

Smart Agriculture using LoRaWan and ThingSpeak Cloud Platform

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Abstract - In India traditional agriculture methods have been used for farming on large scale. There is need of easy and stable IOT system which can be used for carrying out farming processes by farmer. Co-existence of smart agriculture can help farmer to improve the crop yield however, due to lack of network facilities in remote areas and rural areas bring the limitations. In remote and rural areas people face poor internet connectivity and poor communication network. Due to bad climate conditions the broadband and Wi-Fi connectivity may affect the smart agriculture IoT system. It is very important to ensure the establishment of reliable network connectivity with long life span. Thus, we are going to develop smart agriculture system which can measure the soil nutrient data using soil NPK sensor remotely, the data collected from sensors should be displayed on Thing Speak cloud platform via economical LoRaWAN Network setup.

Key Words: Agriculture, LoRa techniques, IoTs (Internet of Things), LoRaWAN, ThingSpeak Cloud Platform, NPK Soil Sensor, N-Nitrogen, P-Phosphorous, K-Potassium.

1. INTRODUCTION

The macro soil nutrients Nitrogen(N), Potassium(K), Phosphorous(P) play vital role in enhancing crop yield. This system detects and analyses the soil sensor data efficiently using soil sensors and further data transmission process can be done using LoRaWAN. The level of these soil nutrients keeps on changing. Thus, to ensure the optimum yield from crop it needs to be monitored through efficient and reliable system. Such type of nutrients are difficult to be added upto threshold level, when they get reduced due to environmental factors. Our system uses Arduino Uno to analyse the soil sensor data and displays it on the webpage. Here we are not only using our cloud platform to detect sensor values but also, we are developing it in order to control the nutrient dispenser remotely. Various technologies have been studied to check their impact on agriculture like Bluetooth, ZigBee. However, they bring the limitations of short range, multi-hop networks. Their cover range area calculates to be approximately 100 meters. Since field area are larger, we need to a technology which can cover comparatively long range area and are low on budget. Cellular networks prove

to be more efficient however in remote and rural areas of India we still face the network issue which can make our smart agriculture system highly unreliable. Here LoRa technology comes into picture. It is new trend in the field of communication network and it operates on LoRaWAN protocol. It uses the free-range RF frequency, which is 865 MHz to 867 MHz. Thus for this type of system setup, farmer needs to make low cost investment for network communication, initially only for the cost of LoRaWAN module, and communication can be established free of cost with no network charges. This system uses ThingSpeak cloud platform for easy processing of the soil nutrient regulation by farmer remotely.

1.1 Literature Survey

1. Mohamad, Auday & Jumaa, Noor & Majeed, Samer. (2019). Thingspeak Cloud Computing Platform Based ECG Diagnose System. International Journal of Computing and Digital Systems. 8. 2210-142. 10.12785/ijcds/080102.

The exchange of data between various nodes and controlling system in order to ensure remote processing in the system using internet communication involves Internet Of things. This study shows the application Of IoT in the field of medical science and healthcare. Human lives are lost around the globe every minute and several patients are affected due heartattacks. Electrocardiogram (ECG) is used to detect heart activity. The main objective of this article is to provide an ECG diagnostic system using Thingspeak cloud platform. Patient monitoring can be done by healthcare professional from remote locations using this system. Component analysis (PCA) principal has been used here to analyze the ECG signals. ECG signals are sent from patient's health data to the cloud platform for principal component analysis (PCA).

2. D. Parida, A. Behera, J. K. Naik, S. Pattanaik and R. S. Nanda, "Real-time Environment Monitoring System using ESP8266 and ThingSpeak on Internet of Things Platform," 2019 International Conference on Intelligent Computing and Control Systems (ICCS), Madurai, India, 2019, pp. 225-229, doi: 10.1109/ICCS45141.2019.9065451.

This paper presents the study that has been done to built monitoring system using the cloud platform. ThingSpeak

cloud platform has been chosen by authors to build the air quality monitoring system. IoT has been used here to establish the safe network between various sensors and cloud to read the information in real time. The monitoring system is able to store the data of air, humidity and temperature of the environment, where the sensors are placed. By using the cloud platform further data analyzing and processing can be carried out for study purpose. This project is beneficial for maintain healthy environment in both urban and rural areas and we can keep watch on these vital factors with this simple IoT system.

3. Haxhibeqiri, Jetmir & De Poorter, Eli & Moerman, Ingrid & Hoebeke, Jeroen. (2018). A Survey of LoRaWAN for IoT: From Technology to Application. *Sensors*. 18. 3995. 10.3390/s18113995. Significant attention has been received by the research community recently in LoRaWAN which is one of the low power wide area network (LPWAN). Wide range of area is covered by its network, with low power requirement. An overview has been provided by this research work that has been published from 2015 to September 2018 which is accessible via Google Scholar and IEEE Explore databases. This study includes, a detailed description of the technology, security and reliability mechanisms have been included in it. This literature overview is structured by categorizing papers according to the following topics: (i) physical layer aspects; (ii) network layer aspects; (iii) possible improvements; and (iv) extensions to the standard. Finally, a strengths, weaknesses, opportunities and threats (SWOT) analysis is presented along with the challenges that LoRa and LoRaWAN still face.

4. Jianhan Lin, Maohua Wang*, Miao Zhang, Yane Zhang, and Li Chen presented the "Electrochemical sensors for soil nutrient detection: opportunity and Challenge": In this paper author described that Soil testing is the basis for nutrient recommendation and formulated fertilization. A brief overview of potentiometric electrochemical sensors (ISE and ISFET) for soil NPK detection has been presented in this study. After studying electrochemical sensors researchers found certain advantages of potentiometric electrochemical sensors which are stimulating the interest of their applications in soil nutrient detection. They have potentials for automated multi-target rapid detection of soil nutrients. As such, they are also faced with the challenge from their reliability.

5. Augustin A, Yi J, Clausen T, Townsley WM. A Study of LoRa: Long Range & Low Power Networks for the Internet of Things. *Sensors*(Basel). 2016;16(9):1466. Published 2016 Sep 9. doi:10.3390/s16091466

The importance of LoRa technology in the field of IoT has been given in this paper. The paper mentions certain features of LoRa which are suitable for building the

economic system in IoT. The LoRa can be used to hop the signals or data from various sensors. Instead of using traditional wireless technology, we can use the recent one. It has long range and low power consumption. The LoRa can be used as bridge between the central server and sensors to transmit data successfully. For functional components, in depth analysis has been provided in this paper. Many possible solutions have been processed which are based on the evaluations done during this survey.

2. Methodology

We are building this system using virtual Proteus platform .ATmega 328 has been used here as the main processor. The NPK sensor has been interfaced with the Arduino Uno which is able to sense the data in real time. We have also connected actuators to ATmega 328 which can be easily controlled according to the requirement. Since we are using IoT platform all the simulation system that has been built is in sync with ThingSpeak cloud platform. LoRaWAN technology that we are using here, its module is placed near the field area within 2km and transmitting antenna are located nearby, as collected data is instantly uploaded to a server, and presented on a webpage for analysis. The LoRaWAN communication enables transmission and reception of data from sensors to webpage and from webpage to actuators. In order to increase the processing capacity and reduce the load on the central processing unit, the LoRa communication block is equipped with a Arduino Uno connected to the LoRa SX1278 module via serial communication. As we send a data request for a particular section of the field, the request is processed and real time data of the field is send over to the control node, this communication takes place via Lora Wan module. In this system we are using LoRaWAN SX1278 transceiver. The data send over LoRa on field is received on LoRaWAN module connected to our computer or compatible device. This is where LoRaWAN plays its vital role. We are using LoRaWAN to make sure that the sensor data from field is successfully uploaded on cloud platform, which is here reliably done by LoRaWAN and thus remote access and controlling of this smart agriculture system is possible through IoT.

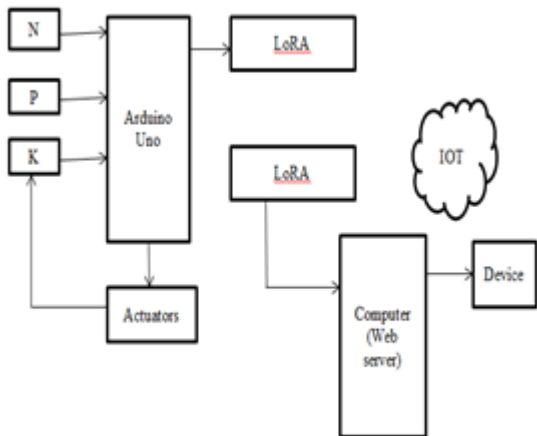


Fig.1- System Block Diagram

3. Result and Discussion

Using Proteus Software the system simulation has been done successfully as shown in fig.2. The Python programming language has been used here for coding purpose. Arduino Uno has been given commands regarding the reading detection of N,P,K signals. Relay and Motor combination has been used here as an actuator, which can further act as soil nutrient dispenser.

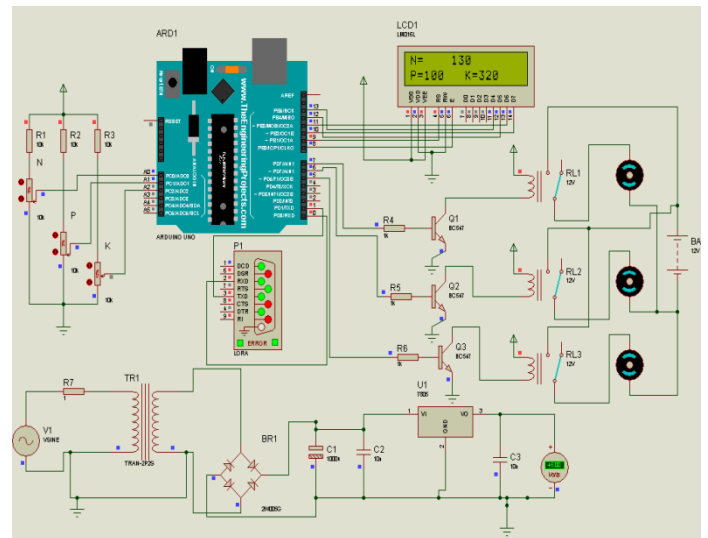
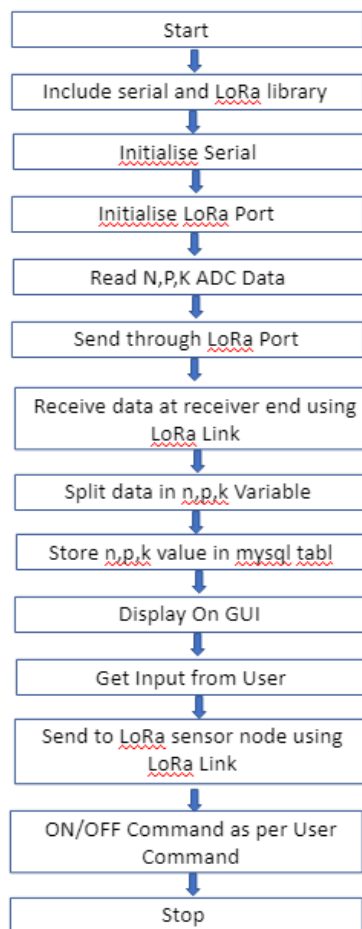


Fig.2 - Proteus simulation

The proposed system mentioned above, can collect the NPK soil sensor data from the monitoring field. Then these sensed values can be plotted in form of graph using ThingSpeak cloud platform, the date is updated on cloud with certain time interval of 15 seconds since, web service is deployed in cloud environment in every 15 seconds as ThingSpeak needs 15 seconds delay between updates. Fig.3 shows Nitrogen(N) and Phosphorous (P) soil nutrient value plotted with respect to time. Since the nutrient values, readings are constant the graph is horizontal line with no fluctuations in readings. On the other hand, Fig. 4 represents graph based on soil Potassium(K) level with respect to time. It shows fluctuations in nutrient values since the nutrient value is decreasing.

2.1. Flowchart



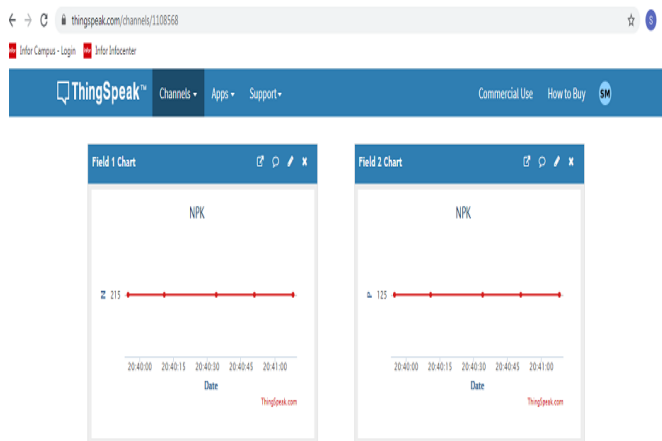


Fig.3- Y-axis:Nitrogen and Phosphorous nutrient value and X-axis:Time

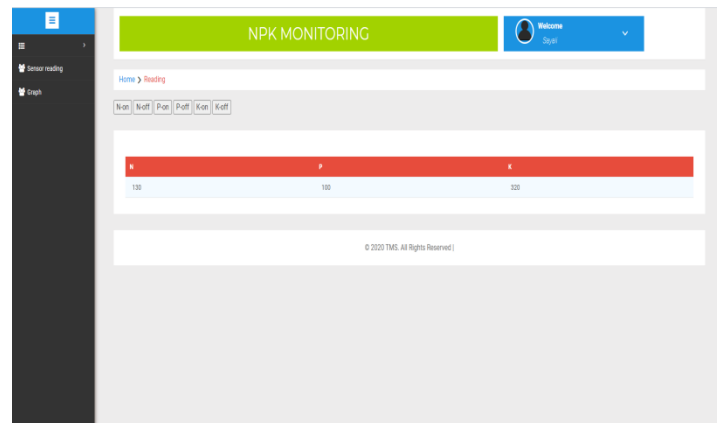


Fig -5: Webpage designed using ThingSpeak Cloud Platform

4. CONCLUSION

Based on above mentioned system setup, different level of soil nutrients and were sensed and based on predefined threshold value of soil macro nutrients actuators are able to operate. Various agricultural websites mention the soil nutrient threshold values for particular crop, that to be cultivated in particular region. Arduino board controls the farming equipment without human intervention. In the absence of human being in the agriculture field, this system provides continuous field monitoring and triggers the appropriate events according to the requirement. It reduces the human effort and cost of farming to a certain extent. The ability to develop low cost and simple end devices for quickly deploying in the field makes this system very attractive for smart agricultural systems. We have focused on building this system with IoT technology using low-cost solution available for agriculture platform. The experiment measures to determine sensor accuracy, select sensor and design a long-range (up to 2km) low power (66 mW per hour) communication platform. The customize web-page design for real time data analysis for the specific wireless sensor network design. In another approach the number of parameters with n number of sensors extends so get real time data with high accuracy. In future this work can be extended as large number of data collected then gives more accurate and precise results by the use of algorithm. Also, the system sends the environmental parameters values to the cloud from the field in real time through wireless communication in every certain time interval. These values can be used for future analysis and can be considered for more parameters to be monitored like biotic factor. Use of this system can maintain the appropriate level of soil nutrients required for certain crop cycle and will help farmer to enhance crop yield and save the fertility of land by avoiding misuse of fertilizers and certain chemicals that were used by farmer.

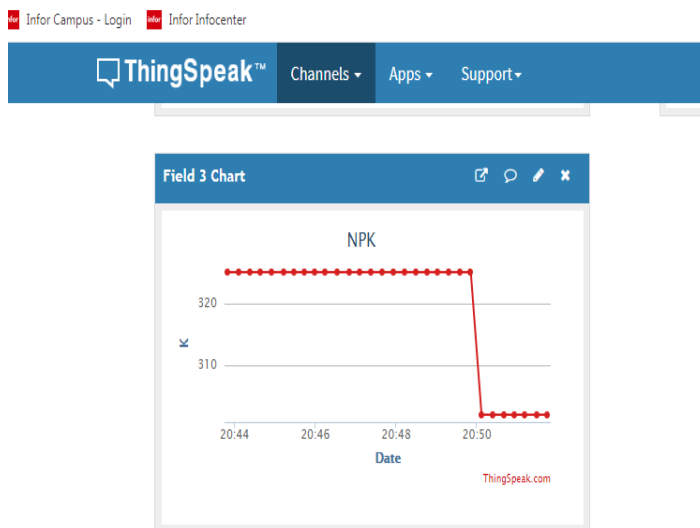


Fig.4- Y-axis :Potassium Nutrient value and X-axis :Time

The webpage represents the live soil nutrient value readings, that are being detected by sensors in the field. The Buttons ON an Off have been designed to access and control the fertilizer dispensers separately. If the ON button is clicked for certain Fertilizer, the actuator associated to it will start dispensing the fertilizer. In the same way, if button 'OFF' is clicked for certain Fertilizer, the actuator associated to it will stop working. Fig.5 shows the webpage that has been designed using ThingSpeak Cloud Platform.

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