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Lorawan Based Smart Agriculture, Remote Sensing and Auto Watering System

Amrutha Kulkarni[1], Shilpa[2], Anjali B[3], Sushma Jain[4]
[1, 2, 3, 4]Dept of ECE.CMRIT, Bengaluru, INDIA

***Abstract:** The smart agriculture is the active process which helps farmers in getting overall yield. Many factors play a vital role in getting yield such as moisture /humidity of the soil, temperature, carbon monoxide on top layer of the soil. This project is undertaken in order to help farmers in increasing the quantity of product and gain. The sensors such as temperature, moisture, carbon and etc. Senses and provides the values and these measured values are then passed through the node where LoRa module and Arduino is present. These data are stored in the cloud and utilized whenever required. Simultaneously a water pump in connected and with the help of measured values, depending on the crop, the water is pumped. Water pumping is mainly dependent on the quantity of CO present on the top layer of the soil. If it is in excess amount, then water is overflowed such that CO on top layer of the soil which is not necessary will be removed. Parallelly the measured values are stored in cloud and utilized by soil testing centers for clearing the issues of the farmer. This helps in water usage reduction up to approximately 50% and helps farmer get good yield and profit.*
***Keywords:** LoRa, LoRa module, Arduino*

I. INTRODUCTION

In today's technical advancements, we have seen LoRa is one of the promising technologies which can make our daily chorus easier. Agriculture is one
such field which has not come in limelight yet from LoRa community. We focus to have end to end Solution for making agriculture, the Smart Agriculture. There are some of challenges involved are maintaining right moisture levels, carbon monoxide level, temperature etc. In India, water shortage is one more problem which farmers need to deal during summers. Many times, crops die due to improper water supplies. Hence, we propose Integrated Agriculture System to solve above problems. We will have smart water pumping system in our solution, which will solve water scarcity problem to some extent. [1]

Now a day's weather is changing drastically. Many times, due to natural disasters, farmers have to face many problems and loss, so due to weather monitoring system he may get to know about it in some extent and he can take proper actions in such situations. Monitoring is an important aspect of agriculture. Our Integrated Agriculture System composed of LoRa and cloud computing. This system mainly contains system which handled remotely by android application and which gives daily updates about environment nearby field. Major objective of system is to collect real time data of soil condition and temperature of nearby farm and provide information related to crops, any drastic change in environment notifications on interface. This system has potential to automate processes and give information for analysis purpose for decision making to make it Smart Agriculture.[2]

The agriculture field now days are facing many issues. One among them is the lack of knowledge of nutrients requirements. Majority of farmers doesn't care about the residual that are present on the top layer of the soil and thus leads to fewer yields in the crops. These issues can be determined by testing of the soil but long-distance transfer of samples is a bit difficult and the samples differ from place to place.

Moreover, climatic and dietary pattern changes will intensify natural resources consumption, exacerbating critical issues such as water scarcity, land degradation, and deforestation. Other problems concern food safety, quality and traceability, since over-exploitation of natural resources and climatic change factors will lead to less nutrient food and favorable environments for food/waterborne pathogens, intensifying the use of pesticides and, consequently, potential risks for people's health. Therefore, leading actors in handling these trends are now and even more in the future digital technologies. [2]Indeed, since the agricultural sector is characterized by unpredictability, heterogeneity and complexity, it can be better understood by monitoring, measuring and analyzing its physical parameters. This is made possible by the adoption of this new technology

In the present agriculture system, farmers after the harvesting, usually burn the residual which is prohibited by the government. This is done due to lack of transport facility availability. It is fine if the carbon present on the top layer of the soil is less than one feet in height. If it is more than that, then it is more hazardous to the future crop. These details are explained by RAITHA SAMPARKA KENDRA {RSK} to farmers in order to get yield.

MSc Agriculture officers present in RSK in each hobli will maintain the details about the land and helps farmers in solving their problem. The carbon residual created on burning settles down on top layer of the soil and these can be removed by overflow of water. Usually the KRISHI HONDHA (pits) is constructed by farmers with the help of NREG scheme in order to save overflow water. This water can be reused by pumping. These pits have 6m depth with the size of 20*30 ft. These has the storage capacity of 20000ltrs of water approximately and can easily irrigate 2acres of land. The RSKs present in each hobli are around 10km distance from each other, thus our LoRa helps us to transfer data to RSK easily. Each hobli consists of 4 to 5 panchayaths which includes around 15 villages. Usually the agriculture lands are slant, which makes the flow of water even easier. We also see two types of drainage system in agriculture lands where water and unwanted residuals flown separately. This transfer of data can be done with minimal cost using LoRa when compared to other networks.

II. METHODOLOGY

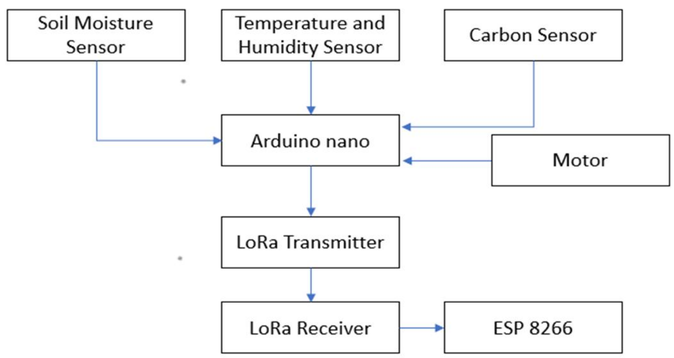


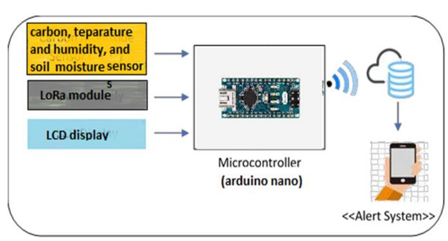
Fig1

Here, in our project we are monitoring capacitive soil moisture sensor, DHT11 temperature and humidity sensor and MQ9 carbon monoxide sensor on our mobiles. It consists two parts they are transmitter and receiver part. Transmitter part contains all the sensors along with the motor and receiver part contains LoRa module with ESP8266. capacitive soil moisture sensor is used to measure the moisture of the soil. [3][4]

DHT11 Temperature and humidity sensor detects the atmospheric temperature and calculate the relative humidity. Relative humidity means amount of water vapour present in the air.[5] [6][7]

MQ-9 carbon sensor measures the carbon content present on the top layer of the soil. The oxygen in the atmosphere reacts with the carbon and forms the C02.We are using co2 in our project because if the carbon content is high in the soil, it affects the growth of plants. To avoid this, we can take measures so that we can check how the plant condition is and move with further steps. In transmitter part the DC motor is connected. For every five seconds motor is being monitored. In moisture sensor never it was certain value which is equal to dry condition. We will give a condition that soil moisture be high. High is word which is used to switch on the motor. [8][9]

And whenever the moisture sensor reads a value which is showing that the soil is wet the motor will automatically turned off. The overall point is If the soil moisture is low then motor starts running, if the soil moisture is high then motor stops running.



Genaral architecture of proposed system

Fig2

Arduino nano is a microcontroller on a receiver part. It collects all the data from the sensors where data analysis is performed using Arduino software. The LoRa transceiver module has the processor which communicates with the Arduino through the serial communication. This LoRa transmitter transmits the data to the receiver LoRa. [10][9]

In the receiver part the LoRa transceiver module is interfaced with the Node MCU ESP8266 Wi-Fi module and receiver LoRa receives the data and transmits it to another controller which is ESP8266. And the values received from the sensors are not understandable hence the Arduino converts them into understandable human language.

On the receiver part LoRa module is connected with the NODE MCU ESP8266 Wi-Fi module where final output will be displayed. Arduino IDE and C programming language are used to program the proposed system.[11][12]

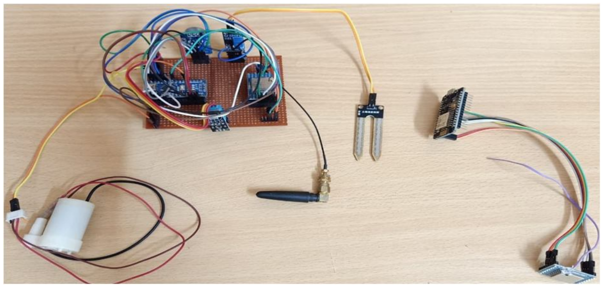


Fig3: Connectivity of sensors

LoRa network is designed especially for IoT applications with the intention of connection sensors. LoRa is similar to Bluetooth or Wi-Fi module but transmits the data with higher frequency. We can connect multiple LoRa to get higher range and the only advantage of LoRa is cost efficient compare to higher Wi-Fi range[13].

The sensor data got from the controller will be send to cloud using blynk app to display the output of the sensor. Blynk app can control hardware remotely and also can display the sensor data along with storing it.[14]

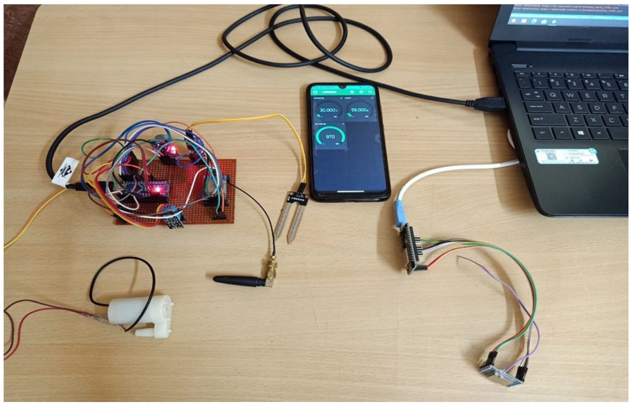


Fig4: Circuital Structure

For the further practical implementation of our project we have utilized menthe seeds and grown up the menthe. We have verified ana analyzed the systems.

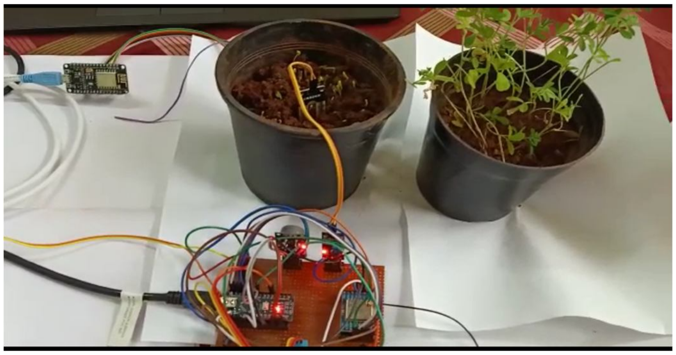


Fig5: Practical implementation

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III. RESULT AND ANALYSIS

To meet the need for smart agriculture a LoRaWAN agriculture monitoring system aims to simplify the process of remote monitoring, build a data driven and insightful farming strategy and help farmer earn more money.

Data can be wirelessly transferred from sensors to users, users can remotely monitor crops environment condition on Blynk app anytime anywhere, users can also set up threshold values and receive an alert once when the threshold is reached then using LoRaWAN controller to take action.

By implementing this solution farmers have the benefits of manpower reduction and labor effectiveness raising, reduction of resources waste, production enhancement, lowered operation costs and more importantly profit increase

Using LoRa based IoT systems in agriculture can solve the limitation of poor internet network in affected areas. Also, the maintenance cost of system decreases due to selection of economical and reliable LoRa technology Various modules are available in the market at affordable price which makes the system economical as well.

Sr. No.	LoRa and LoRaWAN feature	LoRa and LoRaWAN Feature Details
1	Low Cost	Reduction of cost by3 ways: infrastructure investment, operating expenses, end node sensors.
2	Standardized	Enhanced speed adoption of global interoperability and roll out of LoRaWAN based network and IoT Applications.
3	Low Power	Designed for low power consumption to extend battery lifetime upto more than 10 years.
4	Secure	End-to end AES128 encryption is embedded.
5	High Capacity	Can support millions of messages per base station.
6	Long Range	Can connect upto 2-5 km in dense areas and upto 10km in suburb area.

Fig6: Lora Technology Feature

Fig7: Sample Outputs

The above outputs samples are obtained using Blynk App where we obtain values of soil moisture, temperature and humidity and CO content comparing the define threshold values we can also show their units, and can also monitor for any desired time.

Through Blynk app we are able to see all the desired data and similarly we can also print values in computer just to verify the values this can be done using serial monitor of Arduino software.

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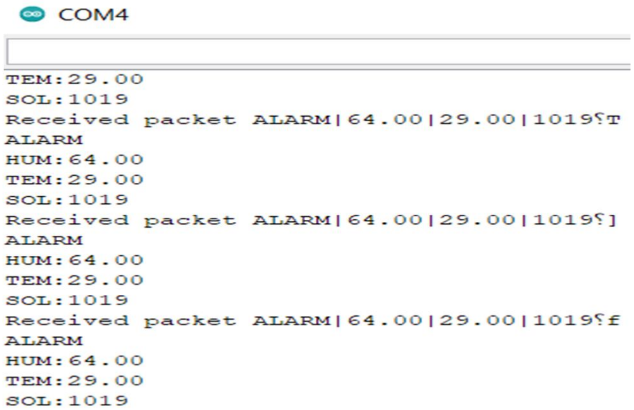

Compared output Sample

IV. CONCLUSIONS

In this paper, the solution using LoRa technology for cost effective wireless control of drip irrigation system has been presented. The system which utilizes LoRa module to develop a smart agriculture control and monitor has been designed. A multi-sensor component and an integrated communications network are established. Wireless sensor networks and network communication technology are used to support intelligent agricultural data collection and equipment control.

The use of LoRa technology in IoT systems can bring positive difference in the efficiency of systems by reducing its maintenance cost and ensuring the sensor data transmission them to cloud platform without major network issues.

The possibility and ease of setting up such smart systems in remote areas can become more easier by using the compatible modules of LoRaWAN and LoRa technology. According to the comparative study done, LoRa technology has many benefits over similar type of technologies such as Wi-Fi, Bluetooth. due to its low cost and long-range data transmission capacity. Use of IoT system in agriculture can enhance the crop yield of farmer and reduce tremendous efforts related to field monitoring.

Furthermore, we have introduced ability to regulate and observe the system remotely via computer software, and also by mobile app, users can control the irrigation system remotely and check the status of system in time.and it is showed in the firgure5.

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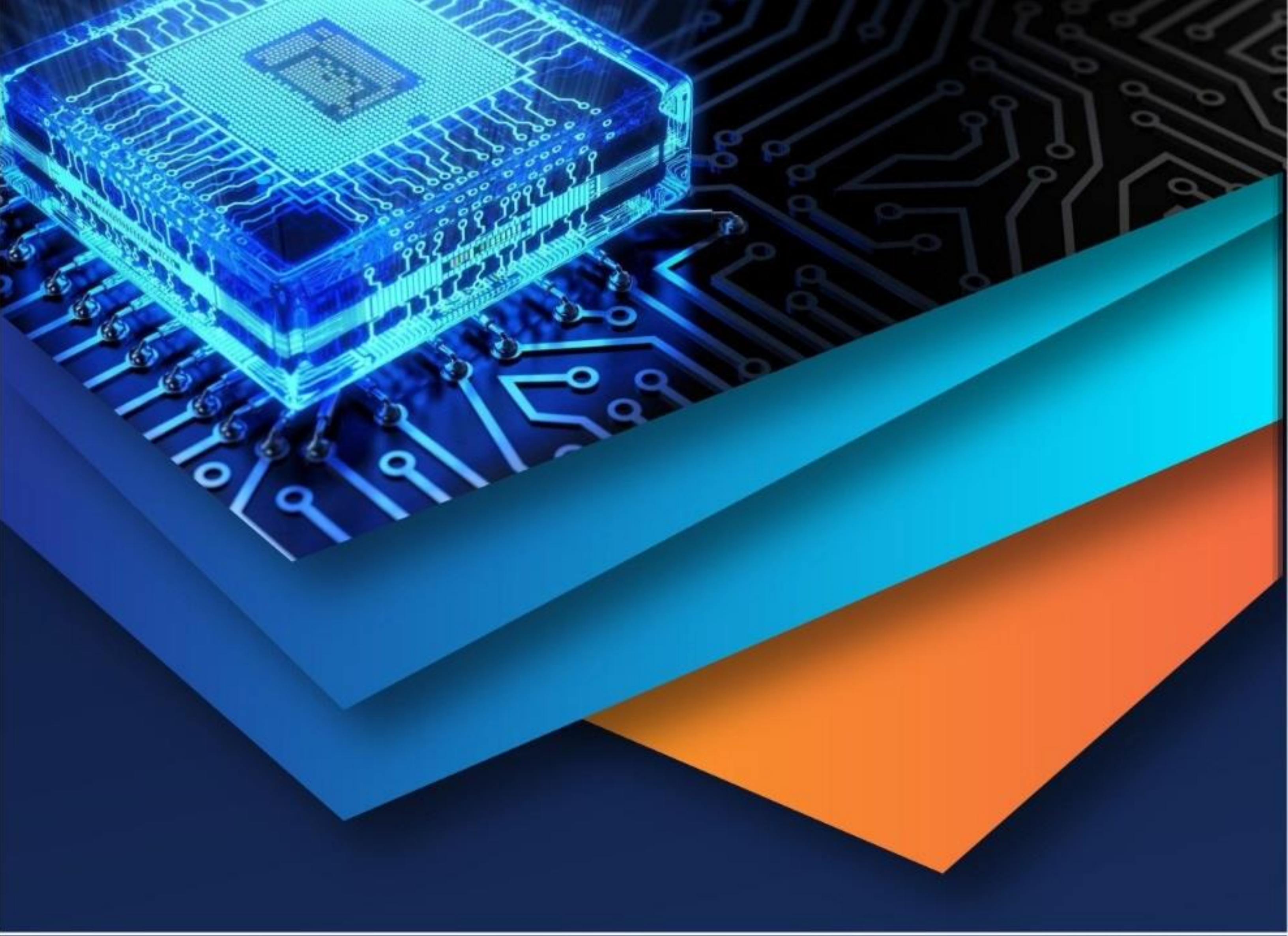

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