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SMART SOIL NUTRIENT MONITORING SYSTEM USING IOT

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Abstract— Remote soil monitoring is the technique tends to increase productivity by transforming agriculture practices. By knowing basic characteristics of soil this helps a farmer regarding application of fertilizer and the types of crops sown. IOT is remodelling the agriculture enabling the farmers with the wide range of techniques such as precision and sustainable agriculture to face challenges occurring in the field. The existing system is developed on STM32 Nucleo platform. The Proposed system determines the soil nutrients through the pH sensor fixed in the ploughing vehicle. The GPS helps to monitor value along with location and transferred to the government agricultural office through IOT. pH value of soil are the basic parameters which help in characterizing the soil and therefore in taking proper decisions regarding fertilizer application and choice of crops sown. The entire system is used to transform agricultural practices and increase productivity. This project is very useful for farmers, during ploughing process itself to know the exact level of soil nutrient present in the soil. **Arduino** is an open source computer hardware and software company, project, and user community that designs and manufactures single-board microcontrollers and microcontroller.

Keywords — *Internet of Things (IOT), soil pH sensor, Adriuno(UNO), The Global Positioning System(GPS).*

I. INTRODUCTION

Indian economy is mainly based on agriculture still we are not able to make most favourable, commercial and sustainable use of our land resources. The main reason is the lack of knowledge regarding the soil analysis for the growth of crops. Soil analysis is a valuable tool for farmer as it determines the inputs required for efficient and economic production. A proper soil test will support the presentation of plenty fertilizer to come across the desires of the crop while taking advantage of the nutrients already present in the soil. In every state, around 9 to 10 lakhs soil sample shave been received in laboratories. Conventional methods of soil testing which involves soil sampling in the field along with chemical analysis in the laboratory are expensive and time intensive. This limits the number of samples analysed in the field which further makes it difficult to describe soil nutrient levels in an agricultural field. The precision agriculture involves the effective control of farming inputs to raise profitability of crop production, improve crop quality, and protect the surroundings. Information regarding variability of different soil parameters in a field is necessary to the decision-making process. The chemical and physical properties of soil can be easily mapped by various soil sensors developed so far. Hence there is a need for soil analysis to be made available to the farmer. According to Agriculture University Survey, problem like Infertility of soil is increasing day by day because of excess of stimulant. Farmer has no knowledge how much fertilizer used for soil. The Proposed system determines the soil nutrients through the pH sensor fixed in the ploughing vehicle. The GPS helps to monitor value along with location and transferred to the government agricultural office through IOT.

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II. LITERATURE SURVEY

In [1], the authors have developed A Smart Irrigation and Monitoring System. The proper water management is a must because Mauritius is a tropical island that has gone through water crisis

since the past few years. With the concept of Internet of Things and the power of the cloud, it is possible to use low cost devices to monitor and be informed about the status of an agricultural area in real time.

In [2], the authors have analysed problems we design a low cost system for monitoring the agriculture farm which continuously measure the level of soil moisture of the plants and alert the farmers if the moisture content of particular plants is low via sms or an email. This system uses an esp8266 microcontroller and a moisture sensor using Losant platform. Losant is a simple and most powerful IOT cloud platform for the development of coming generation. It offers the real time data visualization of sensors data which can be operate from any part of the world irrespective of the position of field.

In [3], the authors have developed Precision Agriculture Monitoring System using Wireless Sensor Network and Raspberry Pi Local Server Precision Agriculture is utilized to improve the productivity and efficiency of limited agricultural resources by monitoring the relevant data in the field. The main objective of this study is to deploy a low-cost sensor system, gather field data, and display the data through a graphical user interface (GUI). Sensors such as humidity, temperature, moisture, luminosity, electrical conductivity, and pH was used for data acquisition and the Raspberry Pi, acting as a local server, was used for data processing and transfer.

In [4] the authors have developed An IOT Based System for Remote Monitoring of Soil Characteristics. In this work, antimony electrode is used for pH measurement. For soil moisture content estimation, the inverse relation between soil resistance and soil moisture has been utilized and corresponding circuitry has been developed. The determination of soil temperature is done using the DS18B20 sensor working on the Dallas one wire protocol. The system is integrated with Bluetooth for the transfer of data to a nearby cell phone. The entire system is developed on STM32 Nucleo platform.

From the literature survey made, most of the monitoring system has been developed for controlled environment, i.e. for green house rather than exposed environment. In this paper soil moisture monitoring system using the pH sensor fixed in the ploughing vehicle. The GPS helps to monitor value along with location and transferred to the government agricultural office through IOT.

III. EXISTING SYSTEM

The system is to collect soil sample and measure its pH value, temperature and humidity remotely in real-time through smartphones. The block diagram of proposed system is shown in Fig. 1. The system is developed on STM32 NUCLEO platform. It has three basic blocks viz. microcontroller block, sensing block, and communication block.

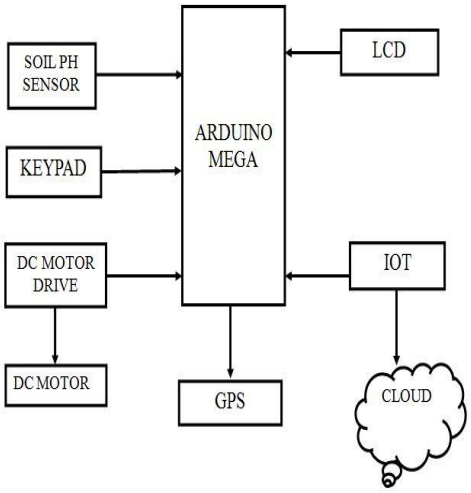


Fig. 1. Block Diagram of Proposed system

Microcontroller is the heart of the device. It is responsible for controlling the sensing and communication blocks of the device and reading soil parameters such as pH, moisture, temperature. It is also responsible for sending the data acquired from the sensors to a smart phone via Bluetooth. In the device we have used STM32L152RE which is a Microcontroller unit (MCU) of the STM32 series of development boards. The MCU used in this work has an additional feature of low power consumption. This is implemented in the form of several power saving modes such as standby mode and sleep mode. Firmware of MCU is developed and debugged using the Freeware version of IAR.

The flowchart of Firmware showing its working is given in Fig. 2.

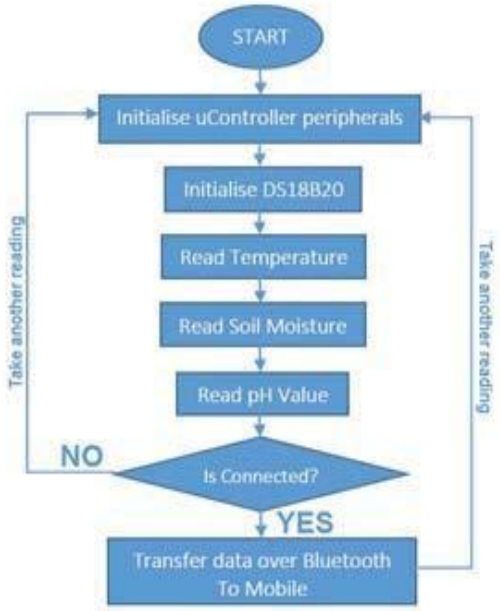
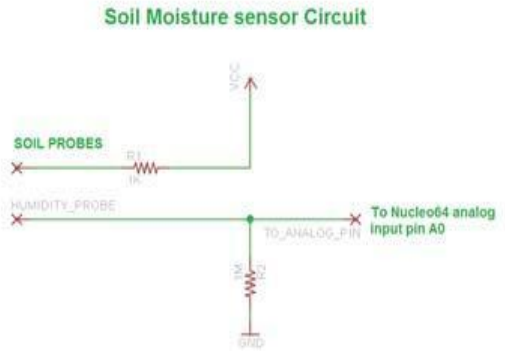


Fig. 2. Firmware Flowchart

The system works as follows. When powered on, MCU initializes the peripherals to be used to control and manage the sensing and communication blocks of device. MCU takes samples from sensors one by one and also checks if the device is connected or not. If it is, it transfers data to mobile, otherwise takes another sample. We have also implemented hibernate mode in the device keeping in the mind the fact that the device has to be used in outdoor applications. STM32L152RE has five power modes, out of which we have used the standby mode. In standby mode controller's use is minimized as it draws a current of about 0.1mA. The controller goes into standby mode for six hours after every one hour of data transmission. The sensing unit contains various agriculture sensors to measure pH value, moisture, and temperature of soil sample. These sensors are interfaced with a 10 bit ADC of MCU. DS18B20 is used as soil temperature sensor, which is a digital sensor based on the Dallas's one wire protocol. It codes temperature data using 12 bits, and thus provides a high level of accuracy. The soil moisture sensor is designed using the inverse relation between soil resistance and soil moisture. Fig. 3 shows the schematic of moisture sensor used in this work.



`Fig. 3. Soil Moisture Sensor Circuit

IV. PROPOSED SYSTEM

The proposed system is used to determine the nutrient quantity of soil. As we Know all the nutrients present in the soil but what amount of nutrients available in that particular field we can't figure out. For that in this project we can use the test bench to recognize the type of soil is good to grow the crop. On the basis of study it is concluded that, there are 3 types of soil available and they are alluvial soil, red soil, and black soil. Every soil has different micronutrient. But to measure the amount of nutrient available in the soil we are going to design device or instrument which gives us proper reading of micronutrient.

Following are the main objectives of the proposed system

- Design and develop a Arduino mega controller based sensor interfacing for reading a soil parameters.
- Build a interface between LCD and microcontroller to show the sensor readings
- Converting the sensor value using ADC port of microcontroller.
- Establishing the cloud server connectivity in order to store all soil test records over server with time and GPS location stamp.

Fig.4. Working model of Soil Nutrient Monitoring

Arduino mega:

The Ardunio controller forms the heart of the device. The microcontroller takes care of the control, sequencing, monitoring and display functions. The controller consists of internal ADC to convert analog input into digital. It receives the input data and displays it on LCD. Whenever required it automatically send Gmail with the help of GSM modem to the customer and sends a reading to mobile application over GSM.

PH Sensor:

This sensor is used to identify the salt value of soil. It shows the copper quantity of the soil from salt. A pH Meter is a scientific instrument that measures the hydrogen-ion concentration (or pH) in a solution, indicating its acidity or alkalinity. The pH meter processes the alteration in electrical prospective among a pH electrode and a reference electrode. It usually has a glass electrode plus a calomel reference electrode, or a combination electrode. In accumulation to computing the pH of liquids, a superior probe is occasionally used to measure the pH of semi-solid substances

GSM:

In order to send all sensor reading to mobile device over serial communication port GSM will be used. This will generate wireless link between mobile device and microcontroller.

The GSM reads all incoming reading form the microcontroller and shows it in LCD display. At the same time this application will uploads the data or reading over the centralized database server over internet through web service and work as a web client in proposed system. It create interface between GSM and web service where it receives data over GSM convert it in the web request and push data to web service as a web parameter data from different location will be collected with the help of portable device and uploaded to the centralized server.

Web Service:

This web service will be located at centralized hosting server with predefined fully qualified domain name i.e. URL or with a predefined IP address. This service will read all the parameters in web request and parse it to store it over database. Proposed system will be having a centralized database where soil testing readings are stored along with soil geo location, description and time stamp. Web service will create a connection with database table and store every reading as a unique record or row to table. As these tables containing multiple records hence these records can be further used for analysis and comparison purpose. It these records are geo-tagged then it can be used to graphical comparison of soil at different location.

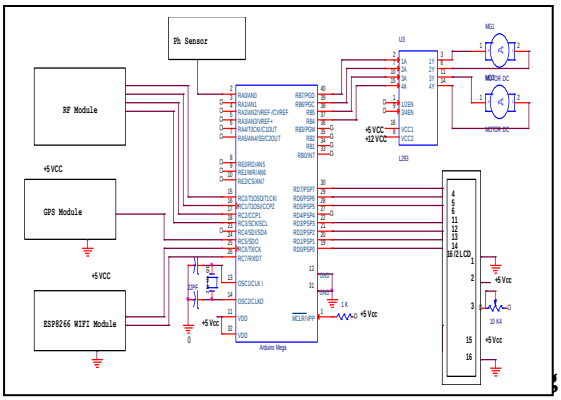


Fig.5. Circuit of Soil Nutrient Monitoring

V. RESULT

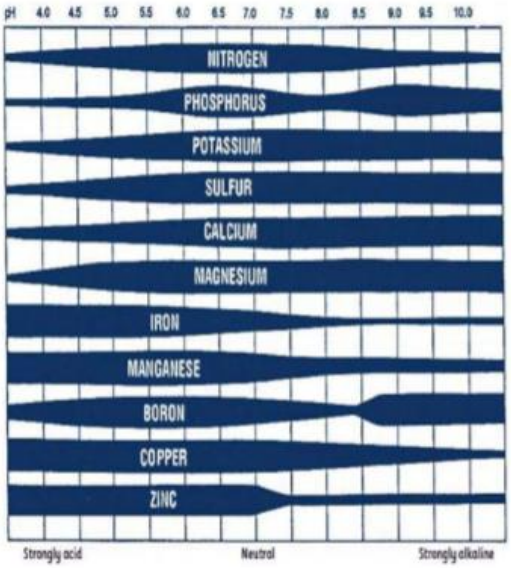


Fig.6. IOT using Soil Nutrient Monitoring

In this project we are getting the soil Appropriate fertilizer doses to suggest the Farmers to cultivate their crops so that there is No issue of ruining the crop or particular land.

VI. CONCLUSION

Soil trying is frequently performed by viable laboratory that deal a change of tests, aiming groups of compounds and minerals. This permits technicians to recommend the tests that are most likely to reveal useful information. With the help of proposed system every user or farmer can directly send the farm statistics to server and get the suggestions for better fertilization. This will leads to huge number of data collection and better planning towards farming. Within near future portable device can be developed for every farmer in very low cost and easy to use mobile application.

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