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Precision Farming Using LoRa Technology

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***Abstract---* Agriculture is the most significant sector in human life. This sector provides all fundamental necessities to human beings. Agriculture sector also plays a essential role in the economy. Using modern IOT based technologies we can improve our traditional farming to the next level. This paper puts forward the idea of the use of LoRa technology for the improvisation of our traditional methodologies of farming. With the help of this, farmers can measure the moisture of soil, temperature, humidity, and pH level of soil using different sensors, LoRa technology, and Cloud computing technology. The data generated from different modules is collected at gateway and gateway sends that data to Things Network thereafter all that organized information is given to end-user. Then end-user must take appropriate action on data. This whole process is done with low power consumption and with a wide range of access. Using LoRa gateway about 10Km range we can access data and take action on data. LoRa Technology and cloud computing enhance the rapid growth of the agricultural sector and modernization. This helps in getting solutions to agriculture and farming-related queries.**

***Index Terms*— Precision farming, LoRa, thethingsnetwork, thingspeak cloud**

I. INTRODUCTION

Agriculture is an important part of the Indian economy and plays a deciding role in the overall socio-economic development of the country. Agriculture is the spine of our country & economy which accounts for approximately 30% of GDP and employs 70% of the population. However, the performance of this sector is not up to the mark. Traditional methods which are used by farmers are not appropriate for increasing farming yield. In western and middle-eastern countries there is continuous improvisation in farming techniques using modern smart techniques. They take large number of yields in small areas by monitoring and studying the field of agriculture. So, for competing with International standards India has to modernize this sector.

Using Precision agriculture this goal can be achieved. By using Precision Farming India can get help in achieving its sustainable goals. Using this technique use of fertilizer can be reduced, which helps in reduction of soil pollution. Precision Farming is a methodology of agriculture management concept supported by monitoring, calculating, & responding to inter & intra-field variability in crops. It is an approach to farming that uses information to make sure crops can grow in optimal conditions. Agriculture in India expects more attention to be given to farming activities as well as farmers. More research must be carried out regarding the latest agriculture tools & testing the quality of various innovative ideas. Precision agriculture aims to improve revenue by utilizing the precise information recorded using technologies available for sensing and communicating.

II. LORA TECHNOLOGY

LoRa Technology is developed by Semtech to transform the IoT (Internet of Things) by enabling data communication over a long range using very little power. LoRaWAN is basically Long Range low-power wide-area network modulation technology. This modulation method is based on CSS that is the Chirp Spread Spectrum. CSS uses wideband undeviating frequency modulated chirp (signal in which the frequency increases/decreases with time) pulses to encode given information. Currently LoRa uses sub -gigahertz license free RF (radio frequency) bands like 868 MHz in Europe and 867 MHz in India. This technique covers the physical layer but the LoRaWAN uses upper networking layer. LoRa can achieve data rates between 0.3 kbps & 27 kbps reliant upon the spreading factor.

LoRa /LoRaWAN technology has many improvement over other IoT enabling techniques. It requires low power, is low cost and easy to handle. It can be used on both private as well as public network also. LoRa modules can be deployed in indoor and outdoor environment. The interesting properties of LoRa technology which makes it a resourceful transceiver are scalable bandwidth, high robustness, multipath resistant, Doppler resistant, long range capability and upgraded network capacity. Subsequently, LoRa provides large distance coverage with low power, thus offering the finest solution for connecting devices like sensors and gateways placed at long distances up to 10 km. Thus, we can make use of LoRa to collect data from different sensor-modules placed in a farm in different places with the help of gateway (which is connected with things network) and store it in cloud for further analysis.

III. CLOUD COMPUTING

Cloud computing is indicating manipulating, configuring, and accessing the applications online. Cloud computing is a prototype of distributed computing to supply the customers with on-demand, benefit-based computing services.

ThingSpeak is a network service (RESTful API) that permit you gather & store sensor data in the cloud and develop Internet of Things applications. It works with all kinds of programming languages and also lets you present online analysis and act on your data. Sensor data can be transmitted to thingspeak from any hardware that can interconnect using a RESTful API. ThingSpeak enables various services like real-time data collection, analysis, and visualization of collected data. Further, it enables the creation of plugins, apps, e-services, social networking, and other APIs.

ThingSpeak is an IoT analytics platform service from Mathworks, the makers of Matlab.It allows you to collective visualize & analyze live data streams in the cloud, Further, ThingSpeak provides immediate visualizations of data posted by devices or equipment. ThingSpeak accelerates the development of concept IoT system especially for applications that require analytics.

The Thethingsnetwork is a global, collaborative IoT ecosystem that enables LoRaWAN solutions. The Thethingsnetwork provides a worldwide LoRaWAN network. This network permits anyone to connect their gateways, register devices, and send/receive data for free.

IV. SENSORS

FC28 sensor is used to perceive the content of water in soil. This sensor has two probes those are used to sense the water in soil. When current is passed through the probes, resistance is measured. If resistance is high then low current will be passed through soil, so the moisture will be less. When resistance is low more current will pass through the soil so moisture level will be high of the soil.

DHT11 is a temperature & humidity sensor. It detects temperature & humidity of surrounding. It has capacitor with humidity sensing material between two electrodes, which senses the humidity. It uses thermistor to measure temperature of surrounding air & gives out a digital signal on the data pin.

V. LITERATURE REVIEW

[1]According to the 2010-11 Agriculture Census, the total number of operational holdings was approximately 138 Million with an average size of 1.15 hectares. Of the total lands, 85 percent are in marginal & small farm categories of less than 2 ha. So, marginal farmers are larger in number. The future of agriculture is a very important question for all other stakeholders. Government as well as farm-related organizations try to report the key challenges of agriculture in India, including smallholdings of farmers, processing, supply chain, the infrastructure supporting the efficient use of resources. There is a necessity to work on cost-effective technologies with environmental protection and on preserving our natural resources.

Precision agriculture with soil testing-based assessments, auto-mation using the Internet of Things will be focused on precise application inputs in agriculture. Sensors will be used for accuracy, quality & environment in a cost-effective manner.

[2]For marginal farmers, these technologies can play an important role in achieving high yield in minimum area. The sensor data compilation & irrigation control were put forward on crops using remote devices and wireless sensor networks for smart farming. The surrounding data can be collected and the irrigation system can be controlled. This paper mainly concentrated on the automation of irrigation by controlling the flow of water by sensing the temperature, humidity, and soil moisture. This execution used ZigBee communication to execute the above functions and communication is between sensor nodes & smartphones for the information collection or monitoring water flow in the field.

[3] The idea of sensing the nutrients in the soil and providing solutions to farmers from analysis done on the data collected in the data collection center was introduced. The proposed idea was implemented with Wi-Fi or ZigBee. In this paper data collection was done using ZigBee or Wi-Fi covers a smaller distance compared to a LoRa.

VI. SUGGESTED METHODOLOGY

Dragino kit presenting LoRa Technology is designed to help developers to implement modules easily and seamlessly. In this project, the first step is to implement Arduino and sensor modules in different places in a farm like 4 corners and 1 in center to collect data precisely. Those four to five modules transmit data to LoRa gateway. LoRa gateway receives all the data and send that data to Thethingsnetwork. Thethingsnetwork is connected with gateway and collects all data and combine data. The combined data is send to Thingspeak for analysis. Thingspeak uses Matlab for data visualization, which makes data analysis easier.

VII. METHODOLOGY

Precision Farming can make an extreme change in increasing crop production. Using remote access farmers can manage time and start part-time businesses or work.

Basically in our project or module, farmers can manage farm fields from a range of 10Km distance by using smartphones or laptops. Moisture sensor and humidity-temperature can take time to make measurements and transmit data using LoRa gateway to Thethingsnetwork. Thethingsnetwork collects all data and combined data is sent to a Thingspeak. Thingspeak the Mathworks based software visualizes data in a graphical manner. Depending on the analyzed data additional measures were taken to increase the crop yield. The analyzed data was converted to useful information and was given to end user. This information can be used in farm field for quantitative as well as qualitative growth of crops.

Fig.1.Blockdigram

VIII. SYSTEM DESIGN AND IMPLEMENTATION

Client Module : -

The client module consists of LoRa node along with Atmega128 controller and is connected with sensors are used to collect condition of soil such as its moisture and humidity-temperature of surrounding.

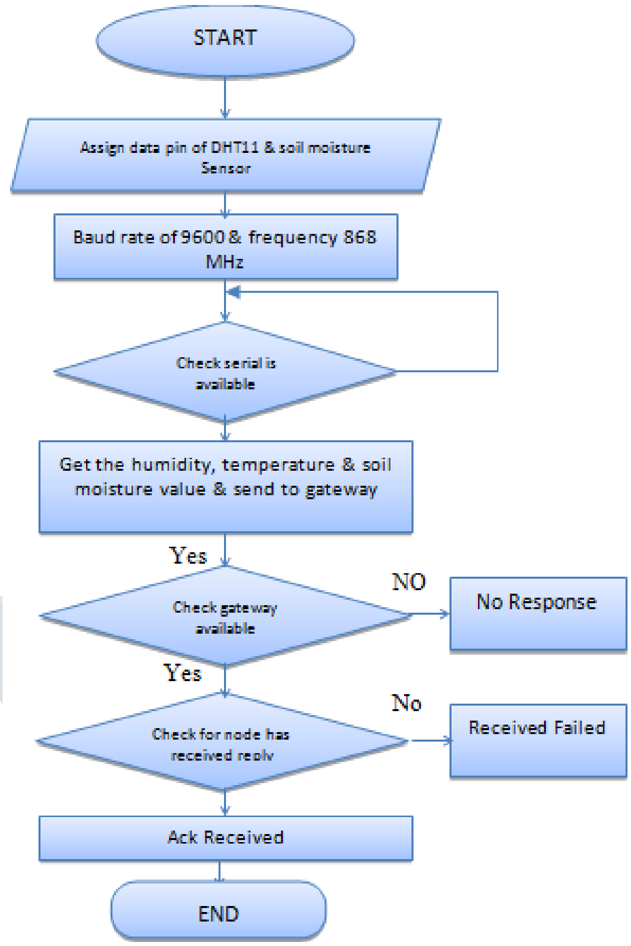

Fig.2.Flowchart of client module

Soil moisture sensor FC-28 is used to calculate the moisture of soil. DHT11 sensor is used to collect humidity and temperature of the field. This data collected, was analyzed to provide information regarding water requirement in the field.

In fig.2 flowchart of client module is showed.

Gateway Module :-

The gateway module acts as a link between the LoRa nodes and the cloud. Gateway collects the data from LoRa nodes and gives it to the cloud to analyze the data. LoRa gateway can communicate with the LoRa nodes placed at almost 10km distance in the open field as their range is higher than any present technologies.

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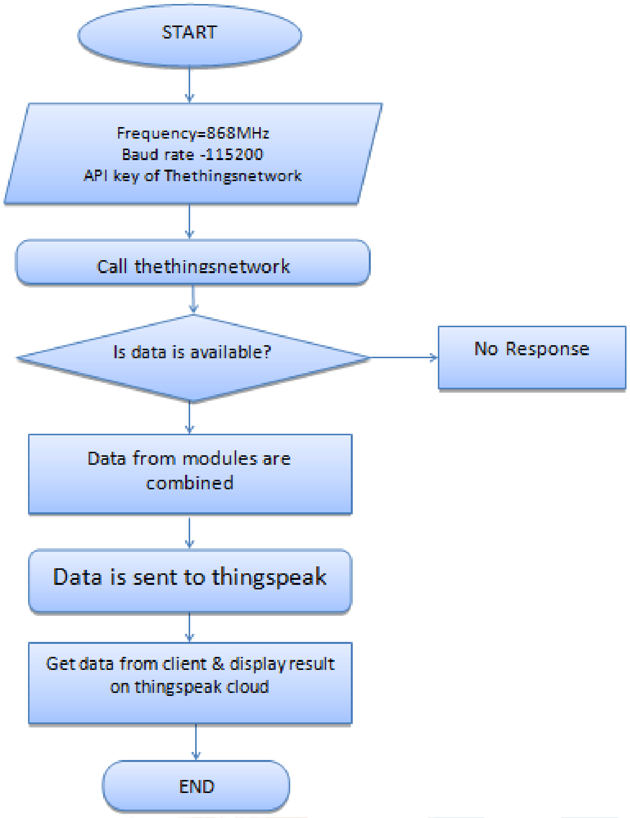

Fig.3.Flowchart of gateway module

Basically, the gateway uses two technologies to communicate one is Lora technology to collect information from LoRa nodes placed in fields and the second one is WiFi, which is used to upload the data collected into the cloud. It uses HTTP protocol to communicate between gateway and cloud. Thus gateway has to be placed as per the requirements. Receive data from LoRa nodes through LoRa communication and upload data to the cloud through HTTP protocol.

For storing and analysing data one has to create account, Thethingsnetwork account and thingspeak account for visualization of data. Once account is created then gateway and Thethingsnetwork integration should be done using application session-key, network session-key & device address. Thethingsnetwork collects all data and sends it to Thingspeak Cloud for further process.

In Fig.3 the gateway module and cloud computing is showed.

IX. RESULTS

The figures below show the implementation on the Thethingsnetwork and graph of information collected by gateway on Thingspeak at real time.

Fig.1 first part of figure describes gateway overview that is connected to LoRa Gateway and second part shows application modules are connected.

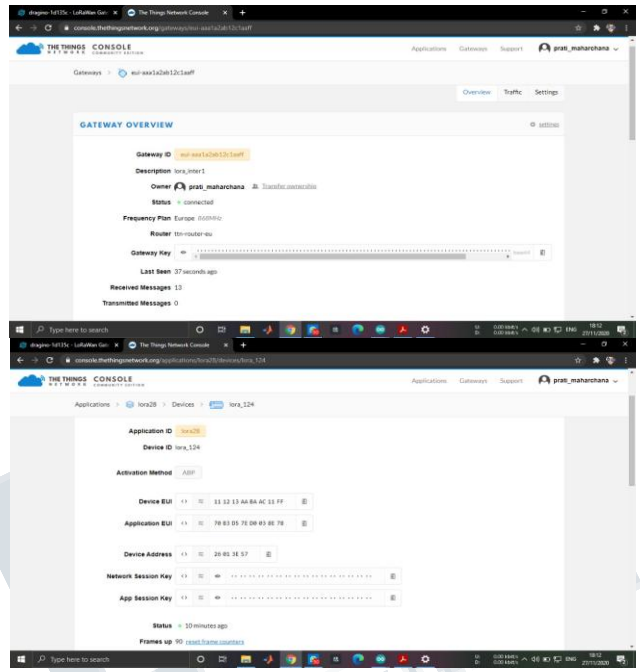

Fig.1. Connection established on Thethingsnetwork

Fig.4 shows the data collected on thethingsnetwork from gateway in hexadecimal form with real-time.

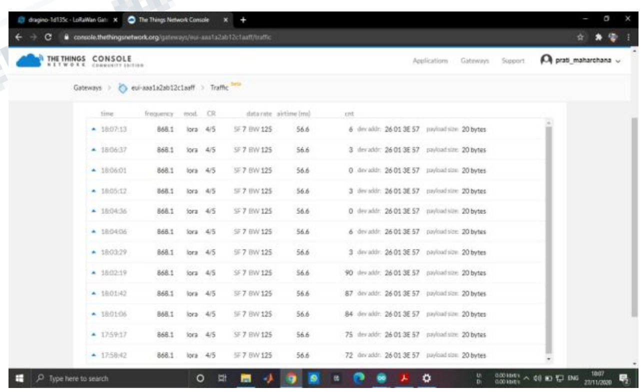

Fig.4.Console of thethingsnetwork

Fig.5. shows program used for connection establishment between Arduino and sensors module with LoRa gateway. In this program from the fig.1 application session key, network session key, and device address is given.

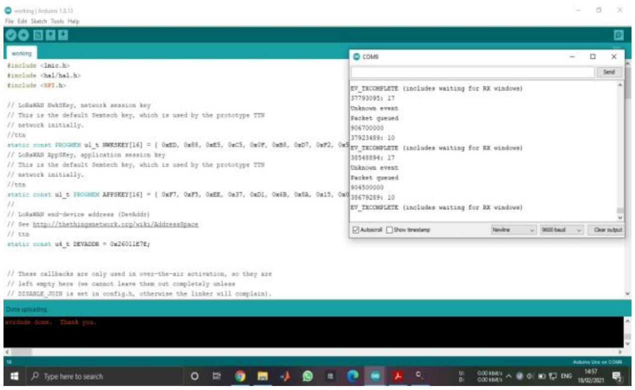

Fig.5.Arduino IDE program connect with network

Fig.6 shows the results obtained from module. It shows humidity, temperature, soil moisture. In this fig.6 graphical representation for analysis and monitoring is shown.

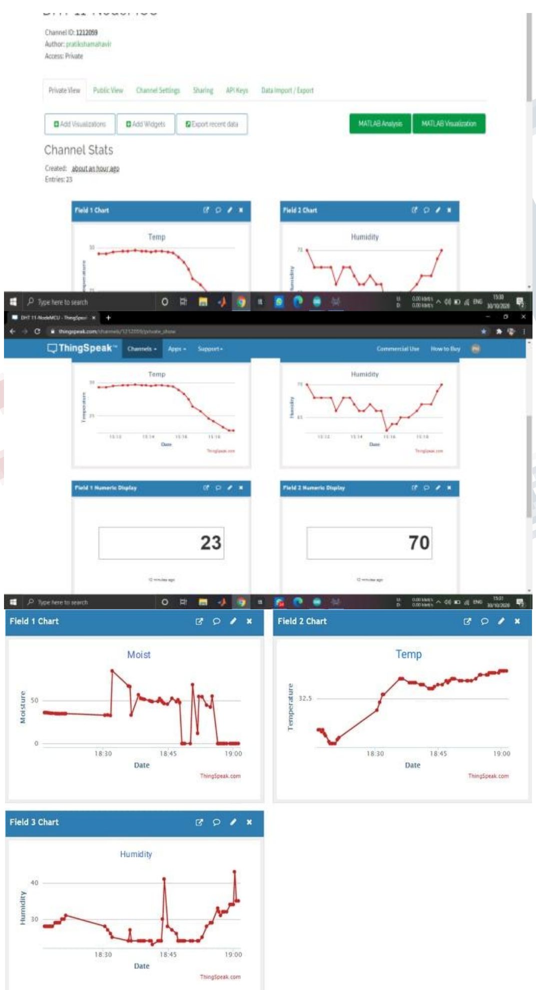

Fig.6. On Thingspeak Data obtained from sensors connected

X. CONCLUSION:

LoRa comes on the top as a robust, schematic, low cost and highly flexible solution. LoRaWAN decides the network's communication protocol while the physical Lora enables long-range communication connections. Here, different variables pertaining to the growth of crops in farming, such as temperature, humidity, PH, soil moisture, etc. are considered. The procedure is tested and established to be cost-effective (cheaper) and correct than the existing procedure.

FUTURE SCOPE:

Changing requirements due to increase in incomes, globalization, and health awareness is affecting and going to affect the production more in future.
Large-scale network will be deployed in a farming setting to demonstrate the benefits of precision farming and each use of the approach. Farmers would benefit from the successful implementation of this project.

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