LORA BASED WIRELESS SENSOR NETWORK FOR SMART AGRICULTURE

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Abstract: The newly emerging technology wireless sensor networks spread rapidly into many fields like medical, habitat monitoring, bio-technology etc. The relevance of WSN are tremendous. The utility of WSN is for collecting the sensed data, storing or processing the sensed data and the transmitting data to the appropriate central station. Agriculture is one of the field which have recently averted their scrutiny to WSN. By taking help of WSN, one can transmit the real-time data quickly with in no time. The WSN system which is used for precision agriculture. Precision agriculture is nothing but applying right inputs at the right time to get more cultivation with less power and work. The real-time data is based on the several characteristics of weather like temperature, humidity etc. The architecture of the developed WSN system in this paper comprehends a set of sensors called sensor node, base station and central station.

Index Terms– Wireless Sensor Network, Long Range Low Power

I. INTRODUCTION

Our nation is agribusiness-based country where half of Indian population has cultivating as their essential occupation or side business. Agribusiness is craftsmanship, science or practice for developing harvests by utilizing diverse planning techniques.

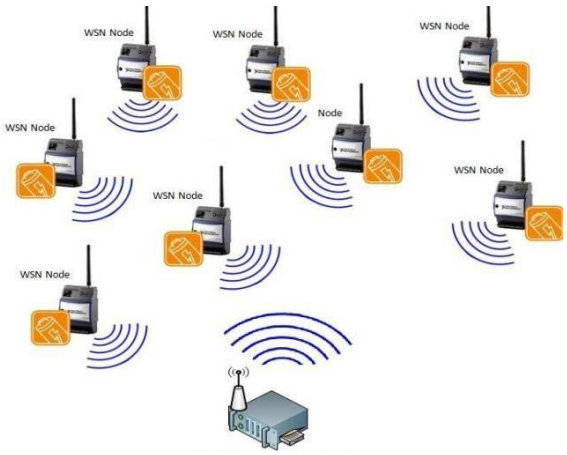

Fig.1. WSN modules

Ranchers develop the different designed strategies, methods and numerous machines. The customary cultivating rehearses with certain conditions that are liable to rainstorm or climatic differences. By adopting the customary strategies proficient outcomes are not watched, we can expand the yield by receiving cutting edge innovations they are additionally called as present- day cultivating. Present day cultivating can be accomplished by including new ideas, for example, Internet of Things (IoT), Wireless Sensor Networks (WSN) and Precision Agriculture (PA). Accuracy agribusiness also known as Precision agriculture is portraying as the condition of workmanship and study of receiving cutting edge innovation to expand the yield development. Horticultural data sources, for example, showering, excrement, bug sprays,and so on are connected in exact amounts as controlled by displaying of yield

development courses of action to misrepresent the plant field and to reduce the effect on nature.

The assurance of the harvests is basic. So, there is a requirement for checking of the information and that information ought to be genuine. So as to give moment answer for the yields the information ought to be gathered in a savvy way yet not by manual strategies. So, to accomplish this we need to utilize remote sensor organize. As of now wireless sensor network is received by numerous applications like water quality administration, informationgathering, wellbeing checking and so on.

The principal goal of this paper is togive quality harvest development method in a predefined standard for example utilizing LoRa innovation. A system contains numerous hubs and every hub will be conveyed in a predetermined and predefined place. In this few hubs, one hub goes about as the organizer thatis associated with the concentrated machine. Every hub comprises of a processor for example Arduino, sensors are used for estimating the accompanying parameters soildampness, mugginess, temperature and light power and a LoRa which goes about as the end gadget.

II. PROBLEM STATEMENT

Now-a-days cultivating crops are becominga very hectic task for the farmers because of the unpredictable and sudden changeof the climate the damage ratio will be high and even the loss rate will be high. So, in order to overcome this scenario, we have to adopt a design procedure which should be effective. The solution for this problem is by following the techniques of precision agriculture also known as smart agriculture. Precision Agriculture is a process of giving a correct set of inputs to the crops or lands according to the environment changes. Precision Agriculture follows a defined set of rules. They are collecting the data, processing the data, sending the data to the centralized machine and according to thedata received the decisions will be taken by theexpert.

III. LITERATURE SURVEY

W. Ye, J. Heidemann et.al[1] proposed , “An Energy- Efficient MAC Protocol for Wireless Sensor Networks,” Wireless Sensor Networks (WSN) have developed in recent years and have also been one of the major focuses of research in wireless technology. This rapid development has been facilitated by the evolution of electronics miniaturization, growth in performance, wireless technologies, energy efficiency, and the development of protocols.

Ch. Apparel, G. Ravi Babe et.al [2] reported “Development of Low Cost Soil Moisture Sensorfor Drip Irrigation System“, Now-a-days cultivating crops are becominga very hectic task for the farmers because of the unpredictable climate and expense cost of the seeds. Due to the unpredictable and sudden change of the climate the damage ratio will be high and even the loss rate will be high. So in order to overcome this scenario we have to adopt a design procedure which should be effective.].

G. Lu, B. Krishnamachari et.al[3] explained “Adaptive EnergyEfficient and Low-Latency MAC for Data Gathering in Sensor Networks,” The advent of Wireless Sensor Networks (WSNs) spurred a new direction of research in agricultural and farming domain. In recent times, WSNs are widely applied in various agricultural applications. The potential WSN applications are reviewed, and the specific issues and challengesassociated with deploying WSNs for improved farming. To focus on the specific requirements, the devices, sensors and communication techniques associated with WSNs in agricultural applications are analyzed comprehensively [3].

R. Beckwith, D. Teibel, and P. Bowen et.al[4] explained “Unwiredwine: sensor networks in vineyards”, LoRa is a long- range, low-power, low-bitrate, wireless telecommunications system, promoted as an infrastructure solution for the Internet of Things: end- devices use LoRa across a single wireless hop to communicate to gateway(s), connected to the Internet and which act as transparent bridges and relay messages between these end-devices and a central network server. An overview of LoRa and an in-depth analysis of its functional components is provided.

Miao Yuqing et.al[5] proposed "New technology for the detection of pH ",Most LPWA networks operate in the unlicensed ISM

bands at 169, 433, 868/915 MHz, and 2.4 GHz depending on the region of operation. Some of the most pronounced LPWA candidates are Signor, Lora, Weightless, and Ingénue.

Ning wang, et.al[6],"Wireless sensors in agriculture and food industry Recent development and future perspective Computers and Electronics in Agriculture", The focus is on Lora (Long Range), one of the most promising wide- area Iota technologies proposed by Semitic and further promoted by the Lora Alliance. At the heart of Lora's success is its adaptive data rate chirp modulation technology allowing for flexible long-range communication with low power consumption and low- cost design.

D Ramesh et.al[7] explained, "Data Mining Techniques and Applications to Agricultural Yield Data" Essentially, this is achieved via spread spectrum multiple access techniques accommodating multiple users in onechannel. Lora Alliance has defined the higher layersand network architecture on top the Lora physical layers and termed them Lora WAN. Together, these features make Lora attractive to developers who canbuild complete system solutions on top of it for both geographical and residential/industrial types of Iota networks, thus fast- tracking its market adoption. Despite this success, Lora has not yet attracted similar levels of attention from the academic and research community with only very few peer-reviewed studies published to date.

IV. TECHNOLOGY OVERVIEW

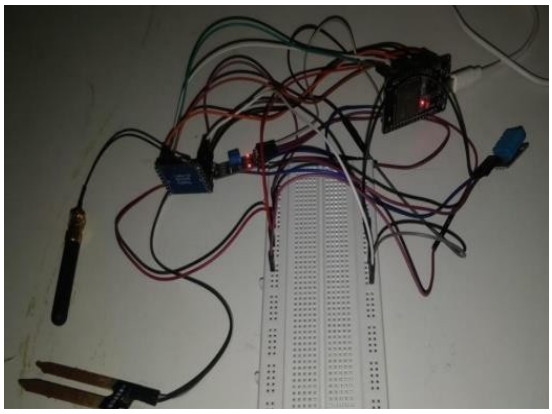

Fig.3: Lora sending kit which shows the interconnection between Lora device, ESP 32,DHT11 sensor and soil moisture sensor

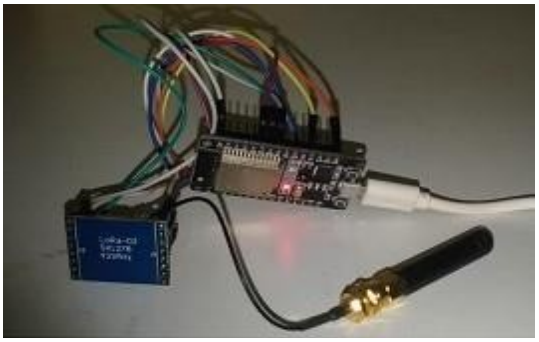

Fig.4: Lora receiving kit which showsLora device connected with ESP32 device.

The main advantage of this technology is we can have communications between two devices up to few kilo meters at low power, this can't be achieved using other technologies such as Wi-Fi, Bluetooth etc. Official vendors of Lora devices are SEMTEC they produce various chips operating at different frequency bands, other vendors such as Hi-tech, AI thinker etc. also there in the market.

Irrespective of vendors all chips will have pins such as ANT antenna,VCC, GND, RESET, SISO, MISO etc. it is not possible to program Lora chips directly, they need to be interfaced with other programmable devices such as ESP32, there are certain boards which comes interfaced with ESP32
, vendors such as HELTECH, TTGO produce such boards. so, choosing right board and right Lora chips playsimportant role.

In the proposed project Lora chips from the vendor AI thinker is used, since they are not ready to program, they have got interfaced with ESP32 development boards.
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Adriano IDE can be used to program the chips, before dive into program we should install libraries which finds handy to control Lora chips for various operations. one such library used is Loraby Sanded Misty. While coding following points needs be followed to establish successful communication.

V. OVERVIEW OF WIRELESS SENSOR NETWORK

Wireless Sensor Networks should quench some basic requisites to be used in precision agriculture. They are Sensor nodes should be deployed accordingly and it should not affect the manual essential method and parameters

like fertilizers etc. Those shouldn't be interrupted in order to get maximum cultivation. The network which we designed should be energy efficient in order the deployed nodes which are operated using battery last for longer periods.

Widely the WSN which we designed are for data collecting and monitoring. the data packet loss will be more for WSN so we should take care about the data loss. Generally, the data rate without loss rate will be 85% so if we able to increase this rate then the WSN efficiency also increases.

Precision agriculture farm field area should beguided by the factors i.e., sensing the different parameters and maintaining the various positions of the node in the field. It is beneficial to use the WSNwhich allows more flexible. Thus, for a desired requisite system scalability is very important.

The WSN must able to communicate or interface with other technologies. The WSN which designed should be able to interface with other technologies to increase interoperability. If the WSN which is designed is able to interfaced with many technologies, then it can be very efficient and easy to transmit the data between many networks' topologies

VI. DESIGN AND IMPLEMENTATION

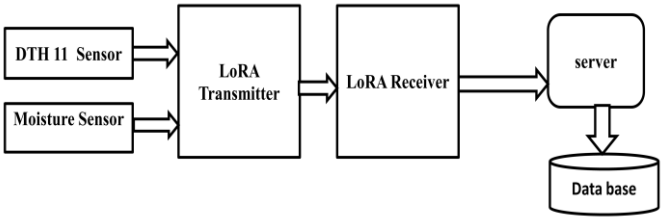

Fig5: Architecture Diagram

The above figure shows the architecture diagram which is a system of various elements: Sensors, Lora sending and receiving kit, Apache web server and a Database. A Lora system comprises of a few components: Lora nodes/ end points. Lora end points comprise of sensors or the applications wheredetecting and control happens. These nodes are usually set remotely. In this project only one sending device is used.

DHT11 sensor fetches the temperature and humidity values of the air. The DHT11 is a regularly utilized temperature and moistnesssensor. The sensor accompanies a devotedNTC to quantify temperature and a 8-bitmicrocontroller to yield the estimations of temperature and mugginess as sequential information. The sensor is likewise production line adjusted and subsequently simple to interface with different microcontrollers. The sensor can gauge temperature from 0°C to 50°C and moistness from 20% to 90% with an exactness of ±1°C and ±1%. So, in the event that you are hoping to gauge in thisrange, at that point this sensor may be the correct decision for you.

Soil moisture sensor gives the moisture value of soil. The soil dampness sensor is a straightforward gadget for estimating the dampnesslevel in soil and comparable materials. The dirt dampness sensor is straight forward to utilize. The two enormous uncovered pads work as tests for the sensor, together going about as a variable resistor. The more water that is in the dirt or some other material methods the better the conductivity between the cushions will be and will result in a lower value. The result of the dirt dampness sensor changes in the scope of ADC esteem from 0 to4095.

Lora gadgets and remote radio recurrence innovation (Lora Technology) is a long range, low power remote stage that has turned into theaccepted innovation for Internet of Things (Iota) systems around the world. Lora Technology empowers keen Iota applications that unravel the absolute greatest difficulties confronting earth:vitality the executives, regular asset decrease, contamination control, framework proficiency, debacle aversion, and more. The sensor values are given to the Lora sender.

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Apache Web Server is intended to make web servers that can have at least one HTTP-based sites. Striking highlights incorporate the capacity to help various programming dialects, server-sidescripting, a confirmation system and database support. Apache Web Server can be upgraded by controlling the code base or including numerous expansions/additional items. In the database, a tableis created and used to store the values sent by the sensors, depending on the values, one can decide if the motor should be switched on or off.

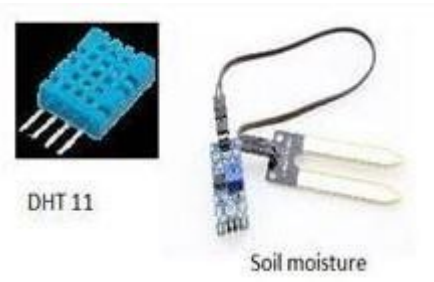

Fig.2. Sensors Used.

Accomplishments of the best in class incorporated advancements give structure and assembling extremely low power transmitters, beneficiaries and sensing devices, for example every single required component for execution of complex remote sensor systems (WSN) in light of the worldview Internet of Things (IoT). Relies upon. application the design of sensor system can be enormous scale or little scale dependent on just a few sensing devices, just as static with fixed configuration and area of sensors or dynamic with for all time changing area in extent. Genuine applications utilizing IoT-based WSN as principle have half and half design joining diverse remote correspondence innovations. Power utilization and time of independent working for remote sensors arethe key elements at planning dependable and maintainable frameworks. PC helped plan of WSN gives enhancement of chose engineering to explicit arrangement of beginning conditions and necessities for the sensible time. Fundamentalobjective of a WSN manages estimating distinctive physical attributes of the item, for example, temperature, vibration, moistness, radiation, and so on., simple change of got information, for example writing the code and forwarding it to a remote host. Gathered informational index can be utilized as crude source for huge information investigation or web-based observing of the item conditions

Vll. ADVANTAGES

1. Farmers could monitor the soil dampness as well as humidity and temperature values fromremote place, their existence in the field isn't must.
2. The ranchers can control the motor from a far spot.
3. Remote access is bolstered.
4. It causes one to limit the water use by giving effective data which is utilized to choose ifthe motor ought to be turned on or off.
5. Since water is maintained scientifically, high return can be acquired.
6. Lora uses frequencies that are allowed to utilize freely anywhere in the world

VIII. CONCLUSION

The proposed model utilizes Lora innovation to share sensor information by means of remote system, it finds helpful in the field where machine to machine correspondence by sharing information assumes significant job. The proposition undertaking peruses fields parameters, for example, soil dampness, temperature, mugginess from field and updates all data to base station which is related with Lora Transmitter. Further information is sent to the Receiver at 433MHZ recurrence by methods for encoded parcels, these bundles are decoded at recipient and populated to database for further choice.

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