IOT Based Smart Agriculture System Using Sensors and Arduino Mega

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Abstract— Smart agriculture is an rising concept, because IOT sensor are talented of providing information about crop growing field and then act upon based on the user input. Most of Indian land area is agriculture land. Agriculture play major role of India country's economical improvement. Water source is necessary and important part of human life. Water automatic irrigation system is the one of the best method to supply the water to agriculture land. It is very important to helping the saving water in that area were lack of rain, it is help to growing plant of crops, maintain the water level of the soil. These systems are enhancing the farming field as well as improve the quality of soil. Water scarcity is the main problem for the planet growing headily. The farmer is suffering for lack of water due to this reason automatic water irrigation system is important. Farmer are used more pesticides and fertilizers for growing the plant, due to these increasing the acidity of soil level. Therefore that reason the ph value of the soil is increasing. In the modern techniques are used in agriculture system there are used moisture sensor and ph sensor check the value of the soil and according to that the message is send to the farmer. The moisture sensor sense the water level of the soil and ph sensor is sense the acidity of soil. Smart agriculture is a growing concept, because IOT sensor is capable of Providing information about agriculture field to the farmer mobile phones or computer system. The IOT is fully based upon the new technology, in the IOT technology internet is maim part of the IOT. These sensor readings are sent wirelessly to the cloud over the internet using ESP8266. Thing Speak, IOT Geek, etc. are various IOT cloud platforms on hand on which the readings are displayed, visualized and stored strongly. In this way, sensors reading are stored digitally and is easily accessed and analyzed by the farmer remotely from any part of the world regardless of place, time and device.

Keywords: Internet of Things (IOT), Smart Agriculture, Ph Sensor, Moisture Sensor, Think Speak

I. INTRODUCTION

Agriculture is strength of character of India. Water scarcity and wastage of water is a main disaster in many state of India. To overcome this problem this system includes is routine water wet system which can avoid the consumption of water as well as avoid the plant from run over water. Agriculture in India has a significant history. India is ranking second in farm output. Even today, traditional methods and backward techniques are been used by different countries in the farming sector. In India, the agriculture technology is labor exhaustive, whereas is the modern agriculture technology is mainly capital intensive. Production efficiency has been increased significantly with the technological progression in agriculture. With the help of new technology like internet of things, microcontroller based embedded system; a novel design approach to smart farming is a farmed as increase the productivity. Sensors are used to collect the data from environment like soil wetness, hotness, clamminess; water Level etc. internet of things is an ecosystem of connected physical objects that are easy to get to through the wireless sensor. Real time monitoring information can be utilized and the Performance can be tracked. Wireless sensor such as moisture, PH, humidity, temperature this sensor is plays measure role in the automatic irrigation system. This IOT based Agriculture monitoring system makes use sensor networks that collect information from different sensors connected at different nodes and sends it through the system protocol. In an on hand automated water management system we cannot take decision at that case by taking special quality of agriculture soil. Current automated irrigation system only works on one parameter at one time. Soil moisture is under threshold value then water valve is open for water supply and after proper water supply if it goes above threshold value water valve is get close. Available system does not concern about accessible water in tank and requirement of water to particular crop. So system does not have decision power. It only works on one condition at one time. In the recent times. the farmer 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. But the new IOT based technology used Adriano Uno in that system automatic sensor are connected wirelessly to the sensor and according to that output is send to the mobile phone or computer of system of famer.

II. OBJECTIVE

The main objective of this paper is the smart agriculture will revolutionized the world of the farming and it will increase the efficiency as well as progress the quality of crops and reduce the farmer hard work. The reason of this paper is to provide an regular irrigation system thereby saving time, money power of farmer. Stick supplementary farmers in getting live data (Soil Moisture, PH value, water level, humidity, temperature etc.) For efficient environment monitoring which will enable them to do well-dressed farming and boost their overall yield and quality of products. Therefore the smart Agriculture will reform the globe of agricultural and it will increase the productivity as well as improve the quality and can save the life of farmer. There is a urgent need for a system that makes the agriculture process Easier and weight free from the farmer's side. With the recent development of technology it has become necessary to increase the annual crop production output of our country India. Smart irrigation system is to save farmer's effort, water and time has been the most important consideration.

III. PROBLEM WITH RECENT TECHNOLOGIES

In the recent times, the farmer have been using normal irrigation method through the physical control in which the farmers irrigate the land at standard intervals by turning the water Pump ON/OFF when necessary. They may have to travel so far for switch ON/OFF the Motor. They may be pain from hot Sun, rain and night time too. Sometime irregular watering leads to mineral loss in the soil and might end up rotting the plant. Sometime the neighbors do too much of the watering and the plants end up dying anyway. There are clock based devices available in India which waters the soil on time interval. They do not good judgment the soil moisture and the ambient heat to know if the soil actually needs watering or not. Due to the present day industrialization, high tech living of people and many other intestinal or non-intestinal actions, atmosphere quality is reducing drastically at a much expected rate. This one of the reasons or the reduction of the soil moisture and increasing PH value soil. As the average temperature of earth is increasing, which is termed as global warming, soil becomes barren and crops cannot be refined. Along with this PH level of the soil play main role in the effective growth of each and every crop this is because the proper PH level helps particular crop to be healthy. Improper and insufficient knowledge of the parameters, farmer keeps using pesticides, growth chemicals the achieve greeter crop production. But unluckily, this even cause more harm to crop by reducing its quality. Soil have different feature like Soil moisture and PH value etc. Soil moisture is below entry value then Water regulator is open for water supply and after proper water supply if it goes above threshold Value water valve is get close. Existing system does not concern about accessible water in tank and condition of water to exacting crop. So system does not have decision power.

IV. HARDWARE AND SOFTWARE REQUIREMENT

A. *Arduino Mega 2560:*

Fig. 1: ARDUINO MEGA 2560

Arduino MEGA 2560 board is just like a brother of Arduino UNO board. It is way more powerful than Arduino UNO and also two times as long from it. This board is the heir of Arduino MEGA. It can be named as ATMega2560. It can have more memory space as compared to other boards of Arduino. Arduino MEGA 2560 is different from all other boards of Arduino that came before as they don't use the FTDI USB-to-serial driver chip. Instead it uses ATmega16U2 programmed as a USB-to-serial converter. It is programmed in Arduino IDE software like all other boards in terms of coding. We don't need to attach extra components or devices to make this board in running condition to use. As per our requirements we can just plug and play with this board as everything is built in that makes it readily available. Arduino Mega 2560 is an amazing microcontroller board for the paper that need large amount of input output pins or if high processing power is required. It is designed for more composite circuitry because as for simple circuitry large amount of input output pins are useless and a board with less memory fails to achieve our requirements.

1) *Atmel Atmega2560:*

The ATmega2560 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced. RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega2560 achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus processing speed. The Atmel AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are in a straight line connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers.

B. *Wi-Fi Module:*

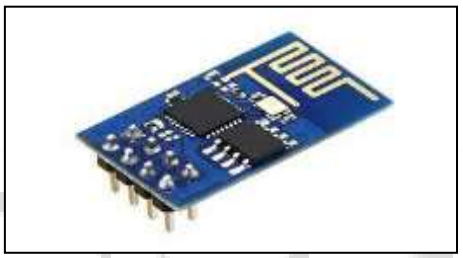


Fig. 2: Wi-Fi MODULE:

The unit that makes this project Internet of Things compatible is ESP8266 Wi-Fi module. This module is a self-contained SOC having an integrated TCP/IP protocol stack which gives any microcontroller-based board an access to the internet. It come with a pre-programmed AT command set firmware. The maximum operating voltage of ESP8266 is 3.6V. But to make the Arduino Uno and ESP8266 communicate, a Logic Level Converter is needed since ESP8266 is not capable of 3-5V logic shifting. The Rx and TX pins of ESP8266 are connected to the logic level converter which is connected to the Arduino Uno. With the help of this module, we can set up the Arduino board to the cloud platform and the transfer of data can be done wirelessly.

C. *GSM Module:*

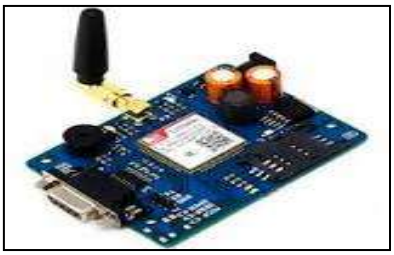


Fig. 3: GSM MODULE

GSM Modem-RS232 is built with Dual Band GSM engine-SIM900A, works on frequencies 900/ 1800 MHz the Modem is coming with RS232 interface, which allows you connect PC as well as microcontroller with RS232 Chip (MAX232). The baud rate is configurable from 9600-115200 through AT

command. The GSM Modem is having internal TCP/IP stack to enable you to connect with internet via GPRS. It is suitable for SMS, Voice as well as DATA transfer application in M2M interface. The SIM900A is a complete Dual-band GSM/GPRS solution in a SMT module which can be embedded in the customer applications allowing you to benefit from small dimensions and cost-effective solutions. Featuring an industry-standard interface, the SIM900A delivers GSM/GPRS 900/1800MHz performance for voice, SMS, Data, and Fax in a small form factor and with low power consumption. With a tiny configuration of 24mm x 24mm x 3 mm, SIM900A can fit almost all the space requirements in your applications, especially for slim and compact demand of design.

D. LCD (Liquid Crystal Display):

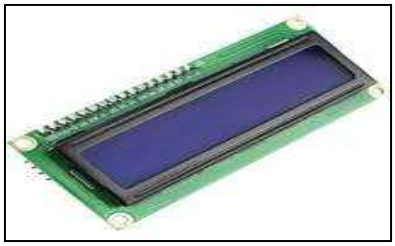


Fig. 4: LCD (Liquid Crystal Display)

LCD display screen is an electronic display module. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. As we all know, though LCD and some other displays greatly enrich the man machine interaction, they share a common weakness. When they are connected to a controller, multiple IOs will be occupied of the controller which has no so many outer ports. Also it restricts other functions of the controller.

E. Water Level Sensor:

Fig. 5: WATER LEVEL SENSOR

Level sensors are used to detect the level of substances that can flow. Such substances include liquids, slurries, granular material and powders. Level measurements can be done inside containers or it can be the level of a river or lake. Such measurements can be used to determine the amount of materials within a closed container or the flow of water in open channels.

F. Water Pump:

A submersible pump (or sub pump, electric submersible pump (ESP)) is a device which has a hermetically sealed motor close-coupled to the pump body. The whole assembly is submerged in the fluid to be pumped. The main advantage of this type of pump is that it prevents pump cavitations', a problem associated with a high elevation difference between pump and the fluid surface. Small DC Submersible water pumps push fluid to the surface as opposed to jet pumps having to pull fluids. Submersibles are more efficient than jet pumps.

G. Moisture Sensor:

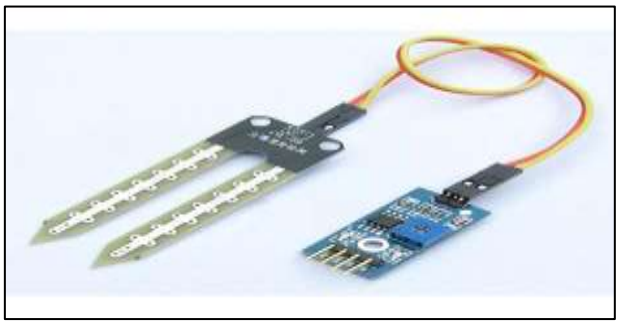


Fig. 6: MOISTURE SENSOR

Moisture sensor (YL-69): Soil moisture sensor measures the water content in soil. It uses the property of the electrical resistance of the soil. The relationship among the measured property and soil moisture is calibrated and it varies depending on environmental factors such as temperature, soil type, or electric conductivity. Here, it is used to sense the moisture in field and transfer it to gsm module in order to take controlling action of switching water pump ON/OFF.

H. Temperature and Humidity Sensor:

Fig. 7: Temperature and Humidity Sensor

DHT11 sensor is used for measuring temperature and humidity. It uses a capacitive humidity sensor and a thermostat to measure the surrounding air. This sensor is cost effective, provides power consumption and up-to 20 meter signal transmission is possible low.

I. PH Sensor:

Fig. 8: PH Sensor

A pH meter is a scientific instrument that measures the hydrogen-ion activity in water-based solutions, indicating its acidity or alkalinity expressed as PH. The pH meter measures the difference in electrical potential between a pH electrode and a reference electrode, and so the pH meter is sometimes referred to as a "potentiometric pH meter". The difference in

electrical potential relates to the acidity or pH of the solution. Use the PH Sensor just as you would a traditional PH meter with the additional advantages of automated data collection, graphing, and data analysis. Typical activities using our PH sensor include: Acid-base titrations; Studies of household acids and bases; monitoring pH change during chemical reactions or in an aquarium as a result of photosynthesis; Investigations of acid rain and buffering.

V. SOFTWARE REQUIREMENTS

A. *Introduction to Adriano IDE:*

The Arduino integrated development environment (IDE) is a cross-platform application (for Windows, mac OS, Linux) that is written in the programming language Java. It is used to write and upload programs to Arduino compatible boards, but also, with the help of 3rd party cores, other vendor development boards. The source code for the IDE is released under the GNU General Public License, version 2. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main() into an executable cyclic executive program with the GNU tool chain, also included with the IDE distribution. The Arduino IDE employs the program argued to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

1) Installing the Arduino IDE:*

This guide contains steps to install the Arduino* IDE on a system with Windows*, OS X®, or Linux*.These steps were tested using the 1.6.8 version of the Arduino IDE. You have connected your board to your computer and gathered any required components. See the list of requirements for details. Choose your operating system Windows.

B. *Thing Speak:*

According to its developers, "Thing Speak is an open source Internet of Things (IOT) application and API to store and retrieve data from things using the HTTP protocol over the Internet or via a Local Area Network. Thing Speak enables the creation of sensor logging applications, location tracking applications, and a social network of things with status updates" Thing Speak was originally launched by Io bridge in 2010 as a service in support of IOT applications. Thing Speak has integrated support from the numerical computing software MATLAB from Math Works, allowing Thing Speak users to analyze and visualize uploaded data using MATLAB without requiring the purchase of a MATLAB license from Math works.

VI. METHODOLOGY

A. *Block Diagram:*

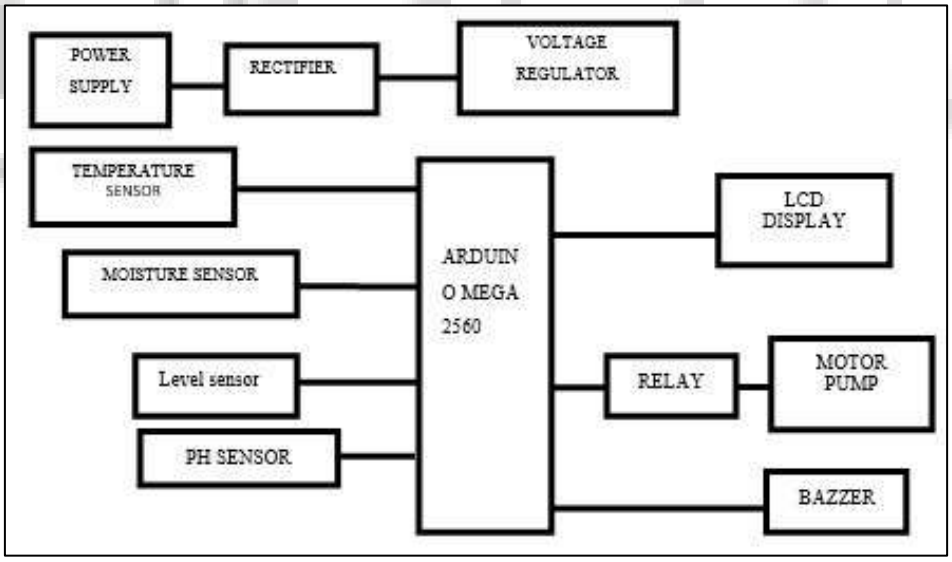
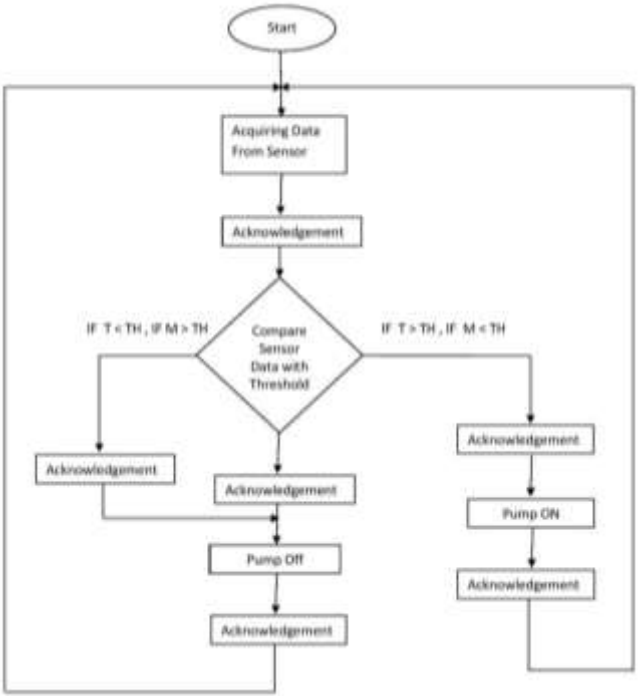


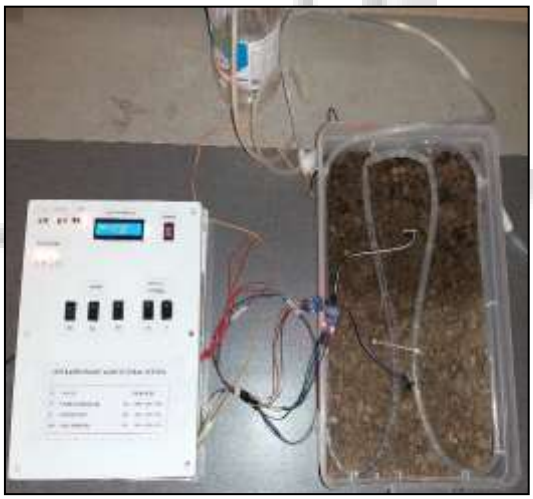
Figure shows the block diagram of the system. In This System, different sensors like Soil Moisture Sensor checks the moisture level in the soil and if moisture level is low then Arduino switches on a water pump to provide water to the plant. Water pump gets automatically off when system finds enough moisture in the soil. Whenever system switched on or off the pump, a message is sent to the user via GSM module, updating the status of water pump and soil moisture. This system is very useful in Farms, gardens, home etc. This system is completely automated and there is no need for any human intervention. Arduino is used for controlling whole the process of this Automatic Plant Watering System. The output of soil sensor circuit is directly connected to digital pin D7 of GSM module is used for sending SMS to the user. A 12V Relay is used to control the 220VAC small water pump. The relay is driven by a BC547 Transistor. An optional LCD is also used for displaying status and messages. Humidity and temperature are common parameters to measure environmental conditions. In this Arduino based project we are going to measure ambient temperature and humidity and display it on a 16x2 LCD screen. A combined temperature and humidity sensor DHT11 is used with Adriano Uno.

B. Flow Chart:



VII. OUTPUT PAPER MODEL

A. Testing of Final Project:

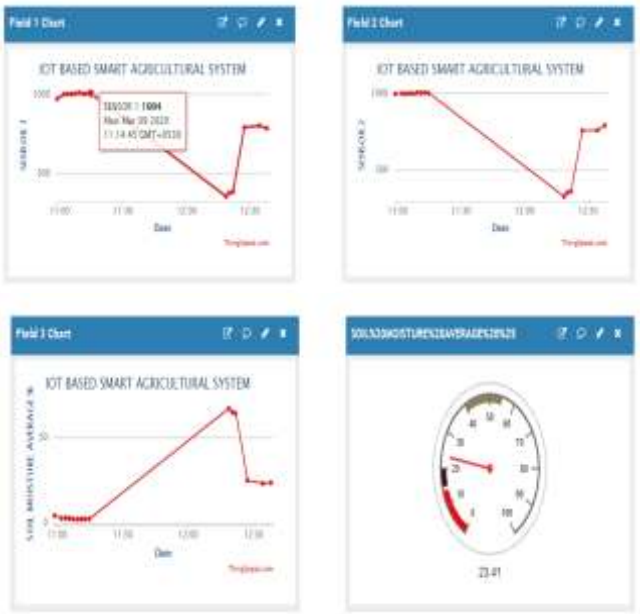


B. Displaying Data on Control Box:

Moisture percentage on LCD

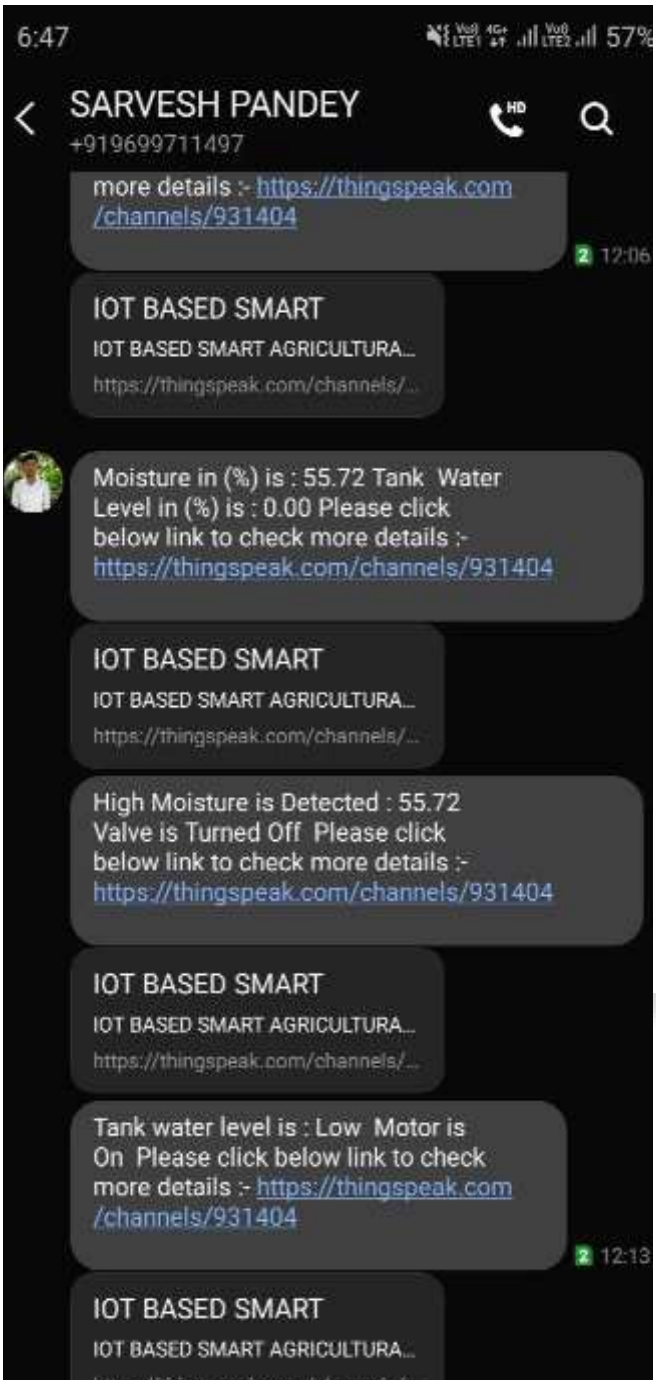
Water level Display on LCD

C. Sending the Data on Cloud:

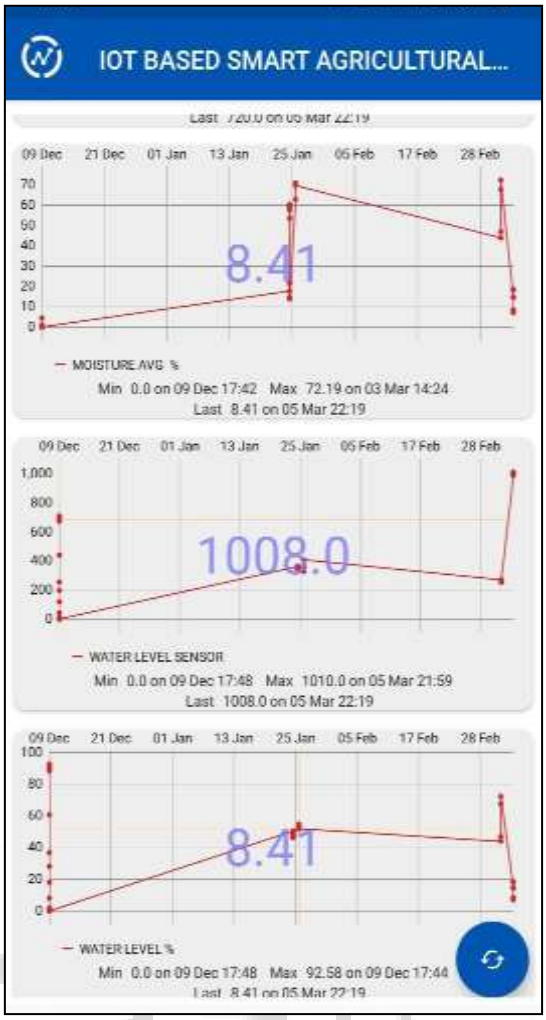


Tracking Live Data on Thing speak

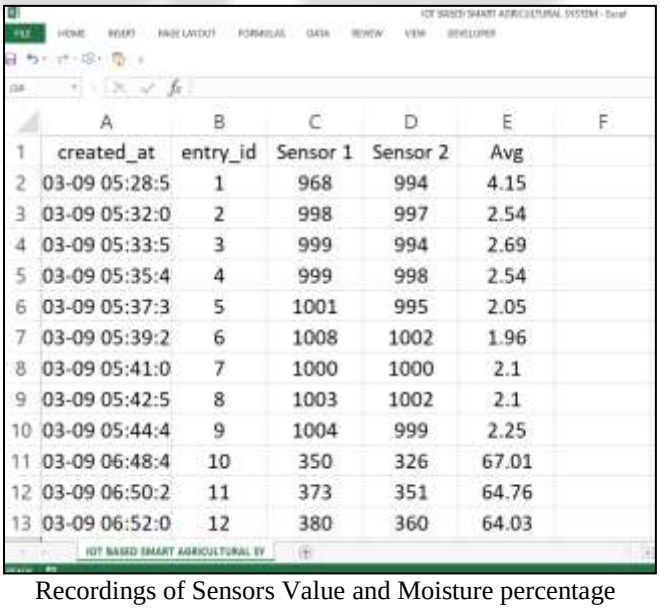
D. Sending Data on Mobile SMS



Tracing data on mobile app.



Database:



	A	B	C	D	E	F
1	created_at	entry_id	Sensor 1	Sensor 2	Avg	
2	03-09 05:28:5	1	968	994	4.15	
3	03-09 05:32:0	2	998	997	2.54	
4	03-09 05:33:5	3	999	994	2.69	
5	03-09 05:35:4	4	999	998	2.54	
6	03-09 05:37:3	5	1001	995	2.05	
7	03-09 05:39:2	6	1008	1002	1.96	
8	03-09 05:41:0	7	1000	1000	2.1	
9	03-09 05:42:5	8	1003	1002	2.1	
10	03-09 05:44:4	9	1004	999	2.25	
11	03-09 06:48:4	10	350	326	67.01	
12	03-09 06:50:2	11	373	351	64.76	
13	03-09 06:52:0	12	380	360	64.03	

Recordings of Sensors Value and Moisture percentage

VIII. CONCLUSION

The proposed systems help in availing automatic irrigation and monitoring of soil moisture from any place, maintaining records in form of digital identity, and this system also helps in water saving and this system reduces the farmers burden .By using IoT to connect different sensors to the cloud and

visualizing, processing and storing the data, real time statistics are made available to the user and can be later accessed by farmer through any device. But since the system is limited to few sensors in future many more sensors can be added using different controller, technologies as such as Artificial Intelligence and making the system more compatible in terms of technology, size and cost.

IX. FUTURE SCOPE

Use of Artificial intelligence (AI): With the use of AI this system can be made intelligent that is all the decisions will be made by the system itself and by using of AI farmers can analyses data in detail. Intelligent devices will not only relay important soil parameters but also provide intelligent alerts to the farmer.

- Instant Information: Intelligent devices can provide instant feedback on requirements of parameters soil parameters.
- Wireless Sensor: By using wireless sensor instead of wired sensor the system will works with more accuracy and this will also reduces the complex wirings, etc.
- Addition of more sensors: More sensors can be added to the system like Electrochemical Sensor, Dielectric Soil moisture sensor, Airflow sensor, etc.
- Sensor specifications: More précised results can be obtained with selection of proper sensor specifications and characteristics.

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