Development of Next Generation IOT Based Agricultural Model with Integrated Land Testing Equipment

Suryaprakash Shanmugasundaram, M. Mathankumar, P. Thirumoorthi

Abstract: Agriculture is the backbone of our country that contributes to 45% of the total GDP that is responsible for the enhancement of country's economy. The project aims at building an integrated module for improving the efficiency of the present agricultural modules. The proposed module consists of a series of array of sensors such as ambient temperature, moisture, air quality and the pH sensor to measure the pH of the soil and environmental condition. All this data are sampled at regular interval of time, formatted and send to the cloud for backend works such as comparing it with the stored data and predicting the type of crop that can be grown in the particular land and these data will be saved in the cloud so that during disaster time, it will be helpful for the government and insurance agents for speedy approval of insurance claim. The developed model would considerably reduce the need for experts to visit the place and to perform manual testing during the disaster.

Keywords: Microcontrollers, Precision Agriculture, Sensor Networks

I. INTRODUCTION

Continous monitoring is the very important for the present day agricultural for efficient and large scale productivity. The unpredictable monsoon and weather pattern is currently going due to climatic shift, the knowledge of the climate is very much important for the farmers to cultivate the appropriate crop to produce the better yield. Indian soil pattern is not uniform and the nutrients. For that to analyze the soil the farmers have to go for the soil testing laboratory to test their soil to get the accurate level of nutrients to that they will get the clear picture about the appropriate crop that can be cultivated in their land. Another crucial factor that affect the crop growth climatic condition, certain crop requires more water and some crops requires more amount of sunlight. For this predication of weather by farmer using olden day's technique is not accurate. Sometime due to false prediction and due to cyclone formation, the whole cultivation land is wasted, which leads to the heavy loss to the farmers. Due to large number of manpower involved in survey the land about the amount loss occurred to the farmer is becomes the tedious process and which results in delayed claim to farmers by government and insurance agencies.

The above discussed problems are summarized as follows

- Improper knowledge about the soil nutrients.
- Variable climatic pattern
- Tedious assessment process

II. RELATED WORKS

Various papers and journals were referred for deciding on the modules that must be included to the project: In developed countries, low cost remote sensing imagery has the potential to make precision agriculture. MoacirPonti et al., [1] described about the image acquisition from eucalyptus, bean and sugarcane crop acquired from the low cost low altitude system to quantify the plantation areas.

Remote Sensing Observation Sharing method based on Cloud Computing was proposed by Lianjie Zhou and et al., [2] the method enhances the remote sensing observation storage, processing and service capability. Using MangoDB and Apache Hadoop as cloud services, the study achieves the high throughput method for remote sensing observation storage and distribution. The proposed methodologies helps to enhance the earth observation data, so as to achieve soil moisture mapping via perpendicular drought index in an efficient way to serve better precision agriculture. Precision Agriculture with autonomous system was made by U S Rajani and et al,. [3], the author proposed by developing autonomous model for monitor and control the various farming parameter such as pumps and monitors such as soil moisture, pH level, and atmospheric temperature. The system incorporates the wireless data acquisition through wireless motes and also sends alerts to farmer using DTMF techniques. From the above works, the image processing through satellite incurs higher costing for the farmer. The advent the IoT based system is available and reconfiguration of such device is simple and in order to predict the better cultivation through proper prediction at lesser cost can be made by wireless sensor nodes. R.Marimuthu et al., [4] discussed about the development of ICT system implementing in agricultural field using persuasive technology method. The author developed a mobile application linked with website with details of marketing and farming accessory like dairy, organic products and farm machineries.

III. PROPOSED MODEL

The proposed system has the following objectives

- To help the farmers to decide which crops can be selected in order to
  avail high yield.

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- To provide comparison chart of the cost of seed and gives the contact of nearby venders.
- To propose sensor node is portable, it can be transferred easily to add a new profile of the land,

so that the sensor can cover all the land area of the owner.

A. Methodologies

The developed system consists of two major parts sensor and server part. The sensor node collects the sampling of data and send to the server by using WIFI (Wireless Fidelity) protocol. In the cloud the collected data is processed and send the information to the farmer for better cultivation.

The developed model is self-sustained models which have multiple numbers of sensors which is connected to the server.

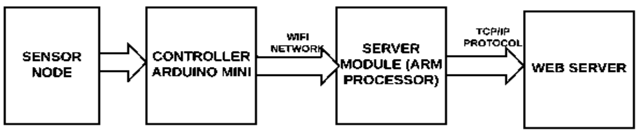

Fig. 1 Block Diagram of System architecture

B. Sensor Node

In this layer, the sensor data from the sensor node are collected and the required conversion formulae are worked on. Different sensors are calibrated, and the data are sent to the controller. The pH sensor sends the data to the controller in the form of string. By receiving the data from the sensor the pH of the given soil may be identified. The temperature of soil is monitored using the LM 35 sensor and is kept for analysis. The atmospheric temperature is measured using the DHT 11 sensor. The sensor node consists of a controller that is embedded with necessary coding for receiving the data from the sensors and sending it to the server node. This acts as a beacon device and sends the data to the server node through the wireless sender by radio frequency transmission.

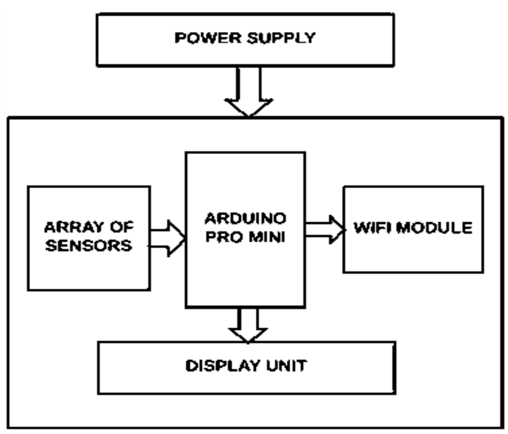

Fig. 2 Block Diagram for Sensor Node

Wireless module is for low-data rate, low-power applications. In contrast to Wi-Fi networks used to connect endpoints to high-speed networks, this module supports much lower data rates and uses a mesh networking protocol to avoid hub devices and create a self-healing architecture. For industrial application Zigbee module can be used that is more secure and has greater range than normal Wireless module. Zigbee is built for control and sensor networks on the IEEE 802.15.4 wireless standard for wireless personal area networks. The wireless operates on 2.4GHz, 868 MHz frequencies. The Flowchart for the functioning of Sensor Node is shown in Fig. 3.

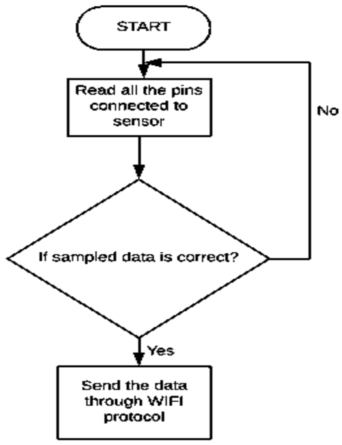

Fig. 3 Flowchart for Sensor Node

The data sampled by the sensor node is not to the limited calibrated values the controller connected to the sensor will not the send the data and it will retake another sample of data for processing and send the data to the server.

The power supply for the sensor node is by solar panel connected to the battery supply. Since the low power sensor and controllers are used the solar panel of small rating is needed.

C. Server Node

The data that is sent from the wireless sender is received by the receiver in the server node. The obtained data is processed by the controller in the server node and the pre-defined value of pH is compared with the table data. The corresponding crop is identified, and the resultant data is obtained as the inferred crop. Here the comparison data is from the internet. Thus, identified crop is sent through the Wi-Fi device to the cloud. The server node sends data through http protocol. The supply to the GSM is through a 12 V adapter while the transformer powers the controller. The rectifier circuit converts the AC supply obtained from transformer is converted to DC and is given to the controller board, Wireless module and Wi-Fi module. The data gets updated within a time interval of 2 minutes and it is updated real-time in the server.

The values of corresponding soil and their pH were obtained from the internet out of three soils were selected. The table taken for analysis is presented as:

pH Value	Soil Identified	Suggested Crop

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5.0 to 6.0	Red Soil	Onion
6.1 to 7.0	Clay Soil	Cotton
7.1 to 10.5	Black Soil	Maize

Table 1 Suggestion of Crops Based On Ph Values

The block diagram shown in Fig. 5 explains the working of the server node. The supply given to the module is collectively given as the power unit that comprises of the ac to ac conversion circuit and voltage regulator that gives both 5 volts and 12 volts output. The sensor node has three main portions controller, GSM and Wi-Fi modules. The data from sensor node gives data is received into the wireless module that is intern processed by ARM controller.

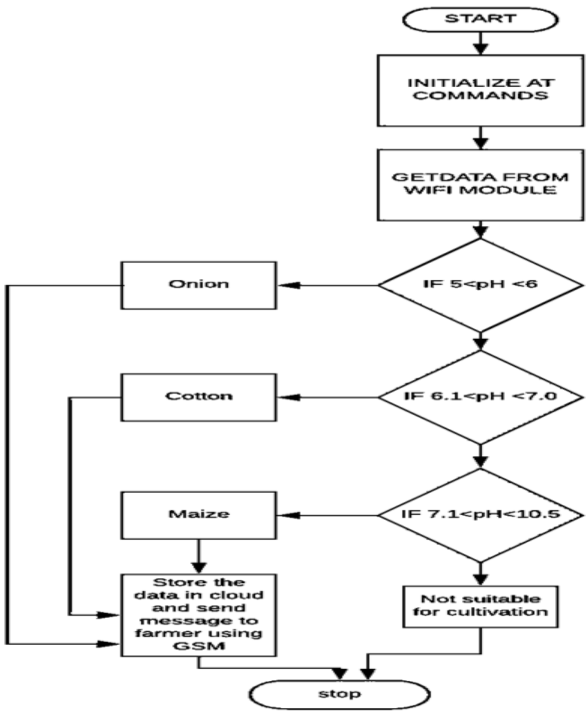

Fig. 4. Flowchart for Algorithm of Server Node

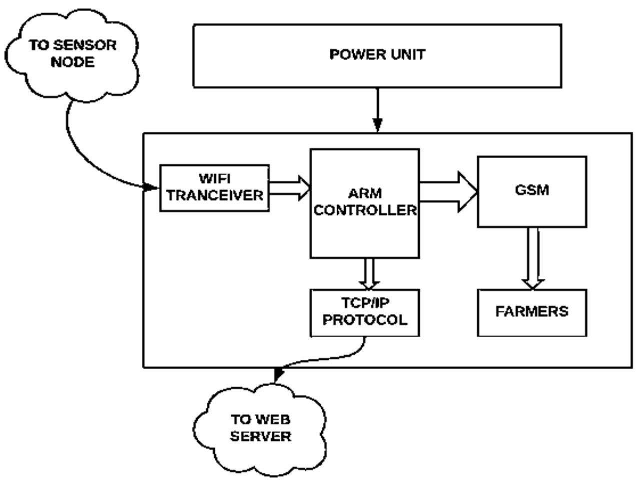

Fig.5. Block Diagram of Server Node

IV. TESTING RESULTS

Since we have used multiple numbers of sensors in a sensor node. The sensor node was initially tested to find out the working of the module. Given below are the pictures taken while testing the module.

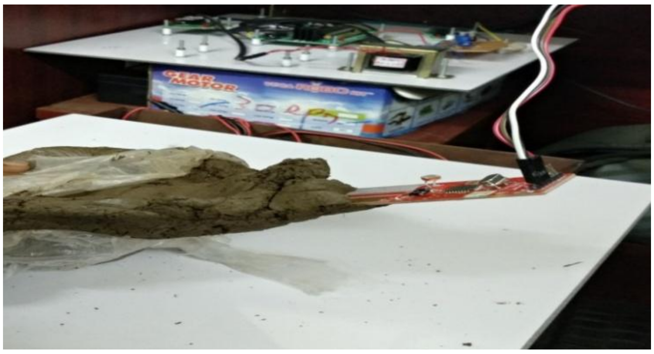

Fig. 6. Testing the Sensor Node

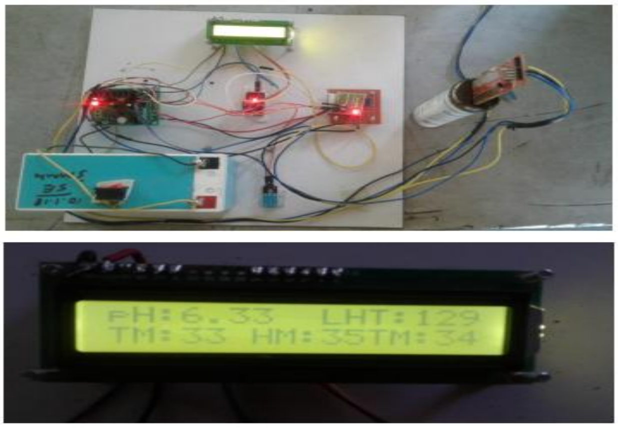

Fig. 7. Testing Result for Clay Soil

The reading observed in the LCD gives precise values for clay soil and thus the pH values are sent to the server node that gives the corresponding crop in the output screen and in the GSM. The server node displays the data obtained from the sensor node in the cloud after analyzing the value obtained with the prefixed values from the internet,

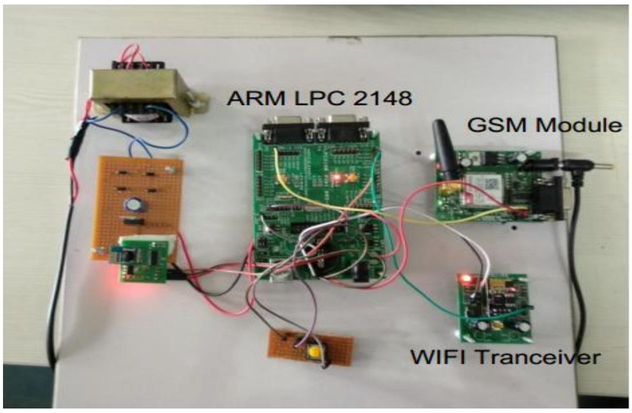

Fig. 8. Server Node

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The server node requires two different supplies. DC supply for the GSM module and AC power for the controller that is converted into DC supply using transformer and voltage control circuit. An external button is used for sending message to the farmers through GSM. The wireless module also uses 5 Volts from the power conditioning circuit and the results are also sent to the website through WiFi. The data is loaded to the cloud and a separate webpage is created for visualizing the condition and environmental monitoring of the agricultural land. The webpage samples are shown in Fig. 8.

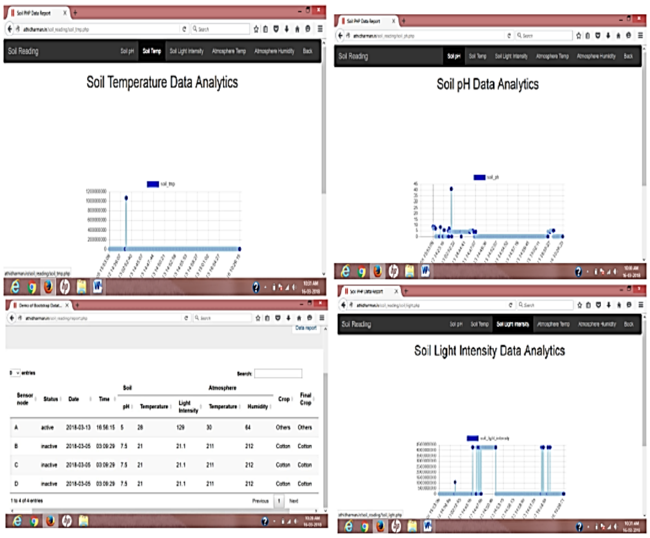

Fig. 9 Webpage Results

The data is analyzed with respect to time so that to get the idea about the change in the nutrient pattern of the particular soil.

V. CONCLUSION

The developed model helps the farmers to decide which crops can be selected in order to avail high yield. The sensor node is portable so that it can be transferred from one place to another easily. Since web-based monitoring is made based on the nutrients level and the type of soil, seeds can be bought through the e-retailer so that the farmer will get better seeds at lesser prize. The future scope for the further development of the system are building up the e-commerce system in the webpage so the if the person need to buy from a farmer he can easily made it through the website itself. Recovery from the natural calamities can be quicker without manly intervention. Thus, when IOT comes into play in a few years we would require every single entity connected to the cloud. Moreover, the agriculture serves to be one of the most important sectors that have to be modernized as it is the basic requirement for sustaining of life on the planet. Thus, the prototype of module proves to be one of the effective and cost-effective one

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