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Smart Irrigation System with Lora & Recording of Lora Broadcast Using RTL-SDR Dongle for Spectrum Analyzation

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Abstract:- Agriculture is important as well as it provides us with food for livestock and for humans to eat and prosper with. Farmers deal with issues on a daily bases as over-irrigation and under-irrigation can demean the quality of crops on the short and long range. Therefore, continuous and precise monitoring is required to ensure maximum agricultural yield. With increase in the population the demand for water also increases concurrently. The population in India is expected to increase 2 times the present by 2050. IoT referred to as Internet of Things proposes an innovative approach to quality of agriculture. Using IoT, we built a smart irrigation system using LoRA technology. This work proposes a solution that has both a conceptualized and actualized prototype of a smart irrigation system that uses an IoT approach for monitoring the fields and controlling water motors to ensure coverage of large fields. Moreover, this work proposes a control over web application with a micro- controller hosting webserver with a two factor authentication over mobile SMS, and saving data over online database. In particular, this work proposes connection using long range communication between nodes to monitor sensor data, with manual or automatic control over irrigation based on sensor thresholds.

I. INTRODUCTION

India is a developing and agriculture based country. 1/3 of rain is falling in our country. Day by day manpower availability for farming is lacking. To introduce new range of technologies and fuel more development on under developed or new technologies for making India developed. Due to this problem, farmer face a lot of issues. Therefore it is very difficult for an average farmer to gain information regarding soil and weather is good for crop production or not. Due to very poor water management and not much scientific development is happened in agriculture, our contribution is on using IOT for Smart Irrigation System with LoRaWAN technology. Through the LoRaWAN communication we can access up to 120 devices. It is the full duplex communication supported device. This proposed system 'an automatic irrigation using LoRaWAN' helps to understand the conditions of soil and humidity conditions that are ideal for the irrigation. A sensor is deployed, which gives information about moisture and humidity content in the different soil. The sensed data are transmitted to the control station LoRaWAN. In control station we receive different soil moisture values and humidity value from different places. These values has been processed through the Raspberry PI processor, if the soil moisture value and humidity value are below the normal, solenoid valve will turn ON automatically this command. By the use of Raspberry-PI IoT processor, we can store the data on cloud also. We can monitor the soil moisture, humidity and control the solenoid value through the internet.

II. LITERATURE SURVEY

- Technologies that are being used to develop IOT Systems are the first phase of an IoT system. In the Near Future IoT is set to become one of the main cross over hub between various technologies by connecting smart physical objects together and allow various applications in the process of smart decision making process. In this paper we discuss Architecture of IoT and technical knowledge that are relevant to IoT. Then, we give an overview about Technologies which come under IoT, protocols, applications and related issues with comparison of other research and survey papers. Our main goal is to provide a basic design framework to an researcher or application developer that how different set of protocols works, overview of major issues that are present in IoT and the relationship between IoT and other trending technologies like big data analytics and cloud computing.
- Most of the networks are implementing the machine to machine communication solutions to scale in coverage. The Low Power Wide Area Network (LPWAN) consumes less power and its range is far beyond the existing technology available. This network can work with thousands of nodes in a single gateway which reduces the network complexity in building them. Implementing the network gateway in the agriculture provide benefit for large fields and crops to monitor.
- The raspberry pi3 is a series of small single-board computers developed in the united kingdom by the raspberry pi foundation to promote the teaching of basic computer science in schools and in developing countries. Processor speed ranges from 700 mhz to 1.2 ghz for the pi 3 on-board memory ranges from 256 mb to 1 gb.
- Self-powered sensors are the future improvisations in contrast to the sensors which are normally used. The usage of a harvest module will ensure that the system which uses LoRa for communication is self sufficient and there is no need for external power source which will make it viable

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for remote deployments of sensor networks for any IoT based deployments. The micro power manager designed and used here can be used both in indoor and outdoor conditions. The receive module for LoRa communication module draws very low power and operates in 900 mhz or any sub-ghz wireless band.

- The automatic irrigation system is superior to the pervious and traditional irrigation system like ditch irrigation, terrace irrigation system, drip irrigation system and sprinkler irrigation system. The farmers save their energy and water by automating the water supply by monitoring the moisture in soil. Each and every time farmer cannot do it perfectly and in time. They do some errors because humans tend to do them knowingly or unknowingly. The valves are turned on automatically when the moisture level in soil is low and in monitors in real time.
- The issue of transferring the collected data from the IoT devices is tedious process. When the collected data are stored in the microcontroller and sent to the server through gateways which are in short range. To overcome this issue LoRaWAN gateways are used to extend the from short to long range. Apart from other long range wireless communication solutions LoRaWAN is accepted as network standard for telecom operators. It allows multiple sensor networks and micro controllers to be controlled from a single gateway thereby eliminating the need for hosting multiple gateways, so it brings down the cost of deployment.
- The difference between the internet and IoT (Internet of Things) is that the constituents of IoT are everything less than the conventional components. LoRa is a proprietary standard coming under the IEEE
- 802.15.4 standards. Its physical layer consists of chirp spread spectrum(css) and traditional radio modulation techniques operating on 433,868,915 Mhz frequency range. The range of the system varies and depends heavily on the factors of the environment where the system is deployed. The range can drastically reduce if there is any electromagnetic interference in the particular frequency spectrum. Gateways can be connected to cloud network to provide a region-wise coverage like a phone service.
- Decision support system using Fuzzy Logic for IoT based System to support functions in a smart agriculture system. WSN based Sensors provide data to the microcontroller system deployed. Using the dataset provided by the sensors,a Fuzzy logic system runs logic and supports the decision making process to run pre configured tasks based on the arrived decision. It is particularly useful in automated environment where there is very little or no manual intervention in making the decisions made in the system mainly concentrating in reducing the wastage of water during irrigation and post fertilizing the crops.
- An IoT system integrates multiple existing technologies like RF, WSN, Point to Point transceivers are typically used in communication links between the gateways and the micro-controller deployment. Nodes are low powered and does not offer much throughput in terms of processing power and bandwidth. These Constraints are taken into account when designing and implementing the IoT system. Due to the constraints in using licensed spectrum,these systems must use the unlicensed spectrum range. Smart agriculture systems use various types of sensors such as optical, mechanical, electrochemical, dielectric,air-flow and location sensors to support the decision making process in managing an agriculture fields.
- When Using a wireless standard for managing a IoT deployment,It is optimal to achieve LoS(Line of Sight) in order to achieve maximum bandwidth and less interference. SNR loss must be minimal in order have a maximum performance gain. RSS,XML and JSON scripts are used to bring the data to a gateway or a server based implementation. In Clear Line Of Sight,It is proved that the LoRa system can achieve a distance of over 100 km if provided that there is minimal interference and the loss during transmission and SNR is very low. Transmission Packets uses CRC for error checking and QPSK for Modulating the signal to improve the bandwidth.
- Identification Of the Particular zones and mapping them is a challenge in deploying them. RFID(Radio Frequency Identification) and the subsystems are used to collect the data. Data is processed based on the zoning done by the RFID system.Data is collected on XML or JSON data streams and they are filtered and collected to use them for analysis for future implementations or to make changes in the current system. The Processed data is stored in HDFS(Hadoop Distributed File System) in order to use the data for analytical or research purposes. Real time application can also be done based on the data stream provided by the Big Data System.
- It uses the help of robotics to help farmers in their several farming activities like weeding,water spraying . This system is developed using (UART) interface and sensors for sampling and buffering the data .This project causes attenuation of Radio Frequency (RF) . This project uses AVR Microcontroller Atmega (16/32) , ZigBee Module , Temperature Sensor (LM35) , Moisture sensor , Obstacle sensor (Ultra-Sonic) , Raspberry Pi . This project also uses softwares like AVR Studio Version 4 , Proteus 8 Simulator , Dip Trace , SinaProg , Raspbian Operating System . Using this remote controlled farming high yield is achieved by saving a lot of energy.
- This project uses WiFi based long distance (WiLD) network for achieving connection to rural areas with low cost . WSN is proved that it is a viable solution to implement in smart irrigation . In this project we use WiLD network and cloud computing in the existing WSN based solutions . It also uses a cross-layer-based MAC and routing solution in this system . It has a proposed network which is the combination of one WiLD network and a set of 6 LoWPAN enabled WSN networks. When there is more number of wireless communication involved, the cost factor rises to peak and network complexity in building it.

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III. PROPOSED WORK

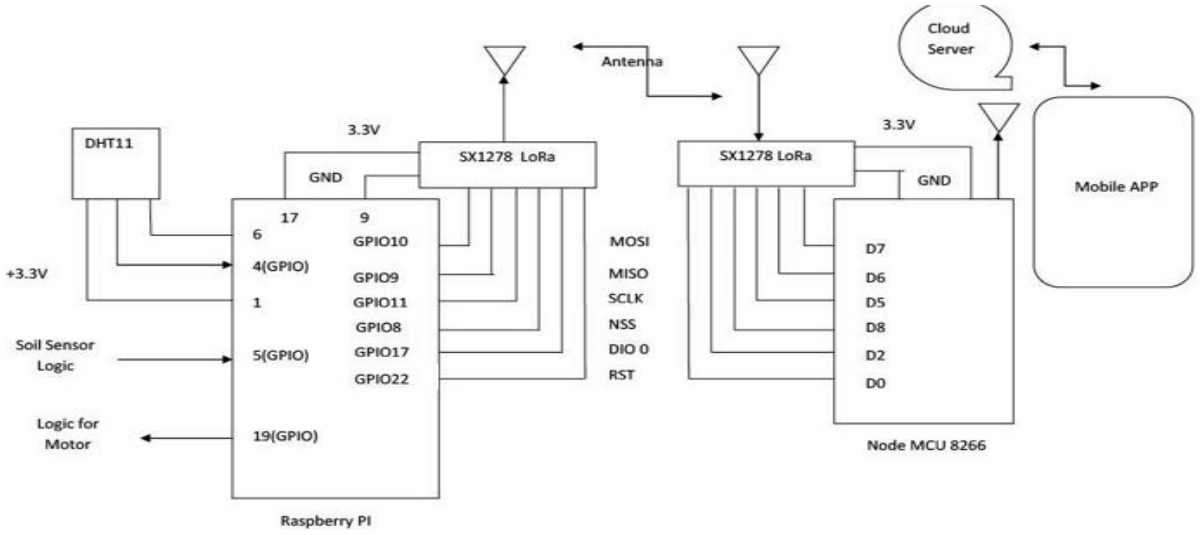

Fig 1

This proposed system is an automatic irrigation using LoRaWAN helps to know the conditions of the soil and humidity for the irrigation. There is a sensor which gives the information about moisture and humidity content in the different soil. If the value of sensed data transmitted to the control station LoRaWAN. In control station we receive different soil moisture values and humidity value from different places. These values has been processed through the Raspberry PI processor, if the soil moisture value and humidity value are below the normal, solenoid valve will turn ON automatically this command. By the use of Raspberry-PI IOT processor we can store the data on cloud also. We can monitor the soil moisture, humidity and control the solenoid value through the internet. This is irrigation monitoring system based on the wireless technology using LoRaWAN protocol. The soil moisture sensor is interfaced with LoRaWAN board. The output of these sensors are analog in nature which is been converted to digital by configuring the ADC block registers in the LoRaWAN. This data is then passed to LoRaWAN receiver device which is connected to Raspberry Pi which acts as a gateway to the cloud. Raspberry Pi has built in Wi-Fi which is connected to a network. So that it can be connected to a network Cloud server. All the data is monitor / Control through the internet gateway.

IV. FUTURE SCOPE

A. Field Deployment Module

The Sensors deployed in the field can be pre-calibrated in order to eliminate the hardships and challenges faced by the deployment team, as the current setup is required to be calibrated every time when it is installed or Replaced. This Can bring the initial setup cost to be significantly down and enable easy setup of the system by a non-technical person. Automation of water flow control and other systems using robotics or any other similar mechanisms. This System can be further improvised by adding automated systems for Weeding, Harvesting and integrate it with the existing system.

B. Communication Module

This Module enables communication between the field deployment module and the other modules or Subsystems. With evolution of technology like 5G it can be used on the public network to get more leverage of the technology and also can be used to avoid the initial deployment cost that is associated with the LoRaWAN based system as it needs to have a proprietary gateway system in order to interface with a public network like Internet.

C. Data Logic Module

The Logical Decisions are made by this module. This can be further enhanced and improved by using AI (Artificial Intelligence) and Machine Learning Technologies to make human like decisions with high speed and Precision. This Precision can be improved by further improving the systems knowledge by training them with large amount of sample data from various implementations of the system.

D. Cloud Deployment Module

The Cloud Systems are used to host the applications that are being used in the implementation of this system. This will all be connected to a public cloud which serves as a supervisor for the field monitoring. The cost factors resembles high in hosting a private cloud and to maintain it. The public cloud are viable and affordable in price. The main advantage is to pay what you use . The future scope of this is to make advantage of public cloud in numerous ways other than real time data monitoring.

V. CONCLUSION

Sensors are deployed in the field, which gives the information about moisture and humidity content in the different soil. The data collected by the sensors deployed in the field are transmitted to the control station using LoRaWAN. In control station we receive different soil moisture values from different places. These values has been processed through the Raspberry PI processor, if the soil

moisture value is below the normal, solenoid valve will turn ON automatically this command.

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