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IOT based Irrigation System for Smart Agriculture

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Abstract— ***Human beings depend on the extensive range of agriculture products. As the population is increasing, the demands for agricultural products are also increasing. To fulfill the demands of increasing population modern agriculture crop growing methodologies are used. Here we are presenting the smart agriculture with the use of different sensors installed the field. The sensor will provide us a variety of significant information like soil moisture content, atmospheric temperature, humidity etc. The data from the sensor node is collected by IOT gateways collecting and transmit it to the internet infrastructure. The objective of this project is to present a reliable IOT based irrigation control system. Here automatic agriculture monitoring systems are proposed over manual method as they are energy efficient and minimize the need for tedious manual labor work.***

Keywords— IOT, GSM, Sensor, Microcontroller,

I. INTRODUCTION

In our country Agriculture is major source of food production to the growing demand of human population. As there is a migration of people due to several reasons from rural to urban there is obstruction in agriculture. In the farming, field crop needs management of pesticides, fertilizers, and irrigation for better growth. The information such as temperature, humidity, fertilizer, and soil moisture can be provided as input to decision support system for maximizing the crop growth with the optimized use of available resources and without affecting an environment. In the farms, there are physical sensors (e.g., temperature, humidity, CO2, and illumination) and controllers (e.g., sprinkler, LED lights, air conditioner, and heater) for monitoring and controlling the environmental conditions of the farm. All the sensors and controllers are connected with the IoT gateways in turn connected with the IoT service platform. End users (i.e., farmers) can interact with the connected farm for monitoring its environmental conditions or triggering some farming utilities. In agriculture, irrigation is an essential process that influences crop production. Generally farmers visit their agriculture fields periodically to check soil moisture level and based on requirement water is pumped by motors to irrigate respective fields. Farmer need to wait for certain period before switching off motor so that water is allowed to flow in sufficient quantity in respective fields. This irrigation method takes lot of time and effort particularly when a farmer need to irrigate multiple agriculture fields distributed in different geographical areas. Traditionally farmers used to be present in their fields to do irrigation process. But nowadays farmers need to manage their agricultural activity along with other occupations. Automation in irrigation system makes farmer work much easier. Sensor based automated irrigation system provides promising solution to farmers where presence of farmer in field is not compulsory. A small processor programmed for controlling the electromagnetic valve that operate motor for watering the field. Farmers need cheap and simple user interface for controlling sensor based automated irrigation system. Now a day's internet is widely used and using internet farmer know about the field irrigation status. This helps farmers to know the status of watering the farm through a message when the farmer is far away from field, he can know the status of motor is as well as and direction of watering the field.

Internet of Things (IoT) plays a crucial role in smart agriculture. It makes use of wireless sensor networks to collect data from different sensors deployed at various locations in the farm and send it through the wireless protocol. These IoT sensors are capable of providing information about the soil properties and environmental factors continuously. Monitoring environmental factors is the major factor to improve the yield of the efficient crops. Then these parameters are controlled through any remote device or internet services and the operations are performed by interfacing sensors, Wi-Fi, camera with microcontroller. This paper presents a prototype for fully automated irrigation system; the prototype includes number of sensor node placed in different directions of field. Each Sensor is integrated with a wireless networking device and the data received by the "ARDUINO-UNO" development board, the GSM MODEM is use to send messages through internet. Here for experimentation we have abstracted number of soil moisture sensor used in different direction of the fields. The soil moisture in each direction of field is sensed by sensor node and the sensed data is sent to microcontroller through wireless networking device. On receiving sensor value the controller node checks it with required soil moisture value. When soil moisture in a particular field is not up to required level then controller node switch on the motor to irrigate associated field and the GSM process all data and notification SMS is send to registered mobile phone which is registered with GSM.

II. LITERATURE REVIEW

The research in agriculture area is enhanced in various aspects to improve the quality and quantity of productivity of agriculture. Researchers have been worked on many different projects on soil attributes, different weather conditions as well as scouting crops. In the article of A Model for Smart Agriculture Using IoT author proposed a sensor technology and wireless networks integration of IOT technology and reviewed the actual state of affairs of agricultural system. Here author develop real time monitoring system of smart agriculture for soil properties like temperature, moisture, pH and use image analysis and SMS based alerts [1]. Most of the people over all worlds depend on agriculture. Because of this reason smart IT technologies are needed to transfer with traditional agriculture methods. Modern technologies can control the cost, maintenance and monitoring performance. Satellite and airborne imagery play a crucial role in modern agriculture. In a Survey paper based on Smart Agriculture IoT with Cloud Computing author presents, simple IoT agriculture model with a wireless network. Author surveyed some typical applications of Agriculture IoT Sensor Monitoring Network technologies using Cloud computing as the backbone. This survey is used to understand the different technologies and to build sustainable smart agriculture [2].

Internet of Things used Wireless monitoring of field reduces the human power and it also allows user to see accurate changes in crop yield. In the article IOT based monitoring system in smart agriculture author making use of evolving technology. Monitoring environmental factors is the major factor to improve the yield of the efficient crops. The feature of this paper includes monitoring temperature and humidity in agricultural field through sensors using CC3200 single chip. Camera is interfaced with CC3200 to capture images and send that pictures through MMS to farmers mobile using Wi-Fi. The system can be used in green house and temperature dependant plants. The application of such system in the field can definitely help to advance the harvest of the crops and global production [3]. In the research article, IOT Based Smart Agriculture Monitoring System, various sensors are deployed in the field like temperature sensor, moisture sensor and PIR sensor. The data collected from these sensors are connected to the microcontroller through RS232. In control section, the received data is verified with the threshold values. If the data exceeds the threshold value the buzzer is switched ON and the LED starts to blink. This alarm is sent as a message to the farmer and automatically the power is switched OFF after sensing. The values are generated in the web page and the farmer gets the detailed description of the values. In manual mode, the user has to switch ON and OFF the microcontroller by pressing the button in the Android Application developed. This is done with the help of GSM Module[4].

The research paper on Mobile Integrated Smart Irrigation Management and Monitoring System Using IOT proposes smart farming by the aid of automation and IoT technology. The proposed automated irrigation and monitoring system consists of the raspberry pi, water pump, and moisture and temperature sensors. Smart phones module is used for communication. In the proposed work, crops or plants are considered along with their water requirement at different stages. The crops or plants are irrigated with respect to the water requirements at different stages of their growth. The smart phone is connected to raspberry pi through Bluetooth. The motor is controlled by the smart phone by the values ON and OFF [5]. In the article, Smart Farming Using IOT, A smart GPS based remote controlled vehicle that performs various tasks like monitoring fields to prevent thefts, scaring birds and animals, sensing soil moisture content, spraying fertilizers and pesticides, weeding, sensing soil moisture, etc. is implemented in this paper. Smart irrigation, by usage of optimum amounts of water, depending on the requirement of each crop type and the soil was executed. Controlling and monitoring of all these operations will be through a remote smart device with Internet connectivity and the operations will be performed by interfacing sensors, ZigBee modules, with micro-controller. The system operates mainly on two modes, namely: automatic mode and manual mode. In the automatic mode, the system takes its own decisions while controlling the various devices, while in manual mode, the user can himself operate the system with the help of an mobile app or PC commands [6]. The article SMART system monitoring on soil using internet of things (IOT) aims in designing a system which is capable of tracking the soil resource level and monitoring PH rate, water level and temperature alerts through SMS to predefined numbers. By using the same existing the soils pH rate, Temperature, water level can be monitored using the wireless sensors. The monitored report of their land can access this information from their mobiles via wireless network and can check their pH rate at their own time. If they notice abnormalities, they can immediately notice their land and use pesticides to overcome the abnormalities. The remote monitoring of the soil pH rate and its temperature rate has been done with the very minimal cost [7].

III. METHODOLOGY FOR SMART AGRICULTURE

At the system level the application layer combines the IOT with the technology of specific industry. The internet of things almost applied in all areas of industry, including smart agriculture, smart parking, smart building environmental monitoring, healthcare transportation and many more. Among them, agriculture is one of the important areas which targets millions of people. The major objective of agriculture based on internet of things (IoT) is to create a smart environment using enabling technologies such as sensors, embedded devices & communication protocols.

A. System overview

This prototype monitors the amount of soil moisture and temperature. A predefined range of soil moisture and temperature is set, and can be varied with soil type or crop type. In case the moisture or temperature of the soil deviates from the specified range, the watering system is turned on/off. In case of dry soil and high soil temperature, it will activate the irrigation system, pumping water for watering the plants. The block diagram of smart irrigation system is

represented in Fig. 1. It consists of a microcontroller (ATmega328) which is the brain of the system. Both the moisture and temperature sensors are connected to the input pins of the controller. The water pump and the servo motor are coupled with the output pins. If the sensors depart from the predefined range, the controller turns on the pump. The servo motor is used to control the angular position of the pipe, which ensures equal distribution of water to the soil. An LED indicator indicates the status of the pump. This system can be implemented on a large scale for farming purposes, which can further prove to be more advantageous. Owing to prevailing conditions and water shortages, the optimum irrigation schedules should be determined especially in farms to conserve water.

Here, we are using modules such as moisture sensor, temperature sensor, arduino uno, transistor as switches, DC motor as motor module, module for communication as GSM shield.

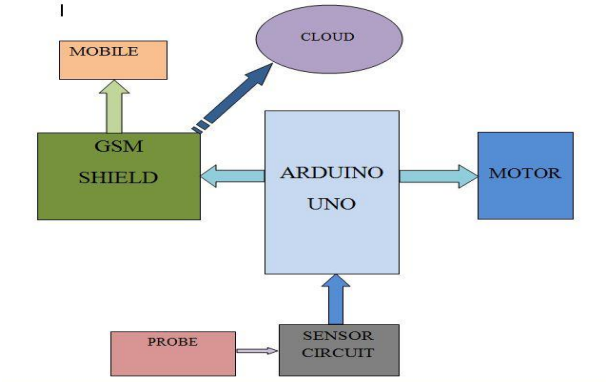

Fig. 1 Block Diagram of Smart Irrigation System

Working of this smart irrigation system is quite simple. First of all, it is a completely automated system and there is no need of manpower to control the system. Arduino is used for controlling the whole process and GSM module is used for sending alert messages to user on his cell phone. If moisture is present in soil then there is conduction between the two probes of Soil Moisture sensor and due to this conduction, moisture sensor will generate the output in the form of voltage. The output of moisture sensor is given to the arduino uno at pin no. A1. If the moisture level of the soil is less than the set value then turns on the water motor and also sends message to user about "Low Soil Moisture detected. Motor turned ON". Motor will automatically turn off when there is sufficient moisture in the soil. At the same time sensor data is send to the cloud via GSM shield.

B. Working of smart irrigation system

In this system sensor (moisture & temperature) reads the moisture contained in the soil and feed it to the arduino- uno. Controller compare the sensor input and the threshold value at the same time GSM shield will upload the data to the cloud. If the sensor input value is less than the set value then user is informed via android phone and plant gets watered or else it continue to read the moisture value. The watering will stop when the moisture level of the soil comes to the normal value. Then the motor stopped and the user will be signalled on an android phone

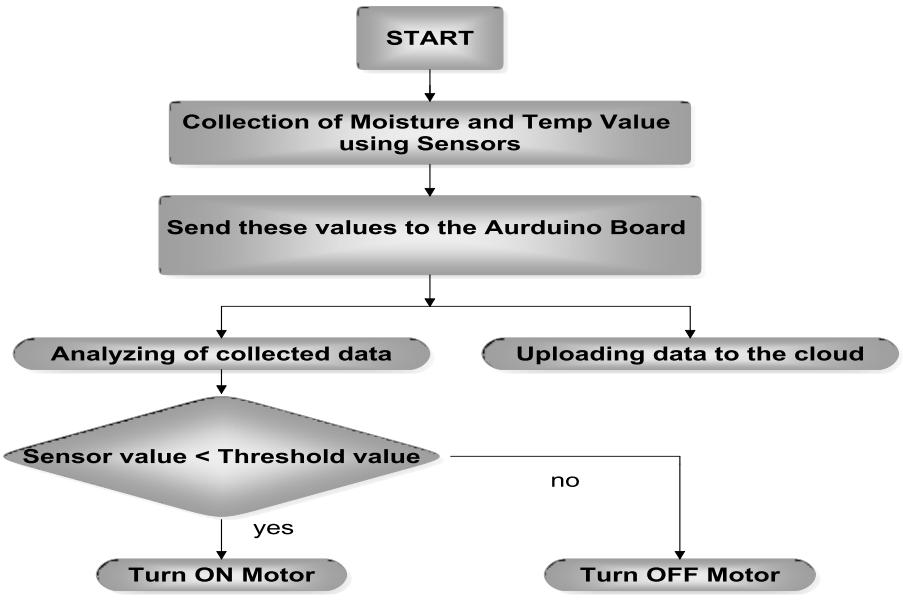

Fig. 2 Flow chart of Smart Irrigation System

With this smart system a farmer can easily manage acres and acres of crops from his laptop and even map the entire farm from his Smartphone.

C. Crop and Land used

1. Type of crop: wheat.
2. How many crops per acre: 3,000,000 seeds/acre, 1 acre = 43,560 sq feet, 26 plants per sq foot
3. Distance between two plants: 22.5 cm between two plants, 30 cm between two rows.
4. Depth of roots : Ideally 1.5-2 inches
5. Type of soil : Loam soil- Clay + silt + sand
6. Surface layer - Dark brown fine sandy layer. This type of sand has more nutrients, moisture and has better drainage , with infiltration of water & air.

IV. RESULT

A. Output of Serial Monitor

Temperature in Fahrenheit and degree is displayed on the serial monitor. Sensor continuously checks the physical quantity under test.

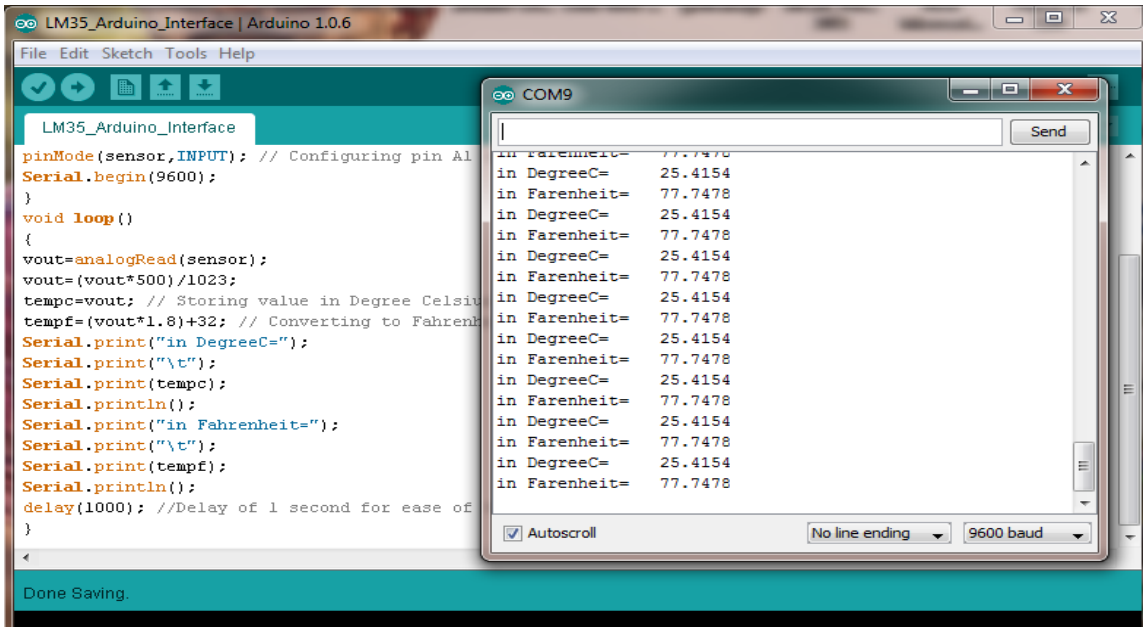

Fig. 3 Output of serial monitor for temperature

B. Output Temperature and Humidity

Farmers Humidity and temperature is observed on the serial monitor all together and the threshold value is compared with the moisture level and decision is taken to turn on a motor or not.

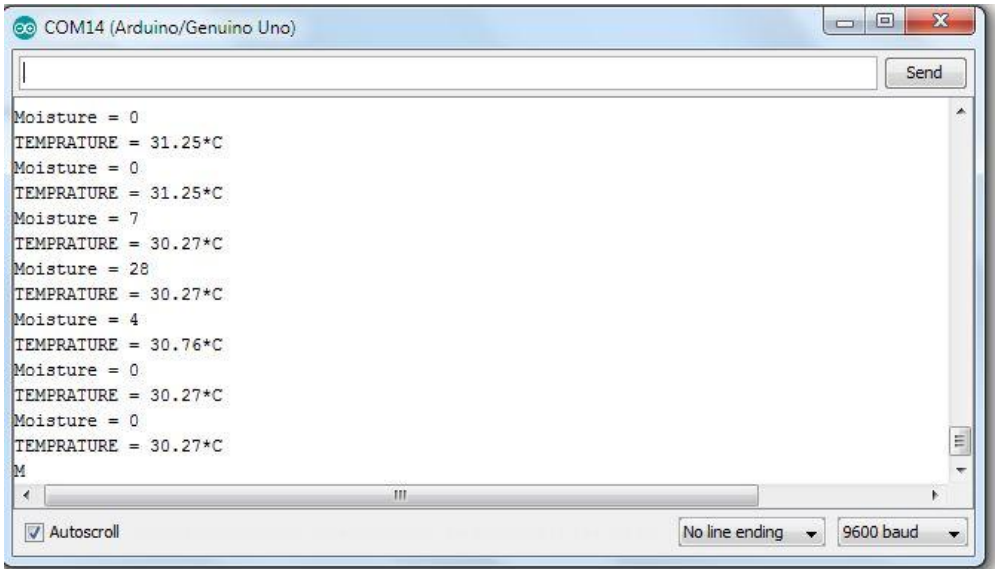

Fig. 4 Output showing temperature and humidity

C. Information via SMS

Farmers need to manage their agricultural activity along with other occupations and daily activity. Automation in irrigation system makes farmer work very efficiently without bothering about the activity in the field. Sensor based automated irrigation system enable farmer to have a watch on the activity in the farm without being physically present in the farm. On the mobile phone farmer get the information regarding the temperature, moisture, status of motor.

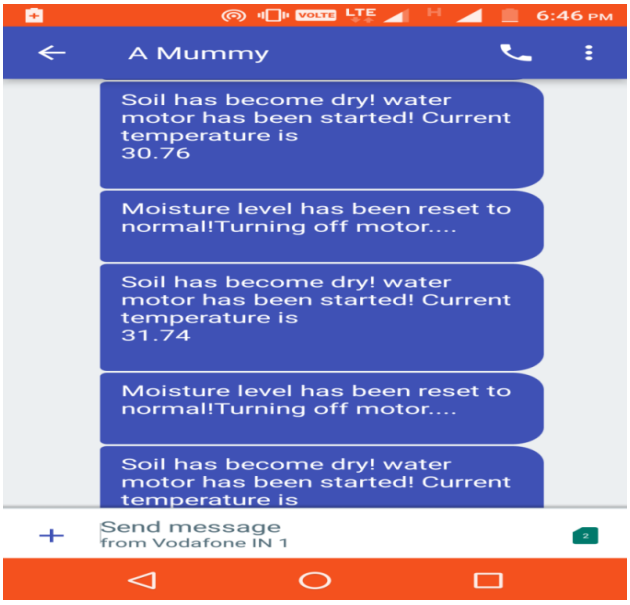

Fig. 5 SMS received on user mobile about temperature and motor status

V. CONCLUSION AND FUTURE SCOPE

Here, we have presented the methods of detecting various parameters such as moisture of the soil, temperature of surrounding of the field. In the present era, the farmers use irrigation technique through the manual control, in which the farmers irrigate the land at regular intervals. This process seems to consume more water and results in water wastage. Moreover in dry areas where there is inadequate rainfall, irrigation becomes difficult. Hence we require an automatic system that will precisely monitor and control the water requirements in the field. Installing Smart irrigation system saves time and ensures judicious usage of water. Moreover this architecture uses microcontroller which promises an increase in system life by reducing power consumption.

This system can made more efficient by using more sensor, like a sensor for checking the amount of pesticides and insecticides, humidity of the surrounding, light intensity, ph value of soil etc. To monitor the multiple farms at a time a mobile application can be built and user can command the desired field using the application. Power is main concern so for reducing the power requirement, solar plates can be implementing in farm and the whole circuitry can be operate using the solar energy. In case of inclined farm, solenoid valve and logic circuitry can be implemented in farm watering can be done as per the moisture level in the segments of the farm. PIR sensor can be used that detects human, animal available in the field and proper action can be taken to avoid theft, wastage of crop.

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