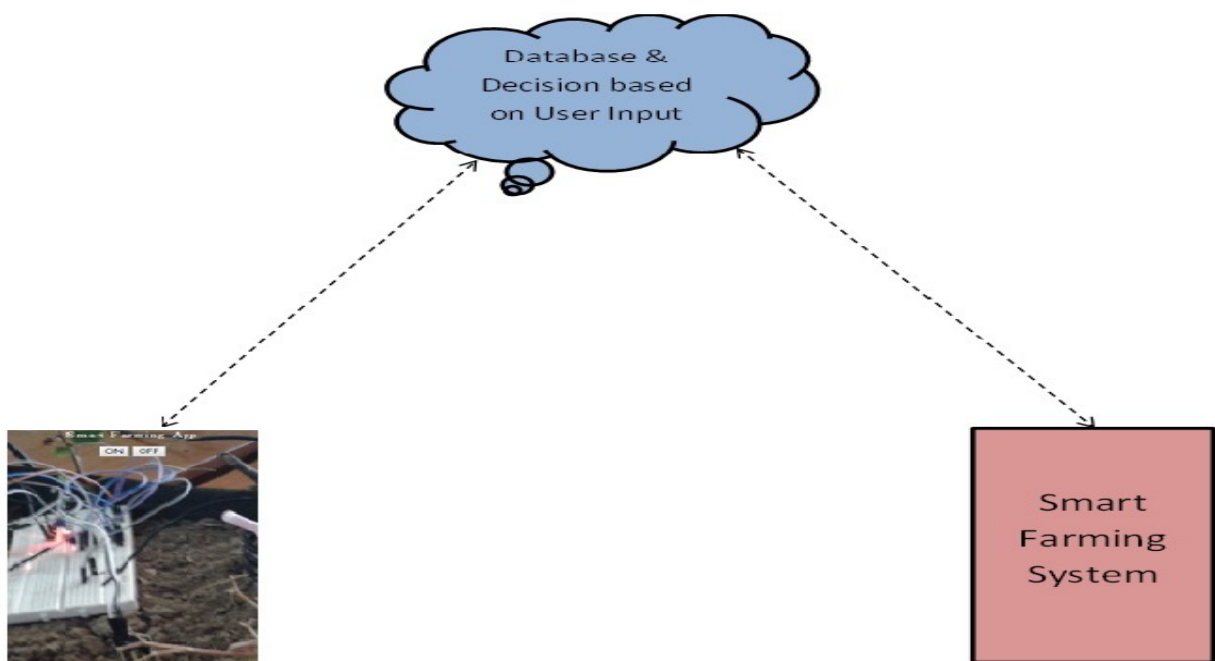


Figure 2

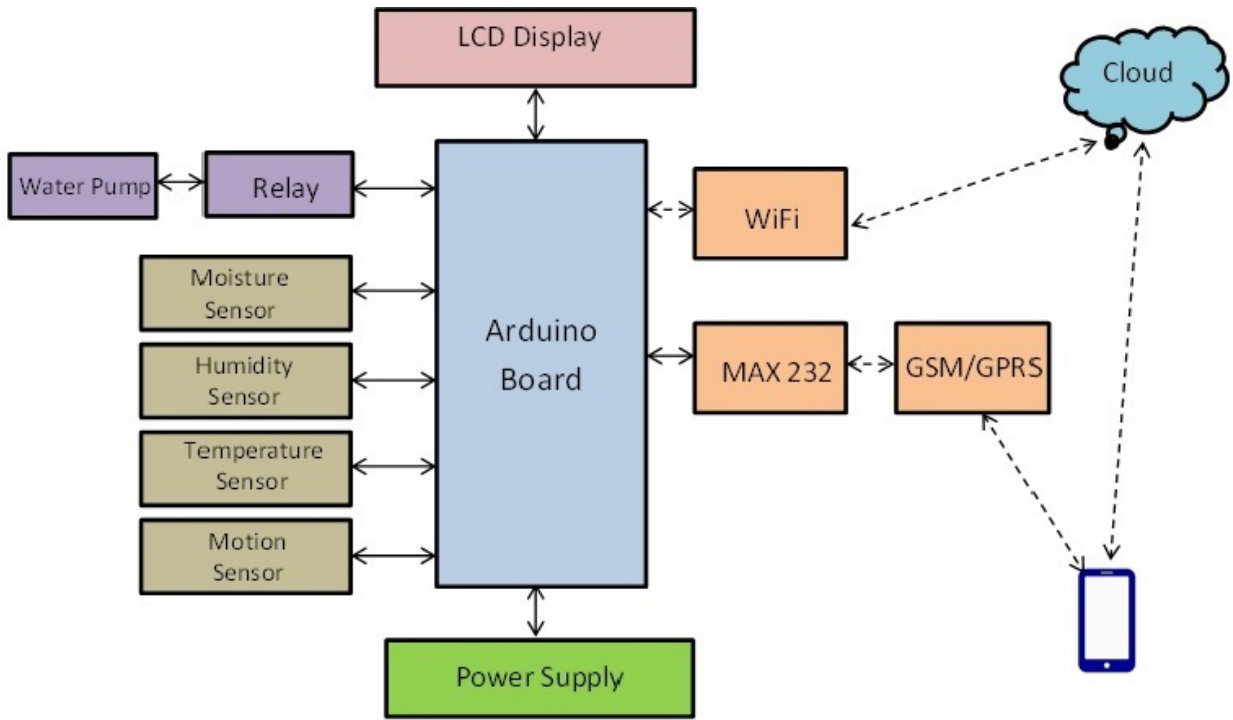


Figure 3

## Implementation

The reason for the ARM7 processor is that it interfaces every one of the parts

related with the Development pack. Number of pins in this processor is

64. Each stick is relegated with specific segment of the unit for performing specific

capacity. The edge estimation of the sensors is set in this LPC 2148 processor

which is in charge of the programmed ON and OFF of the engine which is combined with the pump for directing water to the horticultural land. The

temperature limit esteem will be refreshed to server or framework, through IoT for

each 1 minute from the incorporated advancement pack. LM35 temperature

sensors utilize speaker at the accurate supporters outright temperature (estimated in

Kelvin) into also Fahrenheit or Celsius rely leading it arrangements. The two

resistors are adjusted in the production line to create an exceedingly exact

temperature sensor. The coordinated START Read the information Deployment of

Sensor Is Temperature/the Humidity esteems in gols the water esteems in run

Motor on STOP NO YES Data server (IoT passage) circuit has various transistors

in it - two in the centre, a few in each intensifier, a few in the dependable flow



source, and several in the bend give circuit. The edge esteem is achieved (1 RH%-

3 RH%) this breaking points can be set in the microcontroller if its goes above past

10 RH% conditions will be unusual generally dampness level will be in ordinary

Condition.

IOT based smart agriculture system is used to generate decisions regarding

irrigation using real time data. First of all, farmer logs in to the system using his

credentials such as username and password from an Android application. He

is then allowed to select the crop for that season. System is implemented in three

phases.

\_ Sensing

\_ Processing

\_ Information distribution.

The sensing phase involves the sensing of the physical parameters which includes

temperature, moisture, humidity and motion. All these sensors are attached to the

Arduino Uno R3 microcontroller board. This board acts as the IOT gateway in the

developed system as it has the capacity to transmit the data to the cloud.  
This

transmission is done using Wi-Fi ESP8266 module. The processing phase  
takes

place in the cloud. The cloud consists of a Web Server, a database where  
the

sensed data is maintained and a decision logic which takes decisions  
based

on the sensed data. In the information distribution phase, the output of the  
decision

logic will be sent to the android application and then to the IOT gateway.  
The end-

to-end algorithm of the smart farming system is given below

Start

- \_ Continuously acquire sensor data
- \_ A/D conversion of the sensed data on the Arduino Board
- \_ Send the data to the cloud through the IOT Gateway
- \_ If the data is above the threshold
- \_ Send a notification to the Smart Farming Application
- \_ If user selects Turn ON
- \_ Send a control signal to the server i.e. cloud
- \_ Control signal is then sent to the IOT gateway
- \_ The IOT gateway triggers the relay and the water pump is turned ON
- \_ Else if user selects turn OFF
- \_ Send a control signal to the server i.e. cloud
- \_ Control signal is then sent to the IOT gateway
- \_ The IOT gateway triggers the relay and the water pump is turned OFF



```
_ Endif  
  
_ Else  
  
_ Continue checking for the threshold condition  
  
_ Endif  
  
End
```

The Smart Farming Application is developed on Android.

The features that are provided in this application are as follows

1. Selection to turn ON/OFF the water pump
2. Selection of an irrigation profile i.e. the farmer can choose a time on a particular day to start the irrigation and a time to stop the irrigation. This facilitates the farmer to invest his time in some other productive work. The application profile also allows the farmer to select the same schedule for a week or a month
3. Suggestion to the farmer to use a particular pesticide for their crop
4. Notify the farmer on the invasion of the field by animals.

## Code

Smart Agriculture System

IoT code

Smart Agriculture SystemArduino

```
#include <Arduino.h>  
#include<SoftwareSerial.h>//Header for GSM Module  
#include <LiquidCrystal.h>//Header for LCD Display  
#include "HardwareSerial.h"  
#include "RTC.h"  
#include "SD.h"
```

File file;

RTC\_TIMETYPE t;

```
SoftwareSerial mySerial(0,1);//Object and pin declaration of GSM Module  
LiquidCrystal lcd(7, 6, 5, 4, 3, 2);//Object and pin declarations of LCD
```

```
/*
```

```
* LCD RS pin to digital pin 7
```



- \* LCD Enable pin to digital pin 6
- \* LCD D4 pin to digital pin 5
- \* LCD D5 pin to digital pin 4
- \* LCD D6 pin to digital pin 3
- \* LCD D7 pin to digital pin 2
- \* LCD R/W pin to ground
- \* 10K resistor:
- \* ends to +5V and ground
- \* wiper to LCD VO pin (pin 3)
- \*/

/\*\*\*\*\*/

```
int sm = A0;//Assign input variable and pin for Soil Moisture Sensor
int ldr = A1;//Assign input variable and pin for Light Sensor
int hm = A2;//Assign input variable and pin for Humidity Sensor
int temp = A3;//Assign input variable and pin for Temperature Sensor
//Variables declaration
int smValue,ldrValue,hmValue,tempValue,lightValue,soilValue;
float hmVoltage,relativeHm,tempVoltage,degreesC,degreesF;
```

/\*\*\*\*\*/

```
void setup() // this setup code here is to run once:
```

```
{
  lcd.begin(20, 4);//Declaration of LCD size and begin the LCD
  mySerial.begin(9600);//Start the Serial Communication between GSM and
  GR-Kaede
  Serial.begin(9600);//Start the Serial Monitor
```

```
pinMode(sm, INPUT);//Assign Soil Moisture Sensor as Input
pinMode(ldr, INPUT);//Assign Light Sensor as Input
pinMode(hm, INPUT);//Assign Humidity Sensor as Input
pinMode(temp, INPUT);//Assign Temperature Sensor as Input
pinMode(PIN_LED0, OUTPUT); // for SD access
pinMode(PIN_LED1, OUTPUT); // for File access
pinMode(PIN_LED2, OUTPUT); // for File write access
pinMode(PIN_LED3, OUTPUT);
```

/\*\*\*\*\*/

```
lcd.clear();//Clear the LCD
lcd.setCursor(0, 0);//Set the cursor to origin point
lcd.print(" SMART AGRICULTURE ");//To print SMART AGRICULTURE in
LCD
```

```
lcd.setCursor(0, 1);//Set the cursor to next row
lcd.print("  SYSTEM ");//TO print SYSTEM in LCD
```

/\*\*\*\*\*/

```
  rtc_init();
```



```

    t.year = 15;
    t.mon = 10;
    t.day = 25;
    t.weekday = RTC_WEEK_SUNDAY;
    t.hour = 16;
    t.min = 31;
    t.second = 0;
    rtc_set_time(&t);
    /*****/
if (!SD.begin()) {

    while (1)

        ; // error

} else {

    digitalWrite(PIN_LED0, HIGH); // Success to access SD.

}
    /*****/
if (SD.exists("myData.csv")) {

    SD.remove("myData.csv");

}
    /*****/
File file = SD.open("myData.csv", FILE_WRITE);

if (file) {

    //Write

    file.println("„SMART, AGRICULTURE ,SYSTEM„");
    file.println("DATE, TIME, SOIL MOISTURE, LIGHT INTEN., HUMIDITY,
TEMP.(C), TEMP.(F)");

    file.close();

    digitalWrite(PIN_LED1, HIGH); // Success to open file.

} else {

    while (1)

        ; //Error in opening file

}

```



```

        /*****/
    }
    void loop() // put your main code here, to run repeatedly:
    {
        static unsigned long currenttime, oldtime = 0;
        static unsigned long starttime = millis();

        currenttime = millis() - starttime;

        if ((currenttime - oldtime) >= 2000) //@1sec
        {
            digitalWrite(PIN_LED2, HIGH); // blink LED

            File file = SD.open("myData.csv", FILE_WRITE);

            /*****
            *****/

            rtc_get_time(&t);
            file.println();
            file.print(t.day);
            file.print('/');
            file.print(t.mon);
            file.print('/');
            file.print(t.year);

            file.print(',');

            file.print(t.hour);
            file.print(':');
            file.print(t.min);
            file.print(':');
            file.print(t.second);

            file.print(",");

            /*****
            *****/

            soilValue = analogRead(sm); // Get analog values of Soil Moisture Sensor
            smValue = soilValue - 24; // Displaying reading within 1000 in LCD
            ldrValue = analogRead(ldr); // Get analog values of Light Sensor
            lightValue = (ldrValue + 200) / 10; // Displaying values within 100 in LCD
            hmVoltage = (hmValue / 1023.0) * 5.0; // Convert hmValue to voltage (5V
            circuit)
            relativeHm = ((hmVoltage + 0.958) / 0.0307); // Convert voltage to relative

```



```

humidity
tempValue = analogRead(temp);//Get analog values of Temperature
Sensor
degreesC = (tempValue / 10)+17;//Convert millivolts to Celsius
degreesF = degreesC * 1.8 + 32;//Convert Celsius to Fahrenheit

/*****
*****/

//Soil Moisture Sensor Details
file.print(smValue);
file.print(',');
//Serial.print("Soil Moisture : ");//Print "Soil Moisture : " in Serial Monitor
lcd.setCursor(0, 2);//Set the cursor in LCD to 2nd row 4th Column
lcd.print(" SM:");//To print "SM:" in LCD display
lcd.setCursor(5, 2);//Set the cursor in LCD to 2nd row 8th Column
lcd.print(smValue);//Display the Soil moisture level in LCD
//Serial.print(smValue);//Display the Soil moisture level in Serial Monitor

//Light Sensor Details
file.print(lightValue);
file.print(',');
//Serial.print("| Light : ");//Print "Light : " in Serial Monitor
lcd.setCursor(0, 3);//Set the cursor in LCD to 3rd row 0th Column
lcd.print(" L :");
lcd.setCursor(5, 3);//Set the cursor in LCD to 3rd row 2nd Column
lcd.print(lightValue);
//Serial.print(lightValue);//Display the Light Intensity level in Serial
Monitor

//Humidity Sensor Details
file.print(relativeHm);
file.print(',');
//Serial.print("% | Humidity : ");//Print "Humidity : " in Serial Monitor
lcd.setCursor(9, 3);//Set the cursor in LCD to 3rd row 5th Column
lcd.print("HM:");
lcd.setCursor(13, 3);//Set the cursor in LCD to 3rd row 8th Column
lcd.print(relativeHm);
//Serial.print(relativeHm); //Display the Humidity level in Serial Monitor

//Temperature Sensor Details
file.print(degreesC);
file.print(',');
file.print(degreesF);

```

```

file.print(',');
//Serial.print("% | Temperature : ");//Print "Temperature : " in Serial
Monitor
lcd.setCursor(9, 2);//Set the cursor in LCD to 2nd row 11th Column
lcd.print(" T:");
lcd.setCursor(13, 2);//Set the cursor in LCD to 2nd row 14th Column
lcd.print(degreesC);
//Serial.print(degreesC);//Display the Temperature - Celsius in Serial
Monitor
//Serial.print("C ");

```

```

//Serial.print(degreesF);//Display the Temperature - Fahrenheit in Serial
Monitor
//Serial.println("F ");

```

```

/*****
*****/

```

```

file.close();

digitalWrite(PIN_LED2, LOW);

oldtime = currenttime;

}

}

```

```

void checkConditions()
{
if(smValue < 300 && (int)relativeHm > 20)//Check soil and air moisture
is below 70%
{
if((int)degreesC > 20 && lightValue > 25)//Do not required to feed at
night time
{
sendMessage();
}
}
}
}

```

```

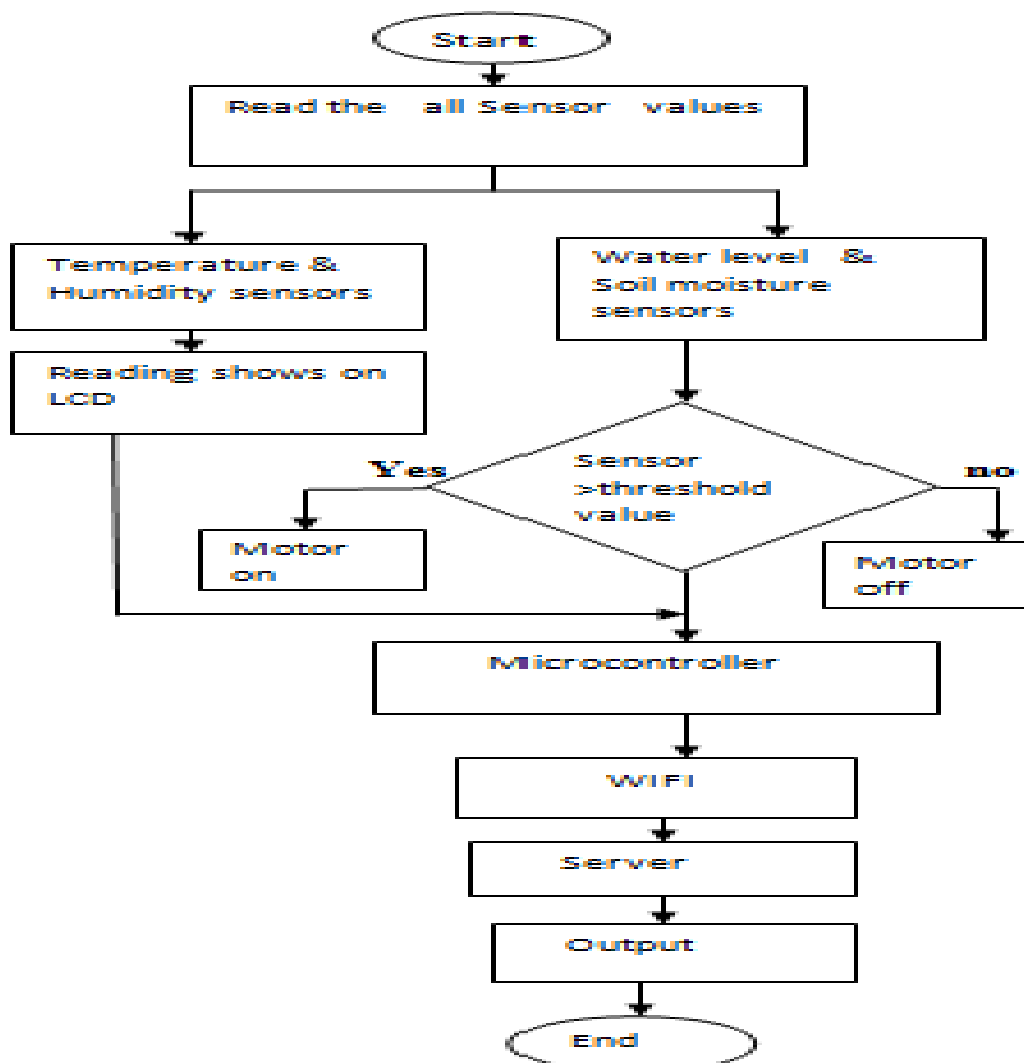
void sendMessage()
{
mySerial.println("AT+CMGF=1"); //Sets the GSM Module in Text Mode

```

```

delay(500); // Delay of 500 milli seconds or 1/2 second
mySerial.println("AT+CMGS=\"+919688755885\""); //Declaring Mobile
number with Country code
delay(500);
mySerial.print(" Soil Moisture : ");
mySerial.print(smValue);
mySerial.print(" % ");
mySerial.println(" Light Level : ");
mySerial.print(ldrValue);
mySerial.print(" % ");
mySerial.println(" Humidity : ");
mySerial.print(hmValue);
mySerial.print(" % ");
mySerial.println(" Temperature : ");
mySerial.print(tempValue);
delay(100);
mySerial.println("\x1A");// ASCII code of CTRL+Z
delay(500);
}

```



## Figure 4

### Conclusion

IOT based smart agriculture system can prove to be very helpful for farmers since

over as well as less irrigation is not good for agriculture. Threshold values for

climatic conditions like humidity, temperature, moisture can be fixed based on

the environmental conditions of that particular region. The system also senses the

invasion of animals which is a primary reason for reduction in crops. This system

generates irrigation schedule based on the sensed real time data from field and

data from the weather repository. This system can recommend farmer whether or



not, is there a need for irrigation. Continuous internet connectivity is required. This

can be overcome by extending the system to send suggestion via SMS to the

farmer directly on his mobile using GSM module instead of mobile app.

Therefore, the paper proposes a thought of consolidating the most recent innovation into the agrarian field to turn the customary techniques for water

system to current strategies in this way making simple profitable and temperate

trimming. Some degree of mechanization is presented empowering the idea of

observing the field and the product conditions inside some long-separate extents

utilizing cloud administrations. The points of interest like water sparing and work

sparing are started utilizing sensors that work consequently as they are modified.

This idea of modernization of farming is straightforward, reasonable and operable.

As relying upon these parameter esteems rancher can without much of a stretch

choose which fungicides and pesticides are utilized for enhancing cropcreation.

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