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Soil Based Fertilizer Recommendation System using IoT

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Abstract: *As the technology is improving, many of the traditional works have been shifted to automated works. In this World of digitisation, remote monitoring of soil parameters is emerging trend which has the potential to transform agricultural practices and increase productivity. The pH of the soil and moisture content in the soil plays an important role in monitoring soil fertility and plant growth. In this proposed system, according to the pH value and moisture content relevant crops to be grown are shown and also the fertilizers to be used are recommended. In this work we have used analog pH sensor kit for measuring the pH. For soil moisture content Estimation, the inverse relation between soil resistance and soil moisture is been utilized and corresponding circuitry has been developed. The system is integrated with WiFi module ESP 8266 for the transfer of data. The system will analyse soil nutrient content at real time and make crop prediction. The system is built on Atmega 328 microcontroller.*

Key Words: **Farmers, crop, Agriculture, Iot fertilizer recommendation.**

1. INTRODUCTION

Agriculture is an essential need for human life and IOT serves as the better platform for the smart agriculture. The use and adoption of IoT solutions for agriculture is constantly growing. Since India is a land of versatile soils, Indian economy is mainly based on agriculture whereas agricultural productivity depends upon the type of soil. But the major problem with the Indian farmers is insufficient knowledge about the soil. Each soil type has different characteristics i.e. there are various nutrients present in the soil. Deficiency of the nutrients in soil decreases the crop productivity. So, there is a need for soil analysis. The alarming situation of farmers suicide has led the idea to put efforts in the design and development of a sophisticated soil testing and fertilizer recommendation system. In Automated farming, we intend to reduce human errors and human efforts by monitoring the soil quality using soil sensor via smartphones and webserver. The key feature of our system is to determine suitable crops and the fertilizers for the current state of soil. By calculating the pH and moisture content in soil. Our system will be used for soil analysis in order to increase crop yield. Based on soil analysis report, fertilizers will be recommended to the user. Fertilizers will be recommended using nutrient status table which is stored in the database. By comparing values of nutrients with table, classification will be done and accordingly fertilizers will be recommended to the user. Our system will help farmers for better yield of crops which in turn maximizes the profit. This increases the financial status of the farmers. Our system is also trying to fulfil the vision of our honourable prime minister that every farmer should have soil health report for the betterment of farmers.

2. LITERATURE SURVEY

Paper 1: Komal Bodake, Rutuja Ghate, Himanshi Doshi, Balasaheb Tarle(1)

In this paper, In order to increase crop field our system will do analysis of a soil using sensors. Fertilizers will be recommended to the users based on the report of soil analysis. The system uses statistical predictive modelling for prediction and recommendation of fertilizers. IOT technology is adopted for smart farming and for enhancing efficiency. Using IOT human efforts are also minimized. It results in increasing profitability and productivity. This system was presumed to evaluate soil conditions and act accordingly in order to help farmers. Our system also trying to fulfill the vision of our honorable Prime Minister that every farmer should have soil health report.

Paper 2 : Dharmesh Vadalia, Minal Vaity, Krutika Tawate, Dynaneshwar Kapse(2)

In this paper PH electrodes are used for determining PH of a soil. In this project microcontroller is also used for identifying PH of diluted acid soil sample using glass pH electrode. It's range is from 0 to 14 with 7 being neutral. PH above 7 is alkaline in nature and PH below 7 is acidic in nature. Here, Human errors are reduced by system by monitoring the soil quality. The system determines suitable crops and fertilizers for soil's current state.

3. SYSTEM ANALYSIS

A. Problem Definition

With every change in weather condition the fertility of soil keeps on changing. The monitoring is necessary for healthy crop production since the fertility of a soil varies at different parts of field. pH electrodes are used for determining pH of a soil. Electrical conductivity and soil alkalinity are sensed by pH electrodes. Nutrient contents are determined on the basis of sensed parameters. The soil fertility state is considered by obtaining average of all observation from different parts of land. After calculating fertility, system will determine suitable crops for tested land and farmer gets an idea of what fertilizer is required.

B. Scope

By using this Proposed System farmer can efficiently monitor their field & soil. Farmer can get the detailed information regarding soil from home itself; Rather than visiting the lab for Soil Testing. System will suggest the Fertilizer and Which crop should farmer bow in that particular soil by analyzing the parameters like PH value, Moisture value, etc of the soil. Maintaining the record of Land fertility will become very easy & access it from anywhere using your mobile device. In Future by using Smart Agriculture, Automatic Fertilizer spraying may also be possible.

C. Proposed System

Human Life is Fully depend upon Food. Due to increasing population and tremendous climate change Production of Crop is a major deal. Therefor Fertilizers are used to gain the Production of crop. Our Proposed System will replace the old fashioned Farming Technique with Smart Agriculture system. In this system, Automated Remotely Monitored Fertility monitoring Technique are used. Detection and Quality of Soil is determined by calculating different Parameters and Nutrients contents of soil i.e. nitrogen, phosphorus & potassium (NPK). A ph of soil is detected by PH sensor, Water content of Soil is calculated by Moisture sensor which is attached to Remote system. Portable device is used to take samples of the soil from different parts of that particular Land. Results will be shown on the Display LCD screen which is fitted on model. Framer will get an User Friendly Mobile Application that works very efficiently. In that application Farmer need to Insert the calculated data physically which is present on the display Screen. After Inserting that Data, The Application will digitally calculate the result and Present Farmer the Fertilizer name which can be suitable for that particular Soil and also recommends which Crop will be suitable to grow in that Soil. So Farmer can make their Strategies for farming accordingly with data that has generated and can take steps to increase the effectiveness of Fertilizer and effectiveness of crops and use them relevantly.

Components of Hardware Model are as follows:

I. Atmega328 Microcontroller

The most popular Microcontroller produced by Amtel is known as Atmega328. It is quite well known microcontroller that are compatible with Arduino Duemilanove board. It is an 8-bit microcontroller that has 32k flash memory, 1k of EEPROM with internal 2k SRAM. The Arduino board comes with two options either Atmega168 or the Atmega328. But the more updated and advanced is Atmega328 chip with 16k of flash program memory and 512 bytes of internal SRAM. It consists of total 28 Pins. It contains 14 digital Input output pins, of which 6 can be used as analog input pins & remaining 6 can used as PWM outputs.

II. ESP8266 Wi-Fi Module

The company named Espressif Systems, a semiconductor company operating from China has produced ESP8266 Chip. Basically it is the series or family of WiFi Chips. It also includes the presently WiFi series like ESP8266EX and ESP8285 chips. ESP8266 is small package which includes 32-bit Tensilica microcontroller, standard digital peripheral interfaces, antenna switches, power amplifier & filter and power management modules. It provides 2.4 GHz Wi-Fi capabilities and also supported to (WPA/WPA2), Inter-Integrated Circuit, analog to digital conversion. It has 64Kb boot Ram and Instruction Ram along with 96Kb of Data Ram.

III. Moisture Sensor

The water content in soil is mainly measured by the Moisture Sensor. The soil moisture sensor that has been used in system is having two probes which can be inserted into the soil. The Output coming from Moisture sensor is in the analog from which is converted into digital form. Percentage of water level in soil will determine us the final output. It is used in various many fields like irrigation & agriculture systems

IV. pH Sensor:

pH is mainly used for water measurements, to measure the water weather it is acidic or alkaline, or caustic or base present. An Electrochemical pH sensor is most common method to detect the Ph value of water. Combination pH sensor includes both measuring electrodes and reference

electrode. Changes in PH value is detected by measuring electrode while reference provides Stable signal for comparison. To Display the millivolt signal in PH units, High Impedance device known as pH meter is used.

D. Working

System Development life cycle Framework provide a sequence of activities for system designer and developer. SDLC is essential for developers for planning, analysis, design & implementation.

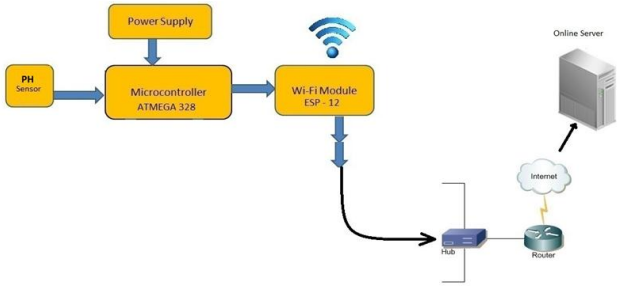

Fig no. 1 represent the Block Diagram of our Remote System System.

I. Sampling:

First we have to take Soil Sample which has been taken in such a way that it must represent area being sampled. But our System Required only Moist Soil. We get moist Soil by adding water in it, because the Sensors which are attached to our System can sense only wet Soil. When our Sampled Soil is ready for testing we will begin the further process.

II. Sensing Units:

Sensing Units in our Proposed System contains various Agricultural Sensor to determine pH Value, Moisture Value of Soil Sample. pH sensor will sense the pH value of Soil. It will absorb the Liquid Solution and gives us the Voltage value. It is completely Analog Device and did required Power Supply to Function. Output from pH sensor will Further goes to our Microcontroller, which acts as processor of this System. On other hand Moisture Sensor measures the Volumetric water Contain in Soil. Data from Moisture sensor will also goes to Processor.

III. Processing:

In our System, Microcontroller **ATMEGA328** performs the most vital role, Brain of the System. It is Responsible for Controlling the sensing and Communication blocks of device and Determine Soil Parameters such as pH, Moisture. Total ATMEGA328 Microcontroller has 28 Pins and some pins are connected to LCD Screen. To Display the Result LCD Screen is used that is attached to Our Hardware System. To Display the Result LCD has 2 Register, Command & Data. When the Command register is selected then it will treat it as Command and if the Data Register than it will consider as data. Remaining Pins are Data pins. In our System we are using 4-bit Mode.

Then this data will store to by Wifi Module. Here we have used **ESP8266** Wi-Fi Module. So basically Wi-Fi Module receives the Value and Create Get Request, That Get request is sent to the server and Data goes directly to the Server. Further Processing is done in Server and it goes to the DataBase for recommendation Purpose.

By using Internet the Scanned data from Sensors will retrieve in our Mobile Application; which we have developed on software called Android Studios. It is very User Friendly and Efficient. Our Proposed System already consist Pre-Defined Data of Crops and Fertilizers from Legitimate Government Sources. By Calculating and Processing with this Data, Our System will give you the Prediction for Fertilizer & Crop Recommendation.

System Data Flow:

Read pH Value / Moisture Value

⬇

Determine pH /Moisture Value

⬇

Send Data to Server

⬇

Analysis Data for Crop Cultivation

⬇

Retrieve Data on Mobile Application

Fig no. 2 System Data Flowchart

User Interface of Mobile Application:

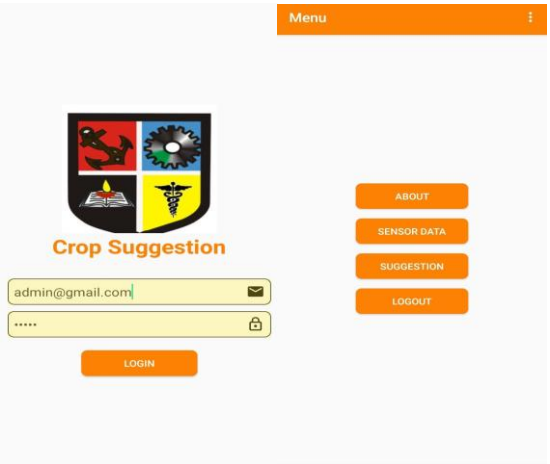

Fig No. 3 Log-in page Fig No. 4 Menu Page

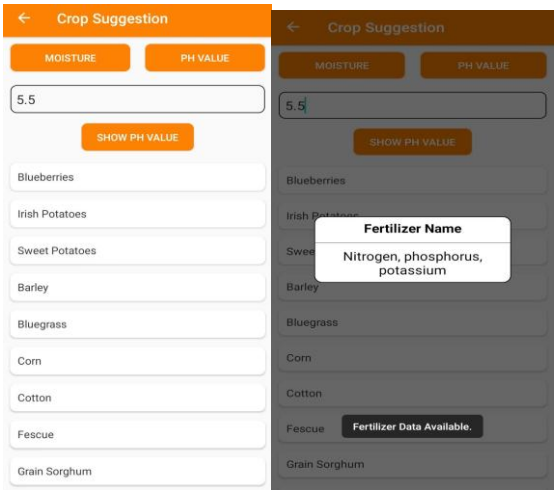

Fig No. 5 pH Value Fig No. 6 Fertilizers .....Detection Recommended

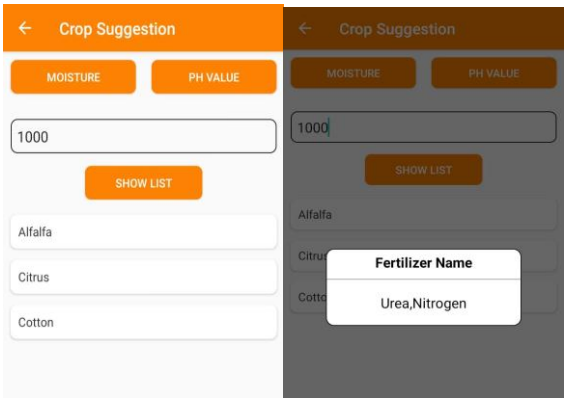

Fig No. 6 Moisture Fig No. 7 Fertilizers .....Detection Recommended

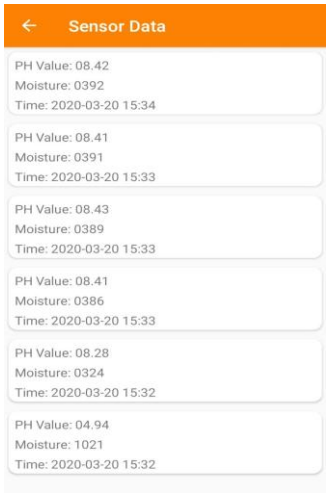

Fig No. 7 Sensor Data History

4. CONCLUSION

In this digital world each and every field is undergoing a dramatic change due to Information technology. But in agriculture field until now not much work has been done. We have proposed a model for advanced farming using multiple techniques: IOT, Cloud-Computing, and Data Mining. With the use of this model farmer will be able to get details regarding required fertilizers from the soil sample report. This Proposed system will give fast and accurate results. This is used for improved crop production with reduction in cost of fertilizer and thus improves the agriculture sector in India. Farmer need not have to take pain of visiting laboratory for soil testing as our system will be used for soil testing. System Distinguish between the various aspects when conducting a soil analysis. The data is collected in the database regarding crop details such as moisture, pH value and soil conditions which provides recommendation of crops along with fertilizer. Our system makes appropriate fertilization recommendations for the soil in the most economical way.

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