High Efficient IoT based modern soil composition identifier for smart yield farming

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Abstract - In Systematic agriculture the accurate readings of soil nutrients are needed, which includes specific crop management. The nutrients applications are adjusted accordingly on requirement basis. The fertility of the soil decides the essential amount of nutrients and water adequacy for proper yield. In soil chemical testing, analytical laboratories provide insufficient data, only few testing are carried out and other essentials were ignored. To enhances from this, our idea deals with complete soil.

1. Introduction
Indian economy always depends on agriculture, but still not able to make most favorable, commercial and sustainable on land resources. The primary reason is lack of knowledge regarding analysis on soil and crop growth. The farmers started intensive cultivation on early maturing crops, more varieties without prior to soil health and nutrient status. Around 10 lakhs samples are given to the soil testing labs, it’s difficult to test each samples and causes time consuming. And more time is taken to provide test report. To consider the fertility status three major components are taken:

-Physical characteristic of soil
-Biological status
-the chemical status
A fertile soil produces healthy crops with disease and pest resistance. Trying to feed crops directly may produce large yield but leads to post harvest problems.

Excessive use of pesticide cited to contamination of surface and ground water. If the soil has high salinity content the cultivation would be abrupt and seeds germination causes problem. Routine testing of soil can rectify many problems and also determine lime requirement and diagnosis problem. Our sampling technique is correct as the results are only based on samples produced and nutrient management plan for farms are enhanced.

2. Literature Survey
Adamchuk et al [1] recommended Ultra precision agriculture is based on the soil sensors. By improving soil sensors the efficiency of precision agriculture increases. Many sensors like optical sensors, electrical and electromagnetic sensors, acoustic sensors, pneumatic sensors and electrochemical sensors were suggested to identify the micro ingredients of a soil. Electrical and electromagnetic sensors often used to find the soil’s electrical properties based on the electrical resistivity and conductivity and it is also a useful method to determine texture of soil and spectral range when the soil surface reflects energy.

W.S.Lee et al [2] suggested that physical and chemical characteristics of a soil can be identified by using many sensing technology namely thermal imaging, Field-based electronic sensors, RFID, photoelectron meters, machine vision, satellite imagery and machine olfaction system. These technologies used for finding a nutrient of a soil, identifying the crop and its moisture content, weed and biomass detection. Thus reviewing all these parameters are essential to diagnoses the precision agriculture.
Bah A. et al. [3] examined the capability of a numerous sensors namely optical and radiometric sensors, electrochemical sensors and mechanical sensors, they perform a significant role for non-destructive and inconstancy of soil nutrient description and supplements of different soil.

On the basis of modern agricultural technologies, the precision agriculture plays an essential role in crop management and effective management of a soil nutrient. Based on the soil color, optical soil sensor has high potential for soil organic matter estimation.

Hak-jin Kim et al. [4] suggested that macro nutrients of a soil like nitrogen, phosphorous and potassium are identified by using two sensing technology. For effective crop production, proper identification of a nutrient is needed. Electrochemical method and optical diffuse reflectance sensing are the two sensing ways which considered as most prominent methods.

Sinfield et al. [5] discussed there are many ways to determine the soil macro nutrients namely nitrogen, phosphorus and potassium which are the most dominant supplements needed for the plant cultivation and these are the best elements in manure. It is impossible and economically challenging by using a variable rate of employment for the crop growth. Nitrate ion selective electrode and nitrate ion selective field effect transistor (FET) methods are used to determine the nitrogen.

Raman scattering and reflectance spectroscopy process are used for the determination of phosphorous which delivers an excellent output of complete content of phosphorous in the soil having the range more or less 0.63 to 0.68. By using a reflectance spectroscopy and potassium ion selective electrode method we can identify the potassium easily which has the value nearly about 0.7. Detection of soil nutrients by chemical analysis is intensive and complicated in laboratory testing. Thus, optical analysis is preferred to determine the soil nutrients.

Jose M. Soriano-Disla et al. [6] recommended three spectroscopy methods namely Visible-Near infrared [Vis-NIR], Near-Infrared [NIR] and Mid-Infrared [MIR] in order to identify the physical, chemical and biological behavior of soil. MIR method is most useful to determine other soil properties like quartz, clay minerals and carbonates.

Hari Prasad Reddy Aenugu et al. [7] examined the use of near infrared spectroscopy for various applications. There are various spectroscopy methods are Raman spectroscopy, near and mid infrared spectroscopy for optical analysis. LED (Light Emitting Diodes) are the important significant source of infrared light which consists of Gallium arsenide used as semiconductor.

At particular wavelength, it produces the radiations for near infrared light emission. The various NIR instruments are discussed which includes scanning spectrometers, Fourier transform spectrometers, acoustic optical tunable filter spectrometers and photodiode array spectrometers. For NIR analysis, the InGaAs detector material makes PDA more powerful. Here silicon Photo diode array [PDA] is very applicable in NIR spectroscopy.

Yubing Wang et al. [8] proposed the possible of VIS/NIR soil sensors and also examined the various prediction models. By using VIS/NIR soil sensors, soil organic matter contents are predicted. There are various regression methods namely Direct Linear Regression, Principle Component Regression and Back Propagation Neural Network.

These methods are used to fabricate the prediction model that provides the exact result for evaluation of organic matter content in soil. In that, Principle Component Regression and BP-ANN have set favorable result that directly denotes the VIS/NIR sensor. This sensor is important tool for detection of organic matter in soil.

Yin Bai [9] examined the characterization and fabrication of an integrated micro fluidic chip for Phosphate detection. Micro fluidic channel are fixed in a micro three-electrode system for analysis of samples. To increase the current response, working electrodes and counter electrodes were categorized as inter digitized array.

The current density and sensitivity of Phosphate detection were enhanced effectively, when compared with normal disk microelectrodes due to the nonlinear diffusion effect of ultramicroelectrodes and high generation collection mode of inter digitized electrode arrays.
The current density and sensitivity for Phosphate detection is -0.00537 meu A/mm², which is 3 times that of the disk microelectrode. But the current density was normally 6.5 times that of the disk microelectrode. For Total Phosphorus (TP) detection, the micro fluidic chip was used. This TP detection results have good consistency with nominal values of standard solutions.

3. Proposed Work

A. Block diagram

![Fig.1: Proposed Block Diagram](image)

The proposed block diagram is shown in fig.1. Moisture sensor is used to measure the volumetric water content in the soil. Nitrogen, Phosphorus sensor are used to check whether the nitrogen and phosphorus content are present in the soil. Soil conducting sensor measures electrical conductivity of substance it can conduct an electrical current in the soil. LM358 ADC IC can be used as a transducer amplifier and high gain operational amplifier. It has 8 pins integrated circuit. Therefore, it converts analog to digital. Power Source is an electrical device that supplies electrical power to an electrical load. Regulated Voltage is a measure of change in voltage magnitude between the sending and receiving end of a component. ATMELE Microcontroller was developed in the year 1996 by ATMELE. It is a memory for program storage as opposed to one time programmable ROM, EPROM or EEPROM. PH sensor measures the hydrogen ion activity in water based solutions, indicating its activity (or) alkalinity. Database EEPROM is user modifiable read only memory. It is one part of ATMELE microcontroller. ESP826 wireless module is a low cost WIFI microchip with full TCP/IP stack and microcontroller. LCD display is the technology used to display the output accurately. Alarm indicators are used to indicate alarm signal whenever there will be any excess level of PH, Nitrogen, Phosphorus content present in the soil. Cloud Storage is a cloud computing that stores data on the internet through a cloud computing. Cloud storage is a model of computer data storage in which the digital data is stored in the logical pools.

B. Cloud analysis

![Fig.2: Block diagram for Cloud analysis](image)

The proposed block diagram of cloud analysis is shown in fig.2. Physical device is one of the wireless sensor nodes. It transfers data to the cloud. Gateway and API (Application Program Interface) means an intermediate between the physical device and to the cloud. It is a single point of entry for a defined group of micro services. Basic Authentication means that the process of verifying the identity of a user or process. It acts as a security code whether it is authorized or unauthorized. MQTT web socket is a light weight messaging protocol that provides a simple way to distribute telemetry information. COAP (Constrained Application Protocol) is a specialized internet application protocol for constrained devices called nodes to communicate with wider internet using
similar protocols. Real Time Analysis on Web server is a webpage where the data can be stored and shown at a particular time; date, hours and day through a text, graphical images etc.

C. Calibration

Fig.3 Calibration circuit

Fig.3 shows calibration circuit with its essential components. Calibration makes the product accurate, safe and affordable. The electrochemical LM324 can be used in the calibration circuit. The individual calibration circuit consists of all the sensors like PH, Moisture, and soil conductivity.

D. Interfacing

While interfacing with ADC the output will be the calibration circuit and the interfacing of ADC 0809 with microcontroller 89S52.

4. Conclusion

The determination of soil nutrients can be discussed by various sensing methods. Adamchuk et al [1] and Bah A et al [3] both of them had given sensing techniques and they used the electrochemical sensors to identify the nutrients it is one of the most important method. In the future we want to develop a hand electronic sensor for the development of agriculture characteristics.

5. References

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