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IoT based Smart Agriculture using Thingspeak

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***Abstract*:- In India, an important growing sector is an agriculture. The major challenges in agriculture are crop productivity, soil nutrient level, smart irrigation system, crop monitoring, etc. This paper review the internet of things (IoT) based smart agriculture system using ThingSpeak. The main purpose of this work is to improve the efficiency of the existing irrigation system and to reduce the human intervention for the complete automation of the system. The proposed system consists of raspberry pi, various sensors, a pi camera, and a motor driver. Raspberry pi is the main controlling unit that can control the operation of various sensors and actuators. The soil moisture sensor detects the moisture level in the soil and irrigates the crop in a controlled manner. If there is any variation in moisture level then the sensor will update the observed value and store in the cloud. In a smart monitoring system, the pi camera captures the video and transfers it to the cloud through raspberry pi. Here Pi camera is used to provide live video streaming. All this sensor data is stored in a ThingSpeak cloud. So that we can view it from a remote location using ThingView Free mobile android application. All this sensor data we can also view on the telegram application using bot API.**

***Keywords*:- *The internet of things (IoT), Raspberry Pi, smart agriculture, ThingSpeak, Telegram*.**

I. INTRODUCTION

In India, most people living in rural areas are dependent on agriculture. Water is a scarce resource in agriculture and its optimal management is emerging as key challenges. The role of various technologies in the agriculture sector is becoming more and more visible. Research has been going on to increase the yield on a farm but if the fields and crops are not monitored properly the results may not be as per expectation. The use of modern techniques can help the farmer to not only remotely monitor their crops on a farm but also take corrective action in time. They can improve the quality of productivity of crops without much need for large manpower. In this paper, we propose a raspberry pi based smart agriculture system using ThingSpeak to reduce the manpower required in the agriculture field. In this, we can deploy various wireless sensor nodes using IoT for measuring the various variable of interest. Raspberry PI is a main controlling device that can send all the sensed data to ThingSpeak cloud and also receive controlling action from ThingSpeak service. ThingSpeak is an open-source IOT platform which enables a farmer to visualize data instantly and remotely. So they can control various parameters from a remote location. Telegram also enables a farmer to read sensor data from a remote location. A camera module is also used to keep watch continuously on the farm. The basic aim of this paper is to reduce the complexity of supervision and manpower required in agriculture.

II. LITERATURE SURVEY-

The numbers of research papers that are related to IoT based agriculture systems with different techniques have been reviewed to identify various approaches to control the irrigation system on the farm. Moreover, the different methods are reported in the research paper to have also been reviewed to get ideas on how to model our irrigation system to achieve the healthy growth of a plant on the farm.

The paper [1] [8] has described an efficient way for agriculture automation which is implemented using a raspberry pi, sensor and raspberry pi camera. They use ThingSpeak as an IOT platform which can collect and store sensor data in the cloud and develop IoT application. The smart agriculture system designed in paper [2] which monitors temperature and humidity in the agriculture field using CC3200 single chip. It also includes a camera that is interfaced with CC3200 to capture images and send that pictures through MMS to farmers mobile using Wi-Fi.

The paper [3] has focused on Bluetooth technology for field monitoring using IoT devices. Agriculture greenhouse production using GSM technology is structured in paper[4]. The remote monitoring of the greenhouse is achieved using GSM technology that supports GPRS. The proposed system in paper [5][9]is based on analyses of various parameters of soil on the ThingSpeak platform. The system consists of various components namely humidity and temperature sensor, soil moisture sensor, microcontroller unit along with Wi-Fi module, Wi-Fi router, ThingSpeak cloud and finally a mobile app. Here YL-69 electrode is used for soil moisture measurement.

The objective of paper [6]is to implement the IoT in agriculture to make it a parallel industry. It focuses on raising the finance required for the implementation of IoT in agriculture wit the help of the PATRIOT strategy.PATRIOT stands for plant and taste to reap with the internet of things. It depicts a gradual and feasible implementation of IoT in agriculture.

The paper [7] proposes a cloud-based IoT architecture that is applicable in different precision agriculture applications. The architecture is consists of three layers that collect the information from the environment and do the needed agriculture actions; a gateway layer that connects the front-end layer to the internet and back-end layer in which the data storage and processing take place.

The paper[10] discusses the need for the latest technology in smart farming using Message Queuing Telemetry Transport(MQTT) protocol. Farmers gather data in various formats using mobile sensors together with mobile devices such as smartphones and tablets regarding mainly the crops, soil, and weather allowing them to effortlessly access their data and monitor their crop. The collected data are sent to the core cloud platform where they are processed and analyzed using a specific algorithm. The results are sent back to the farmers to improve the agricultural process also allowing remote actuating of the irrigation system.

The paper [11] defines different approaches to achieves precision agriculture. Their main objective is to integrated technology research and to educate next-generation students to use and creatively adapt new technology for the future. It discusses possible components to be learned for precision agriculture.

III. PROPOSED SYSTEM

As we have reviewed much paper which discussed a different technique to control the irrigation system on the farm. Most of the existing irrigation system shown in fig1

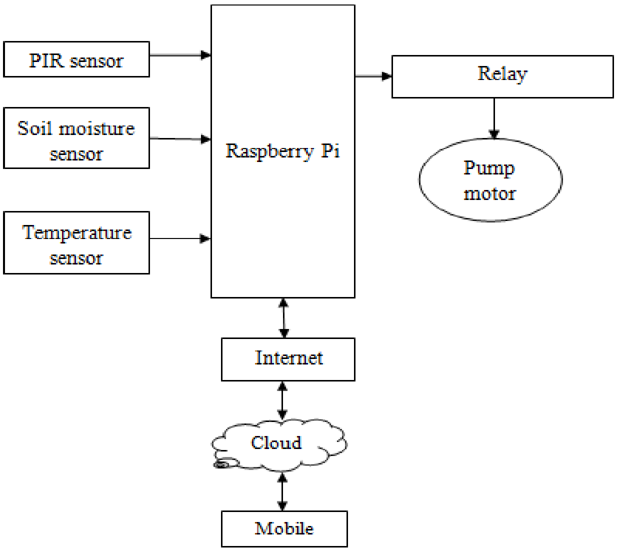

Fig. 1. Block diagram of the existing system

which control only on and off action of the motor to supply the water to the farm. It consists of the soil moisture sensor, temperature sensor, PIR sensor, Raspberry Pi, relay and pump motor. The sensor will sense various environmental data and transmit this data to the smartphone through IoT. Users can see all this information from a remote location and control actuator. But there are some situations where farmland is not uniform. In that case, uniform flow of water is not an efficient way for precision agriculture. There is a possibility of excess amount of water is store in some places on the farm which will degrade the crop productivity. In such a case, we can see some plant growth is good in some places and some plant growth was degraded in some places due to the excess amount of water stored at the root of the plant. To avoid this possibility, we propose the system which not only controls the motor action but also controls the valve of the pipe. So we can achieve a uniform supply of water to the non-uniform surface of the farm.

This paper presents a smart irrigation system using the various sensor, control valve and pumps motor to reduce water utilization in agriculture by combining the internet of things (IoT), cloud computing and optimization tools. The smart irrigation system deploys the various low-cost sensors to sense the variable of interest such as soil moisture, temperature. The sensed data is stored in ThingSpeak cloud service for monitoring and data storage. The model also consists of a camera to keep watch on plant growth from a remote location.

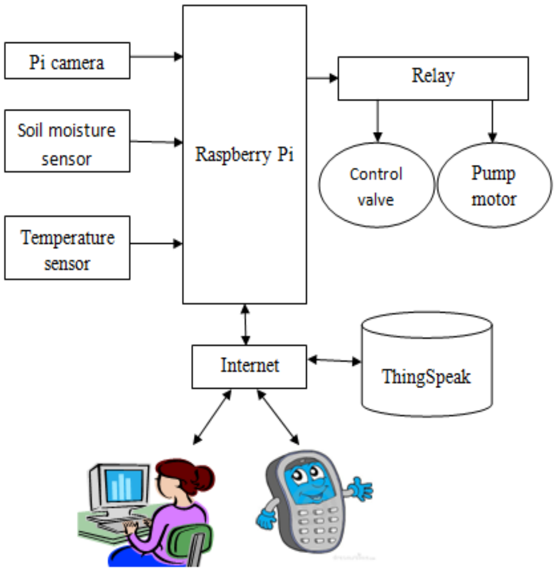

Fig. 2. Block diagram of the proposed system

The proposed system is shown in fig.2, consist of raspberry pi, various sensors, camera, control valve, and motor driver. Using a low-cost sensor node we can measure various environmental parameters such as moisture, humidity, temperature. This sensed data is transmitted to mobile phones through IOT using ThingSpeak cloud service. ThingSpeak is an IoT analytics platform service that allows farmers to aggregate, visualize, and analyze live data streams collected in the cloud. A farmer can send data to take necessary action to ThingSpeak from their own devices, create instant visualizations of live data, and send alerts using web service, Twilio. For smart supervision of the farm, we use the raspberry pi RPI-CAM-V2 camera module which captures the video and transfer it to the cloud through raspberry pi. Raspberry pi is the main controlling unit in this system which activates the valve when the signal from the sensor indicates the moisture level of the soil is low or not enough. We can see all this operation from a remote location using ThingSpeak and Mobile API. We can also see all this sensor data on the telegram app using bot API. Telegram is an instant messaging service like Whatapp but telegram allows you to create new bot through which you can fetch the sensor data from raspberry pi from remote location.bot is nothing but small chatbox. bot API is a third party application that allows the telegram to interact not only a user but also a machine.

VI. RESULTS AND DISCUSSION

In this work, a system has been developed which helps irrigation by analyzing the moisture level of the ground. This system regulates irrigation work without any manual intervention using IoT technology.

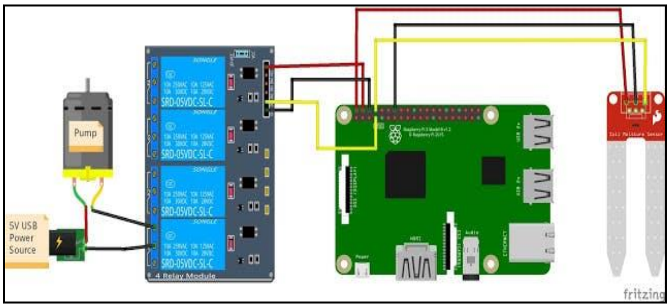

Fig. 3. Connection setup of smart irrigation system.

The smart irrigation system proves to be useful as it regulates the watering without any manual intervention. The primary applications for this project are for farmers and gardeners who do not have enough time to water crops/plants.

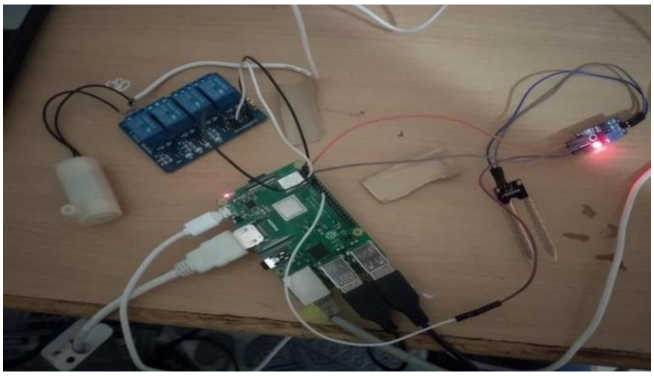

Fig. 4. Prototype experimental setup

The moisture sensors and temperature sensors measure the moisture level (water content) and temperature at a different location on the farm. If the moisture level is found to be below the desired level, the moisture sensor sends the signal to the Raspberry Pi which triggers the water pump to turn ON and supply the water to plant using the mobile application. The continuous measurement of moisture content from the sensor is noted down in the above table from date 15-9-2019 to 27-10-2019. The first 3 reading is where the weather condition is rainy then weather was dry then again the weather was somewhat winter. According to weather conditions, reading was noted down and plotted on the graph shown in fig 5.

Sr no.	Date	Output from sensor
1	15-09-2019	534
2	17-09-2019	423
3	29-09-2019	153
4	06-10-2019	90
5	07-10-2019	50
6	13-10-2019	163
7	20-10-2019	149
8	27-10-2019	134

Table. 1. Experimental results for Moisture Measurement

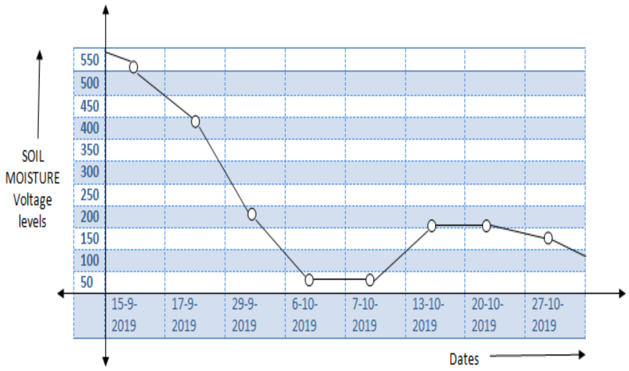

Fig. 5. Continuous manual measurement plot of the output of the sensor

All this sensor value is sent to ThinkSpeak cloud. So that we can fetch it using the ThingSpeak tool or ThingView free application on the mobile phone.

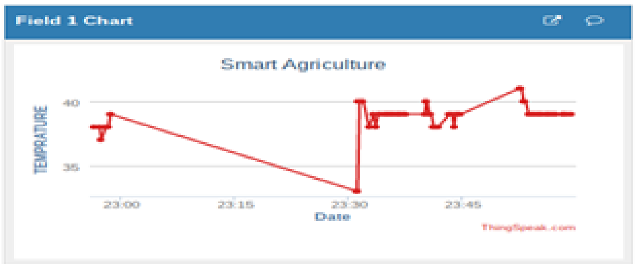

Fig. 6(a)

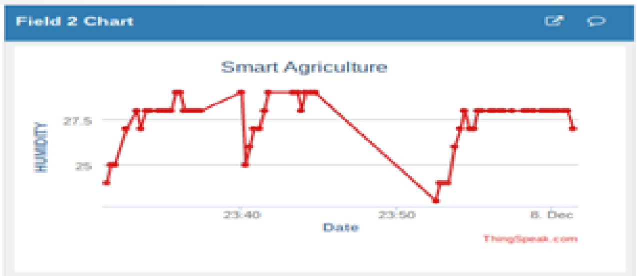

Fig. 6(b)

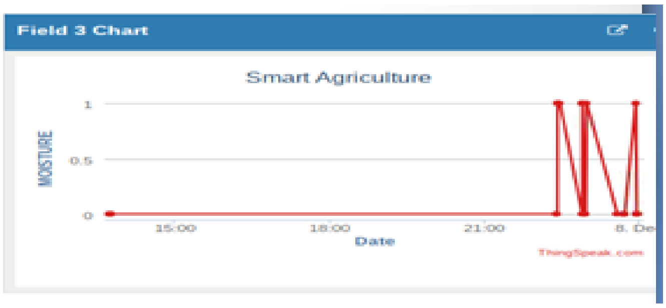

Fig. 6(c)

Fig. 6(a)(b)(c). Sensor output on ThingSpeak channel.

We can also see ThingSpeak data on mobile phones using ThingView Free application available in the play store. We just need to install it and type channel id in that which is created during the ThingSpeak channel. The sensor output on ThingView Free application is shown in fig 7.

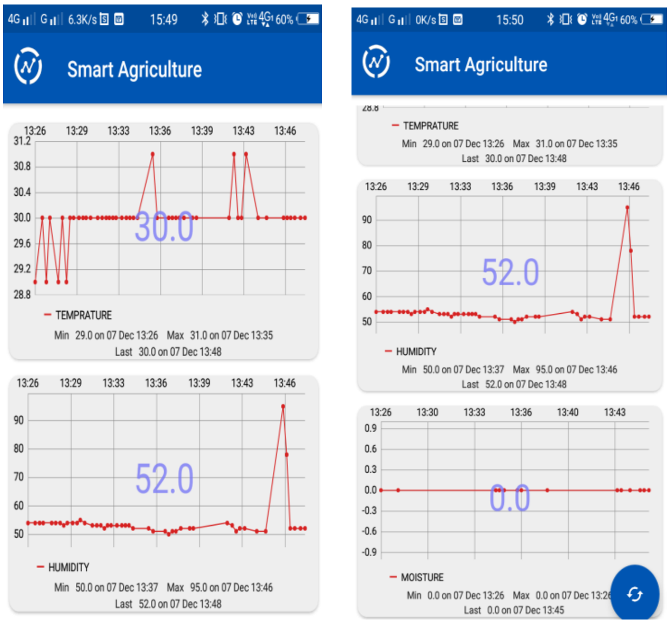

Fig. 7. Sensor output on ThingView Free application.

This sensor data is also seen on the telegram application using bot API. Telegram is a messaging app like Whatsapp, but telegram can allows you to create the bots. It has an API bot that not only allows the human to talk to it but also a machine. Telegram has a botfather that will help us to create a new bot. sensor output on the telegram application is shown in fig. 8.

ThingView Free and Telegram application allow us to see all this sensor data on the mobile phone from a remote location. So it satisfies all our aims of the smart agriculture system.

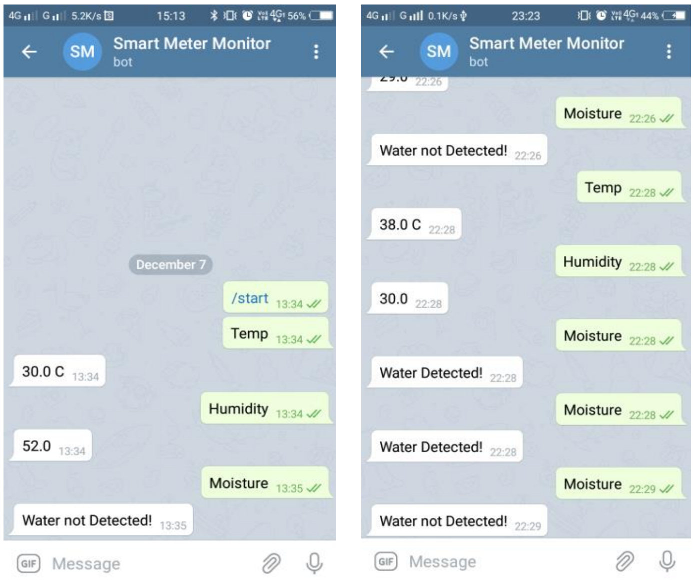

Fig. 8. Sensor output on a telegram application

V. CONCLUSION-

IoT based smart agriculture system using ThingSpeak can prove to be a very helpful system for the farmer since non-uniform and excess irrigation is not good for agriculture. We can achieve uniform irrigation with this proposed system for the non-uniform surface of the land. This system control irrigation system based on sensed real-time data from the field and we can supervise the overall system with the help of raspberry pi camera from a remote location. This agriculture monitoring system serves as a reliable and efficient solution for farmer and corrective action can be taken.

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