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Development of Smart Agricultural Monitoring and Automatic Irrigation System

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***Abstract*: The Conventional farming that is practiced in India are insufficient in satisfying as the demand is expanding day by day for agricultural products because of expanding population, Therefore, farmers are in high pressure, even despite of efforts, resources, labor, productive output are not getting for farmers. One way to deal with beat this issue is build up a smart system with less cost means by which the wastage of resources and labor necessity could be cut down and in the meantime the farming profitability would be expanded in quality as well quantity. This paper introduces Smart Farming which is one of the applications of Internet of Things (IOT) and uses Wireless Sensor Networks as transmission technology. The main aim of this paper is to reduce the wastage of water, real time monitoring of crop field and sending data to cloud for future references and text messages are send farmers about the field. Smart System is developed using GSM technology and Data is stored in AWS.**

***Index Terms:* IoT, GSM, GPRS, GPS, PIR**

I. INTRODUCTION

The demand for food in India economy is continuously increasing due to growing population and degradation of natural resources. Hence developing a system that uses the resources in a sustainable manner is of outmost importance. Scarcity of available fresh water resources, less rainfall and depletion of ground water adds to the above problems. Smart Farming is one of the application of IOT where a smart system is developed to monitor the agricultural field and to automatically the irrigation system so wastage of water is reduced and another advantage is only required water will be taken by plants and power is also saved.To improve we have to focus on the agriculture monitoring system and to collect more area information [1].

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Fig.1: Smart Agriculture

A. Wireless Sensor Networks (WSN)

Wireless sensor network is a rising technology. Using WSN Sensed data can be collected, stored or processing Processed and the data is transmitted to the appropriate central station. With the help of WSN, data can be transmitted in the real-time data quickly with in less time. Precision agriculture is only applying right contributions at the ideal time to get more development with less power and work. The real-time data is depends on the few qualities of climate like temperature, humidity etc. Smart Farming relies on latest wireless technologies like Bluetooth, GPS, GPRS, Wi-Fi,, RF, ZigBee, etc., in this Smart system GSM[5]

B. Internet of Things (IOT)

In this paper IOT plays a major role. IoT connects different objects for example sensors, actuators, hardware and network connectivity that empower the objects to data between them and stay connected. It is a network of physical objects. In IoT-based smart developing, a framework is worked for observing the crop field with the assistance of sensors (light, humidity, temperature, soil moisture, etc.) and automating the irrigation system. The farmers can screen the field conditions from anyplace. IoT-based smart farming is highly efficient when compared with the traditional approach. IoT can be used by farmers to empower remote checking of plant status, automate

essential services and getting recommendations in a 24x7 manner. The method will assist the farmers with diminishing the specialist visit to the field for further processing [3].

II. CHALLENGES FACED IN WIRELESS TRANSMISSION TECHNOLOGIES

A. Cost

Major challenge in precision agriculture is cost of hardware devices which are costly for farmers, hence selection of hardware devices such that selection of sensors, microcontrollers, and technology used must be low cost and efficient to use.

B. Battery life

Wireless sensors run on batteries-which should be energy efficient and if any battery dies users are expected to replace them regularly and that too for hundreds and thousands of sensors.

C. Band range

In many remote rural locations across the world strong, consistent internet connectivity is not available, which in turn fails to attempts to apply wireless communication techniques at such place.

D. Efficiency

The wireless technologies in monitoring agriculture field should be efficient to get the parameters from the field and to activate the water pump should be efficient in all aspects.

E. Power Consumption

Power is an important to consider in precision agriculture whatever the technologies used Should provide an efficient consumption of power, The technology adopted must consume low power so it will be beneficial for farmers.

III. OBJECTIVES AND GOALS

- In this work, a Smart System is developed to continuously monitor the agricultural field with low cost devices.
- To Develop Automatic Irrigation system to reduce the wastage of water and increase the crop yields.
- Text messages are sent to farmers mobile frequently.
- Data from the field such as temperature, moisture level, and when motor is on or off is stored in cloud for analysis purpose
- Smart System uses GSM as wireless sensor network which send data from crop field to farmers The work is consolidated with GSM innovation so it will fill in as a connection among microcontroller and rancher. By utilizing GSM innovation [2].GSM has advantages over other transmission technologies.
- It provides very cost effective products and solutions.
- It sends messages over long distance.ie provide extensive coverage area which helps the farmers since farmers will be having their farm land away from home.
- Easy deployment i.e. easily it can be connected microcontroller.
- It provides internet connectivity strongly

IV. SYSTEM DESIGN

The system module is divided into three parts, the main aim is to

- Identify temperature, moisture level, human detection, rain level and automatically switching on water pump and off.
- Using GSM sending data to Amazon cloud services for future analysis
- Sending details about crop field through text messages to farmers frequently.

The system mainly consists of Identifying whether conditions in the agriculture field and to automate the irrigation process, sending data to mobile phones and web service.[4] The central node i.e the Arduino microcontroller is responsible for controlling all the activities in the system. To identify the temperature of the field temperature sensor is used, To identify water content in the soil moisture sensor is used, PIR sensor is used to detect the Human detection and water pump to automate the irrigation system. The relay switch is used to control the on and off the water motor.

The GSM module is used which helps in sending text messages to farmers [9]. The GPRS is used to send the data from hardware component to the amazon cloud through the internet using the IP address.

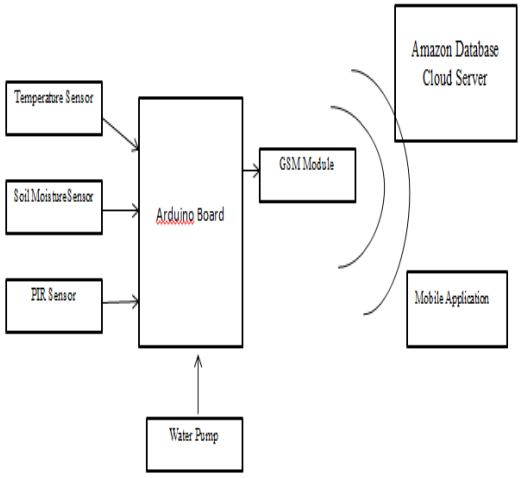

Fig. 2: System Design for Smart Agriculture

The sensors continuously sense the temperature and moisture level of crop field and if the moisture level is below the threshold value the water motors gets on and if the moisture level is high the water motor gets off and all these activities is received through alert message in the smart phone [6].

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V. SYSTEM REQUIREMENTS

A. Hardware Requirements

ATmega2560
DHT-11 Temperature and Humidity sensor
Soil moisture sensor
PIR Sensor
GSM module
Water pump
Relay Switch

ATmega2560-The Arduino Mega is a microcontroller board used in this project on the AT Mega. The microcontroller has 54 computerized input/output pins (of which 14 can be utilized as PWM outputs), Arduino is an open-source, prototyping platform which is outstanding because as a due of its simplicity. It is a readymade microcontroller board with inputs and outputs and it is a simply should be associated with PC utilizing USB cable or a AC-to-DC connector or battery to get started. Arduino comes in numerous flavors, to name a few like Uno, Mega 2560, Leonardo, Nano, Lily pad and so on.

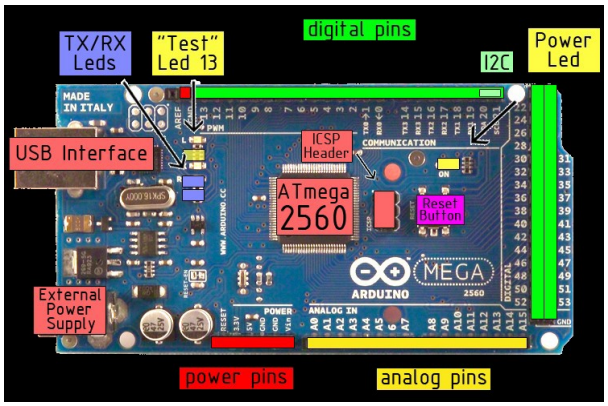

Fig. 3: Arduino mega Board

B. Selection Of Sensors

Sensors are used for real time monitoring of the system. Irrigation is based on the readings obtained from them.

DHT-11 Temperature and Humidity sensor

DHT11 sensor is used to find temperature of the crop field it also measures humidity of the soil.

Soil Moisture sensor

This sensor estimates the volumetric substance of water inside the dirt and gives us the dampness level as yield. The sensor is furnished with both simple and advanced yield, so it tends to be utilized in both simple and computerized mode. This Moisture Sensor can peruse the measure of dampness present in the dirt encompassing. Figure 5 shows the Soil Moisture sensor which should be dipped in land [7].

PIR SENSOR

PIR sensor recognizes an individual moving around inside roughly 10m from the sensor. This is a normal esteem, as the real discovery extend is somewhere in the range of 5m and 12m. PIR are fundamentally made of a pyro electric sensor, which can recognize dimensions of infrared radiation. Fig 6 shows the PIR sensor

Rain level Sensor

Rain level sensor detects the rain droplets and indicates rain has been detected which helps the farmer to take any action before rain has been detected. Figure 7 shows the Rain sensor

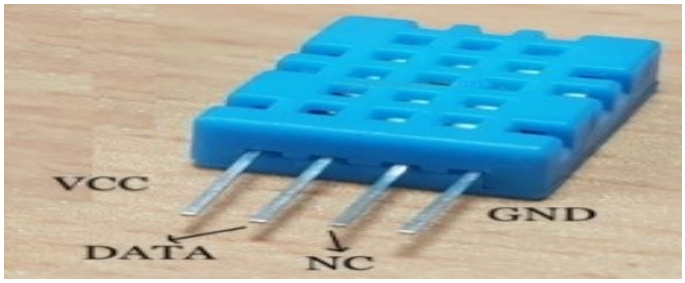

Fig. 4: DHT11Sensor

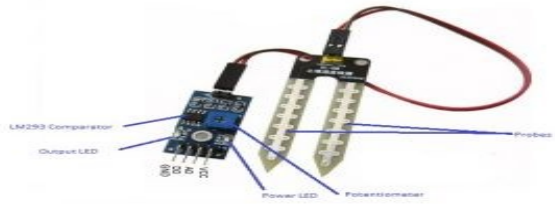

Fig. 5: Soil moisture Sensor

Fig. 6: PIR Sensor

Fig. 7: Rain Sensor

C. GSM-Global System For Mobile Application

Here we are utilizing remote sensor organize as GSM (worldwide framework for portable correspondence). GSM is a versatile correspondence modem; it is represents worldwide framework for portable correspondence (GSM)[10]. The work is additionally consolidated with GSM innovation so it will fill in as a connection among microcontroller and rancher. . To consistently estimating screen in the dirt with the assistance of soil dampness sensor and furthermore evaluating the element of the water content using sensor and furthermore check the temperature, dampness with the assistance of temperature sensor .By this on the off chance that any dimension of water or temperature changes happens, at that point quickly the message is go to the designer with the assistance of GSM[8]. This GSM transmit the loaded with data about the field to the designer to the composer By utilizing GSM innovation, data in regards to crisis circumstance might be send to the rancher so they may make essential move in unavoidable circumstances[1].

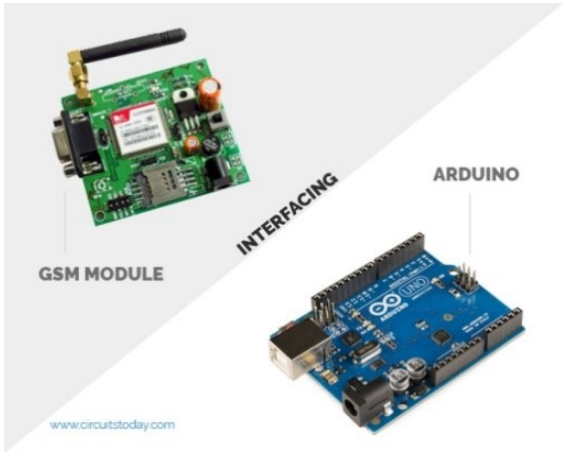

Fig. 8: GSM module interfacing with Arduino Board

D. Software Requirements

Software is used to provide instructions to the hardware units by loading the program into the controlling unit of the hardware system. Arduino IDE.

Arduino IDE

The software used to write and upload programs to Arduino microcontroller is Arduino IDE which is a open-source Software Arduino IDE supports operating systems such as Windows, Mac OS X, and Linux Installations. This software uses programming languages such as C and C++ for writing program. The program or the code written in IDE is known as sketch. When the sketch is prepared, it is compiled. If without errors, the code is uploaded to the Arduino board. Figure 4 shows the Arduino IDE Software

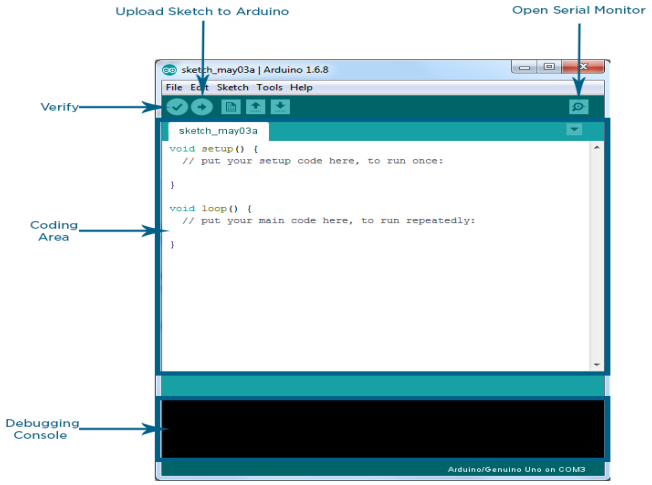

Fig. 9: Arduino IDE

If uploaded successfully, the LED on your board should blink on/off once every second. Most Arduino boards have an LED prewired to pin 13.

E. Amazon Cloud Services

It is the use of remote servers on the internet to store, manage and process data rather than a local server or personal computer. AWS stands for **Amazon Web Services**. The AWS service is provided by the Amazon that uses distributed IT infrastructure to provide different IT resources available on demand. Here all data of Agriculture field is stored in Cloud for further analysis.

VI WORKING

Project mainly consists of 3 modules-

First Module: Connecting all Temperature, soil moisture, PIR sensor, water pump, and GSM module to Arduino Microcontroller, then upload program to automate the irrigation system and to send data to farmer's mobile frequently and sending data to cloud.

Second Module: Sending Data to farmers mobile frequently through GSM module by inserting SIM card. if

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temperature is high smart System sends to farmers as High Temperature, LD indicates Land Dry, HD indicates Human Detected which is showed in Figure 5.

Third Module: Sending data cloud through GPRS by creating account in AWS,IP address will be provided ,through that IP address data will be uploaded, by using IP address webpage will opened where all the Information will be stored which is showed in Figure 6.

VII. RESULTS

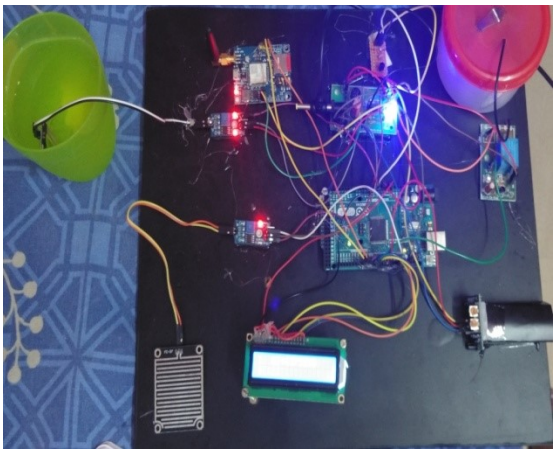


Fig. 10: Hardware Setup

Figure 10 shows the hardware connection consists of Arduino microcontroller, Sensor ,Water pump, GSM module external power should be given to run Text messages sent from Arduino microcontroller from farm field to farmers as shown in the figure LD refers Land Dry, HD Human Detected frequently so it helps the farmers for further analysis.

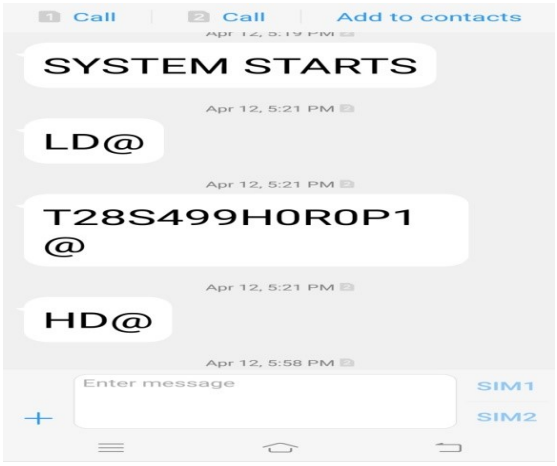
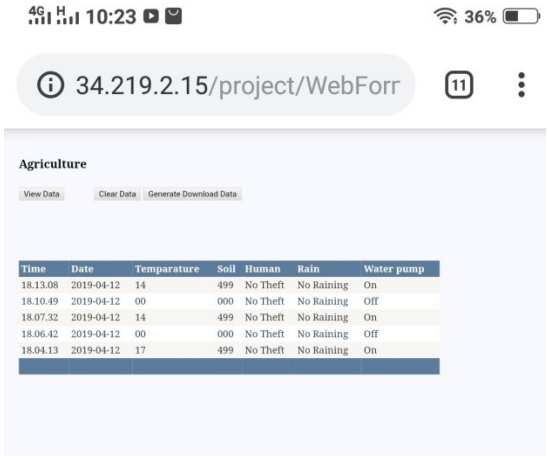


Fig. 11: Text messages to Farmers

Sensor values are sent to AWS for further processing or further analysis where Temperature, Soil moisture, Human detected, Water pump is whether on/off are stored.



Time	Date	Temparature	Soil	Human	Rain	Water pump
18.13.08	2019-04-12	14	499	No Theft	No Raining	On
18.10.49	2019-04-12	00	000	No Theft	No Raining	Off
18.07.32	2019-04-12	14	499	No Theft	No Raining	On
18.06.42	2019-04-12	00	000	No Theft	No Raining	Off
18.04.13	2019-04-12	17	499	No Theft	No Raining	On

Fig. 12: Webpage displaying crop field data

VII. CONCLUSION & FUTURE WORK

The Developed Smart system helps to monitor crop field and automate the irrigation system based on moisture level, so wastage of water is reduced and all the information is sent to farmers mobile through text messages and data is stored in amazon cloud services for further analysis. This smart system reduces the wastage of water, reduce farmer time and their physical work in less cost and increase their crop yield.

Mobile application can be created for this smart system and voice alert messages can be sent to mobile phone which can be easily understood by farmers.

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