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Modern Agriculture using Wireless Sensor Network

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Abstrct- Indian economy majorly depends on the agriculture sector hence it is known as the backbone of India. Here agriculture segment accounts for 18% of India's GDP and is providing employment to 50% of the country workforce. The main aim of this work is to reduce the manual monitoring of soil testing and plant irrigation and help farmers in increasing the agricultural production. The testing of soil is done through various sensors and based on the data received the farmers can cultivate the appropriate crop that is suitable for soil. Detection of plant's diseases is done through image processing technique. And also includes pest detection and control by using Acoustic sensor and we make use of Ultrasonic sound emitter to keep the pests away from destroying the crops. It alerts farmers through a message. All the information is sent to IBM Bluemix Cloud by ZigBee protocol. A direct communication link is set up between farmers and the consumers without the involvement of any middleman via mobile app.

Keywords—pH sensor, NPK sensor, Temperature sensor, Humidity sensor, moisture sensor, Irrigation system, MATLAB

I. INTRODUCTION

Agriculture is the basic support and the backbone of Indian economy . In the past decade, it is been observed that there is very less progress in agricultural sector. The cost of Food are reaching great heights day by day because good and healthy crop production rate is being declined. Since 2010 it has assaulted over 40 million population into poverty[1].

Even though many advancements has taken place in field of agriculture , the farmer is unable to get profitable yield due to the lack of knowledge on the nutrient's required and also on the parameter's like PH, temperature, humidity, moisture etc.

The nutrient's like Nitrogen, Phosphorus, and Potassium (NPK) play an important role in plant growth. Low nutrition level tends to various plant disorders and low crop yield. The quality of recommended macro nutrient's like NPK(nitrogen, phosphorous, potassium) is dependent purely on the type of crop and also on plant growth status. The main idea behind this is to measure the real time values of PH, humidity, moisture, NPK etc. by using sensor nodes which is sent to cloud by ZigBee protocol.

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The data is analysed by datamining technique for a specific crop which can be obtained via mobile application. Infection on plants intimates to the major reduction in quality and quantity of farming foodstuffs. Checking the strength and diseases on the plant shows a main role in fruitful production of crops. In initial days, observing and scrutiny of the plant diseases were through physical method by the proficiency persons in the field which requires incredible amount of work and also require extreme handling time. Image processing methods are used in detection of the plant disease.

In most of the time symptoms are observed on the plants stem, leaves and fruit. It has become the toughest task for the farmers to prevent crops from pest and its related diseases. The pests could damage the crop, which leads in reduction of crop yield and the quality of the crop.

Farmers make use of lot techniques to kill the infectious pests. detection of pest disease is essential before treating it. Without prior knowledge of the pest, using of pesticides may lead to negative impact such as pests will be able to develop resistance towards the pesticides leading to change in results, which also kills useful pests and natural enemies of pests which leads to increase in the pest population. We also make use of Ultrasonic sound emitters to prevent pests in the field and thus protects the crops from being destroyed and also ensures that growth of the grains completely done, and also alerts the farmers through the message. More over a direct communication has to be setup between farmers and customers.

With the world being more modern and technical oriented, smart phones has come into the hands of people even in the rural area. A Web cum mobile application will reduce this difficulty. All the details of the requirements needed for functionality such as the Details of products from farmer and the consumers, Expertise analysis, Cost estimation and crop quality checks can be known easily within less duration.

II. LITERATURE SURVEY

Many studies has been done on the field of agriculture to increases the yield and the quality of the food grains using modern technologies. [1]

The main intention of the authors was to collect realistic data of the agriculture farm that provides information on the weather pattern, crops etc by the combine approach of IOT and wireless communication .[2] In this paper we make use of different kind of sensors such as pH sensor, temperature sensor, and humidity sensor. Based on the real time values obtained they are analysed and particular crop pattern is been suggested which suits the soil. [4] This paper major intention is to restore macronutrients present in the soil by measurement of nutrients present. The presence of nutrients is obtained by using sensors.

[5] Here make use of different sensors to measure the real time values of the nutrients like Nitrogen (N), Phosphorous (P), Potassium (K) and the data measured is sent to the cloud through ZigBee protocol. [6] In this system the real time data is analysed using different technique and the data is sent to the cloud which can be accessed through mobile application. [8] In this the author specifies of the automatic irrigation. Soil moisture sensor is used to detect the moisture level present in the soil, based on the values obtained the field is irrigate using the valves. This also includes pest control using ultrasonic sound emitter to keep pest away from the farm. [9] In this pests are been detected, controlled and monitored using wireless sensor network. [10] Here we make use of plant leaf images to detect different kind of plant diseases is been discussed in this. This paper also includes different methods of segmentation and feature of extractions. [12] Image processing using MATLAB is implemented to `detect the weed areas in an image we took from the fields. [13] The major role of this paper is the electronic exchange which is to matches the production of the farmers with the requirement of the wholesalers and retailers. Hence there will be no loss to both seller as well as consumer. [14] In this a mobile and web application is developed to set a direct communication between farmers and consumers to buy and sell the products without the involvement of a middleman at reasonable price. The agricultural experts will analyse the crop that comes to final stage of production, they approve it based on quality and grade the product. This would make easy for the farmers and consumers access easily.

III. PROPOSED METHODOLOGY

In figure 1, A system is been developed to increase the agriculture production by nutrient analysis like pH, moisture, temperature, humidity and NPK using sensors and the data Analysis Is done through the datamining technique and assessment for specific crop is made via mobile application. In further stages the plant diseases are detected through image processing using a tool developed through MATLAB, also pest is detected through WSN, which is controlled through Ultrasonic sound emitters and also alters the farmers through message. This system also proposes of automated irrigation based on soil moisture. Finally, the direct communication is set between the farmers and the buyers which helps in avoiding the involvement of mid dle man.

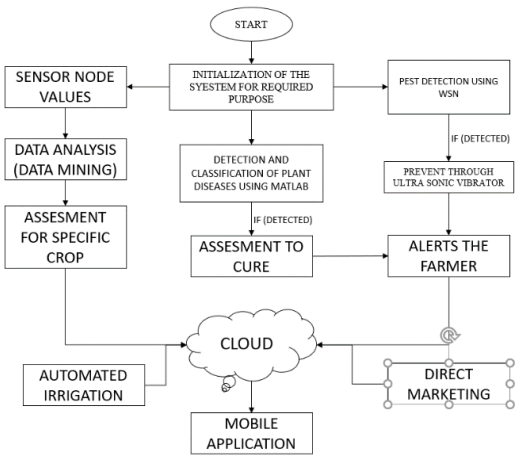

Fig (1) Proposed system

I. Soil testing

The system consists of many sensors to measure the pH, moisture, humidity, temperature and also soil nutrients like Nitrogen, Phosphorus, and Potassium (NPK).

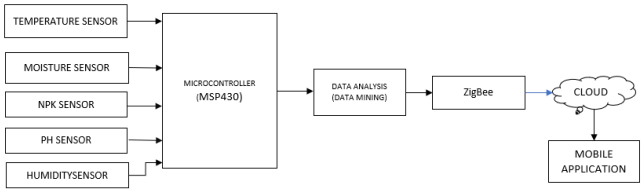

Fig (2) sensors block diagram

- **Temperature sensor**

LM35 is an Integrated temperature sensor specially designed for measuring the surrounding temperature.
the main advantage of this is the output is directly proportional to the surrounding temperature hence its accuracy is more compare to the thermistor. Its self heating is about 0.1 °C hence power consumed will be less.

- **Soil Moisture Sensor**

Soil moisture sensors are mainly used for the volumetric analysis of the moisture present in the soil. Which helps in the suitable irrigation of plants. It increases the quality and yield of the crop, by providing the required amount of water using relays through microcontroller.

- **pH sensor**

A pH sensor consist of electrodes which measures the concentration of hydrogen ions, which indicates whether the soil is acidic or alkalinity. Here pH sensor used is a analogy pH meter. The output is obtained by connecting BNC connector and PH2.0 sensor interface to microcontroller.

- **Humidity sensor**

A humidity sensor measures moisture content present in the air. The amount of moisture present depends on the air temperature. The humidity changes with change in air temperature Which is important factor to increase the yield by looking into other surrounding parameters.

- **NPK sensor**

The NPK sensor detects the amount of nutrients present in the soil. Where NPK are the major nutrients for the growth of the plant. based on the NPK value received from the sensor which is sent to cloud through ZigBee and analysed through datamining technique. Thus, the suitable crop is suggested to farmer via mobile application.

- **MSP430**

MSP430 is a microcontroller which operates at low power.it is very effective for the low power applications where the batteries cannot be replaced repeatedly. A 9V battery is enough to operate the microcontroller over a period of 10 months.
The sensors are connected to the MSP430 via I2C bidirectional bus to process the data received from each of the sensors. The I2C bidirectional bus provides a direct communication link between integrated circuits. The program of the sensor collects the temperature, pH, soil moisture, humidity, NPK values and analysis for specific crop is done through datamining technique.

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The collected data is processed and extracted parameters are transmitted to the cloud through the ZigBee protocol. A mobile application Is developed that delivers results to concerned person. The information delivered by the app helps the farmers to increase the yield and can minimize the crop production cost.

	SENSOR	OUTPUT VOLTAGE	OUTPUT CURRENT	TEMPERATURE	ACCURACY
TEMPERATURE SENSOR	LM 35	4V-30V	60uA	-55 to +150°C	±3/4°C
MOISTURE SENSOR	YL-69	3.3-5V	35mA	-	-
PH SENSOR	PH SENSOR	5V	-	0-60 °C	±0.1PH
HUMIDITY SENSOR	DHT11	3V-5.5V	100uA	0-50 °C	±5% RH

Fig(3) sensor specifications

ii. Automated irrigation

This proposed system consists of sensors like soil moisture sensor, humidity sensor and temperature sensor. These sensors collects the present soil moisture, humidity and temperature of the surrounding. This data is taken by microcontroller and sent to cloud through ZigBee protocol. This data analyses the water required for the proper irrigation of the plants. We also gather the moisture requirement for various crops in different climatic conditions. This helps the system to start the irrigation on its own by analysing the data. The moisture sensor measures the moisture content present in the soil for the specific time interval. If the moisture content is lesser than the threshold value the system directs the microcontroller to open the valves using the relays and allows the required amount of water to the field. When the values are reached to its threshold the valves are automatically closed. By this technique we can improve the crop yield and also avoid the wastage of water.

iii. Pest detection and prevention

a) pest detection

Pest detection and prevention plays a major role in improving the crop yield. Here Pests are detected using WSN, here we make use of acoustic sensor which is nontoxic, remotely operated and very efficient in the detection of hidden infestation.

This sensor is the best for detection of pest with more efficiency and less cost. This system has been designed in such a way that it monitors the crops by monitoring the sound level produced by the Pest. When the sound reaches above the threshold, it alerts the farmers of the specific area from where the infestations are taking place.

b) Pest control

Pests are one of the main reasons for the reduction of crop yield. Hence prevention of the pest using proper pesticides in proper quantity is necessary. Unnecessary usage of pesticides leads to loss of crop yield. Hence in this proposed system we use alternative technique i.e. we use ultra sonic sound emitter which is placed in different places of the field. They emit high frequency, short wavelength sound waves which is about 20KHz, which is too high hence that cannot be heard by human ears. This sound waves varies from 50KHz to 240KHz which scientifically proved to get rid of pests. It affects the pests nervous system by causing irritation and keeps the pest away from the farm. By using ultrasonic sound emitter we can avoid the pest which is cost effective and also helps the plants to grow healthy and reduces the usage of pesticides in fields.

iv. Plant Diseases

The elementary steps for recognition and classification of plant disease through image processing using the MATLAB tool.

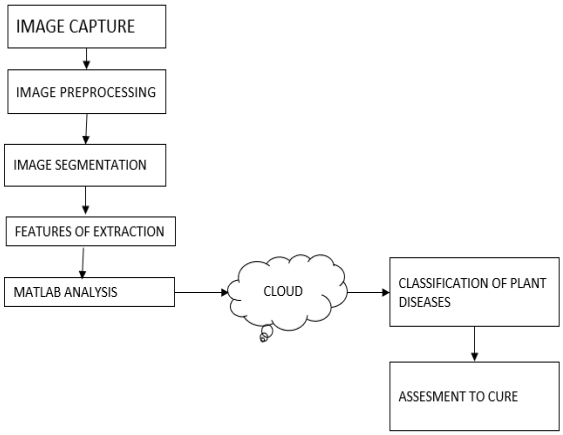

Fig (4) disease detection and prevention lo;0p

A] Image capture

The plant leafs images are taken through the various cameras placed in the field. This images are classified into Red, blue and green form.

B] Image Pre-processing

The image processing technique is been used to remove noise and other unwanted objects present in the images by different image pre-processing techniques.

The images are cropped to get the necessary image region. The smoothing filters are used to smoothing the image. The RGB images are converted into grey images for further processing.

C] Image Segmentations

Here the images are divided into many parts of having similarity. The separation of images can be done through different methods k-means clustering, and by converting RGB images into the HIS model etc.

D] Feature Extraction

Feature extraction plays an major role in the recognition of an object. The feature of extraction are used in many applications of image processing. Colour, texture, morphology and edges are the main features in detection of plant diseases.

E] MATLAB analysis

After feature extraction is done, the special tool is developed through MATLAB which detects and plants diseases. Which is sent to cloud through ZigBee protocol and suggests the farmers to cure via mobile application.

Finally, the crops are rated based on the quality (high, medium, low). And a direct communication link is set between farmers and the consumers through mobile application through this we can make all farm products easily accessible.

Through this farmers wont face any middle man entry and he self can sell his products. Farmers can become more connected to society and form cooperatives (like amul, more, reliance) through mobile application.

IV. RESULT ANALYSIS

The proposed system is implemented and tested. The sensor nodes functionality is verified and tested by requesting, receiving and evaluating the sensors data, transmitted from sensing nodes to the base station. The data transmission is realised via the wireless ZigBee protocol. Later the working of this proposed system is tested by sending data to and receiving data from the platform. Then it measures humidity, temperature and other parameters. And this crop details are logged at the CPU and is saved; it is logged on cloud by the MATLAB. This data in cloud can be obtained by mobile application. The cloud-based log gives the users the opportunity to obtain this information from anyplace and any time.

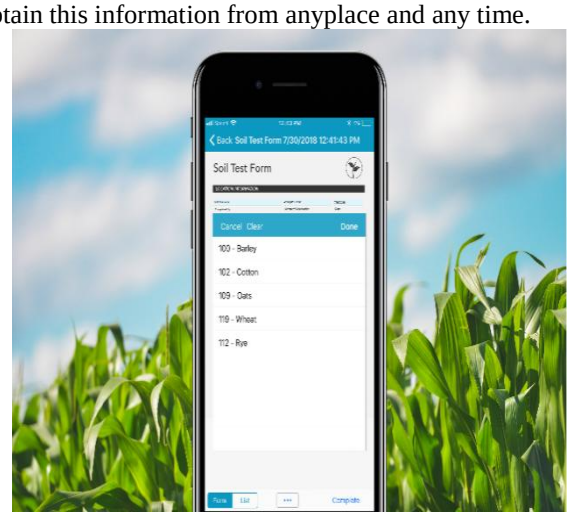

Fig (5) crop recommendation's

Fig (6) Diseases detection

V. CONCLUSION

The proposed technology helps in determining the nature of soil by extracting the contents of the soil using variety of sensor nodes. This particular system helps the farmers in finding the suitable crop for their field. It provides the suggestion about the suitable crop that can be grown by analysing the sensor values. In the cloud the comparison of sensor values with the threshold values takes place. The images of the crops are taken and monitored in such a way that they can protect the crops from pests and insects. Detection of diseases of plants is also done using MATLAB processing in order to protect plants and produce good quality plants. This helps to monitor the crops anytime from any place using the developed app. The main purpose of this system is to increase the agricultural yield and reduce the investment of the farmer.

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