MONITORING OF SOIL NUTRIENTS USING IOT FOR OPTIMIZING THE USE OF FERTILIZERS

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***Abstract*—**Agriculture is the backbone of all the developing countries. Focusing on encouraging innovation in agriculture, smart farming is the answer to the problems that the industry is currently facing. All this can be done using the smart phones and IOT devices. Farmers can get the required data or information as well as monitor his agriculture sector. IOT connects the whole world with the help of sensors, acutators and other embedded devices. There lies an urgent need for using IOT in agriculture which makes it more reliable for farmers. Due to the rapid increase in the population,the production of crops has to be increased. To produce more efficient crops, soil moisture, temperature and soil pH is more important. Crop growth is based on soil nutrient level and its moisture level. Hence the nutrient level has to be monitored frequently for crop production. For this there are various techniques for nutrient detection. The level of temperature, soil pH and moisture level are measured frequently. Nutrient level, ph and moisture level of soil are detected and monitored using soil moisture sensor and pH sensor along with that temperature sensor and a microcontroller is used. The values are then stored and updated to cloud server for future use. In this system an electrochemical sensor is developed to determine the percentage of soil nutrients i.e., Nitrogen, phosphorous and potassium. It will analyze soil nutrient content present in soil at real time and it will also suggest based on determined PH of soil. Monitoring of the field and to provide the proper fertilizers depending upon the soil nutrients is the main feature of this paper. IOT esp8266 is used to display the information to the farmers by MMS**.**

***Index Terms*—** Agriculture ,IOT ,MMS and Farmers**.**

1) INTRODUCTION

Agriculture is the essential need for human life and IOT serves as the better platform for the smart agriculture. The adoption of IoT solutions for agriculture is constantly growing. .Namely,BI intelligence predicts that the number of agriculture IoT device installations will hit 75 million by 2020, growing 20% annually. At the same time, the global smart agriculture market size is expected to triple by 2025, reaching $15.3 billion (compared to being slightly over $5 billion back in 2016).A proper soil testing will help to decide the amount of fertilizer to get the proper results of the crop based on the nutrients already present in the soil. A complete nutrient management plan is done by using the soil testing. Major nutrients present in soil are Nitrogen (N), Phosphorus (P) and Potassium (K).Based on relation between the pH and macro nutrient concentration of soil, we decide the fertility of soil.

Depending upon the minerals available in the soil, we can estimate the plant rate of nutrient absorption. Due to the insufficient rate of nutrients there is degradation in the production of crops. The major requirement of the nutrients for necessary plant growth is known as Macro nutrients. However the better amount of fertilizer is required for better growth.

pH sensor is used to measure the POWER OF HYDROGEN value of any substances. pH sensor is used in industries, laboratories agriculture, manufacturing, pharmaceutical etc.. In this project, pH sensor is connected to Arduino microcontroller. It finds out the pH level of nutrient in agriculture soil. The data is sensed and monitored. The data collected from various soil ,at various places of the field are uploaded to the database which is then stored in cloud server. Based on the pH level of nutrient in soil, the usage of fertilizers can be decreased. The pH scale extends from 0 – 14 where 7 is neutral, range below 7 is acidic and range above 7 is alkaline. Soil moisture sensor is mainly used in agriculture to determine the water level in soil for irrigation and efficient crop production. Due to the prevailing weather conditions the water availability is very low. So depending upon the soil moisture content farmers can decide the amount of minimized by this process .This arudino Module sends the information to the cloud and then to the user. Color sensor is used to determine the nutrients amount such as high,low or none. To detect the deficient nutrients content of the soil, the sensor probe is connected along with the proper signal conditioning circuits. So , by this method only the required amount of fertilizers is dispensed into the soil. Utilization of adequate amount of fertilizer also reduces the water wastage. Passive infrared sensors and ultrasonic sensors are used to detect the animal and human intrusion.The information is recorded and send to the farmers through the MMS. Ultrasonic sensors generates sound waves above 18khz that can detect movement of humans/animals and measure the accurate distance

2) LITERATURE SURVEY

G.sushanth and s.sujitha presented the work on the development of a smart agriculture system using sensors, microcontroller within an IOT system . The aim of the implementation is to demonstrate the smart and intelligent capabilities of the microcontroller to allow the

decisions to be taken on watering the plants based on the continuous monitoring of the environmental conditions in the field. It also aims at a predefined irrigation schedule as per the farmers convenience, uploaded into the application developed for the same. The implementation is a photovoltaic powered automated irrigation system that consists of a distributed wireless network of soil moisture and temperature sensors deployed in plant root zones. These sensors continuously monitor the parameters and send it to the Arduino board for further processing which acts as an IOT gateway. This gateway has been given the wireless capability by installing a WiFi module which will be updating the data to the cloud. The IOT gateway also has the GSM capability through the module connected. This receiver unit also has a duplex communication link based on a cellular-Internet interface, using general packet radio service (GPRS) protocol, which is a packet-oriented mobile data service used in 2G and 4G cellular global system for mobile communications (GSM). The data being uploaded to the cloud allows the user to continuously view the parameters from home.R.nageswara rao and b.sridhar developed a paper based on agriculture irrigation system is with low complex circuitry. A two sensors are used efficiently those are temperature and moisture of soil in the circuit to get the calibrated information to the system. Two sensors and Raspberry pi microcontrollers of all three Nodes are successfully interfaced various Nodes. All observations and experimental tests proves that proposed is a complete solution to field activities, irrigation problems, Implementation of such a system in the field can definitely help to improve the field of the crops and overall production. The irrigation system completely automated also provides real-time information about the lands and crops that will help farmers make right decisions.

Bah A. et al. [4] discussed the potential of various on the go sensor like electrochemical sensors, optical and radiometric sensors, acoustic sensors and mechanical sensors and they can play an important role for nondestructive and rapid characterization of soil nutrient variability and various soil nutrients. They proposed different sensors that are exclusively appropriate to decide maybe a couple soil traits. Acoustic sensors are helpful to separate the physical and mechanical attributes of soil. G.Naveen Balaji1 , V.Nandhini , S.Mithra , R.Naveena N.Priya proposed the paper on the image processing using video surveillance and embedded system using the sensors are taken into consideration for monitoring area. The crop water requirement and temperature, humidity values are measured by using the sensors. The average value of temperature and humidity of the surrounding and the soil moisture measured is sent to the arduino UNO R3. This average value from the controller is displayed in digital form in the webpage. The animal intrusion into the agricultural land is detected by image processing technique. It is based on the movement detection of the animal using the continuous video surveillance through the cameras placed. The cameras are fixed in multiple areas in the agricultural land. The images of the animals are already stored in the database. If any animal is intruded into the land, the image of the entered animal is captured. The captured image is then resized to the defined size and then it is converted into the gray scale image to detect the foreground image of interest. Now the converted image is compared with the previously stored images. If both the images are matched then an alert message will be sent to the person through GSM module.

3) MATERIAL AND METHODOLOGY

EXISTING SYSTEM

The existing system mainly deals with two types of soil testing methods.

1.Laboratory testing for soil nutrients

2.Mobile soil testing

The first method involves soil testing which is a time consuming process. It takes weeks or days to test the fertility. It involves taking the soil sample and sending to the laboratories for soil testing. By using chemical analysis , they detect the NPK values of the soil .The mobile soil testing involves chemists who come and do the soil testing then give the solution regarding the fertilizers but it will done in once per crop. So, this method is not suitable for effective crop production and it does not give the accurate results. Another method for detecting the soil fertility are conductivity and electro chemical sensor methods. But those are cost effective and accurate results are not obtained.

4) PROPOSED SYSTEM

Food is the basic need for human life. Due to the growing population and increasing climatic changes the production of food crops is a major deal. Water scarcity also is the main drawback. Hence fertilizers are used for more crop production. But due to this more amount of water is used. To avoid this fact, we have to detect and monitor the soil parameters by the monitoring of: *A.* ph of soil using ph sensor

B. Moisture of soil using soil moisture sensor

C. Nutrient level of soil is determined using colour sensor

D. To prevent intrusions by using PIR and ultrasonic sensors.

E. All the data's are collected from various places through various sensors and are monitored day by day.

F. Then data are uploaded to cloud server for future use.

G. Farmers are able to know the message through an android application by giving their name and phone number or a message is sent to farmer every day.

parameter information on the mobile phone as well as laptop using web browser in the form of graph

The useful components to implement the proposed system is given below.

Ultrasonic sensor

PIR sensor

Color sensor

PH sensor

GSM module

IOT esp8266

LCD display

Power supply.

PARTIAL NUTRIENT BALANCE

PNB is the nutrient recovery efficiency which is expressed as nutrient output per unit of nutrient input.

$$PNB=Uh/F$$

Uh = Nutrient portion of Harvested portion of crop

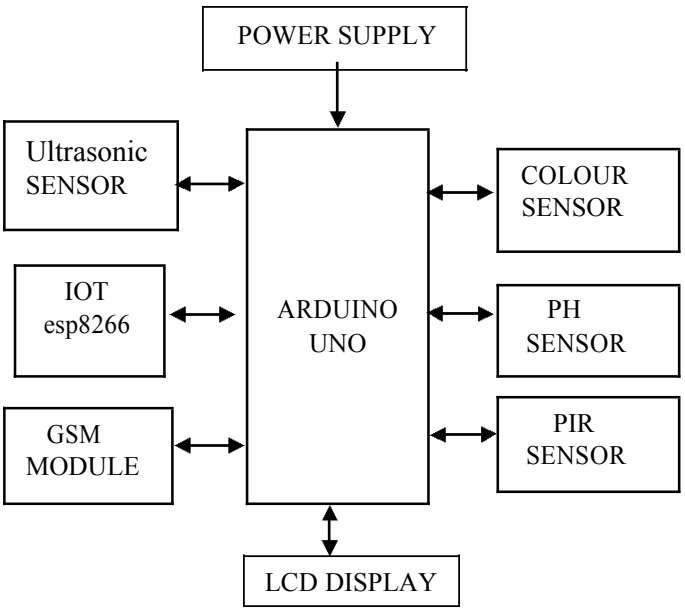
F = Amount of Nutrient applied

PNB gives the information of how much nutrient is taken Out of the system in relation to how much it is applied.

By using the nutrient detection in the soil and supplying only the required nutrients,

PNB is increased which leads to the high yield.

5) BLOCK DIAGRAM



6) COMPARATIVE STUDY

BEFORENUTRIENTS TESTING	AFTER NUTRIENTS TESTING
Water usage is not optimised .	Water requirement calculated by using the PNB and nutrients analysis and hence is optimised.
Fertilizers are used in large amounts and is cost effective.	Fertilizers are added only according to the need of the plant.
Nutrients supply beyond the particular level may cause damage to the soil .For ex., excessive nitrogen supply in *solanum melongena* causes decline in flower and fruit production.	Soil is not affected since only the small amount of required fertilizer is used.

7) RESULTS AND DISCUSSION

Thus by designing and fabricating this nutrients testing and monitoring of agricultural field system, it helps farmers to easily identify the correct usage of fertilizer to minimize water usage and to improve the yield. It also avoids any intrusion so that the crops are not affected.

8) FUTURE SCOPE

It is to help farmers to easily monitor the field to increase the crop productivity. Smart agriculture is the work from home process that allows automatic watering of field and fertilizer spraying may also be done.Intrusion avoidance may be the future scope of this project.

9) CONCLUSION

Smart agricultural system can prove to be helpful for farmers.

But In the present situation it has been realised that the use of inorganic fertilizers should be integrated with renewable and environmental friendly organic fertilizers and green manures.

Sensor network and their usage in farm monitoring is the most useful innovation for the people of INDIA.In smart farming , there is need to increase the productivity with descrease in cost , time and human effort.In this paper we use IOT sensor and cloud to monitor the soil nutrient , intrusions for the betterment of agricultural yield.As outcome of challenge, soil nutrient , animal and human intrusion if occurred in the field are monitored.

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