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Real Time Embedded Based Soil Analyzer

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Abstract: In this paper, adding today's technology towards agricultural fields, a cost effective Real Time Embedded Based Soil Analyzer can be developed with quick and reliable automated system which is used to analyze various soil nutrients with the help of pH value. As per the availability of nutrients, recommendations of cultivating the particular crop and proper fertilizer will be given.

Index Terms: RTEBSA, Automated System, pH, nutrients

I. INTRODUCTION

Soil analysis is a valuable tool for farmers, it determines the inputs required for efficient and economical production. A proper soil test will help to ensure the application of enough fertilizer to meet the requirements of the crop while taking advantage of the nutrients already present in the soil. It will also allow you to determine lime requirements and can be used to diagnose problem areas.

Sampling technique is correct as the results are only as good as the sample you take. Soil testing is also a requirement for farms that must complete a nutrient management plan.

Tests often check for plant nutrients in three categories

- Major nutrients: Nitrogen (N), Phosphorus (P) and Potassium (K)
- Secondary nutrients: Sulphur (S), Calcium (C), Magnesium (Mg)
- Minor nutrients: Iron (Fe), Manganese (Mn), Copper (Cu), Zinc (Zn), Boron (B).

Soil pH is the most commonly measured soil properties. It is also one of the most useful and informative soil parameters because of its relationship to many aspects of soil fertility and plant growth. Despite its importance, the implications of inadequate soil pH on forage response, particularly nutrient use efficiency, is often overlooked.

A .Soil pH and Nutrient Availability

The optimum uptake of most nutrients occurs at a soil pH near neutral. The availability of most micronutrients (nitrogen, phosphorus, potassium, sulfur, calcium, and magnesium) decreases as soil acidity increases.

Figure 1.1 shows the nutrient availability for a corresponding pH range [6].Therefore, application of lime to moderately acid soil tends to increase the availability of these nutrients. On the other hand, most micronutrients decrease their availability as soil pH increases.

Under these conditions, nutrient deficiencies may occur in response to excessive lime application. This "lime induced" deficiency is particularly important in Florida, where the majority of the inorganic soils present low buffering capacity and, therefore, can change the pH easily in response to liming.

The most important implication of the relationship between soil pH and nutrient uptake efficiency is that fertilizer use and crop response are expected to change as a function of soil pH.In acid soils, liming improves soil pH and thus, increases nutrient availability and use efficiency.

B. pH Value

The soil pH is a measure of the acidity or basicity in soils. pH is defined as the negative logarithm (base 10) of the activity of hydronium ions (H+or, more precisely, H3O+aq) in a solution.

It ranges from 0 to 14, with 7 being neutral. A pH below 7 is acidic and above 7 is basic.

Soil pH is considered a master variable in soils as it controls many chemical processes that take place.

It specifically affects plant nutrient availability by controlling the chemical forms of the nutrient. The optimum pH range for most plants is between 5.5 and 7.0.

C. Electrical Conductivity (EC)

Electrical Conductivity is a very quick, simple and inexpensive method that farmers and home gardeners can use to check the health of their soils.

The Electrical Conductivity (EC) reading shows the level of ability the soil water has to carry an electrical current. The EC level of the soil water is a good indication of the amount of nutrients available for your crops to absorb.

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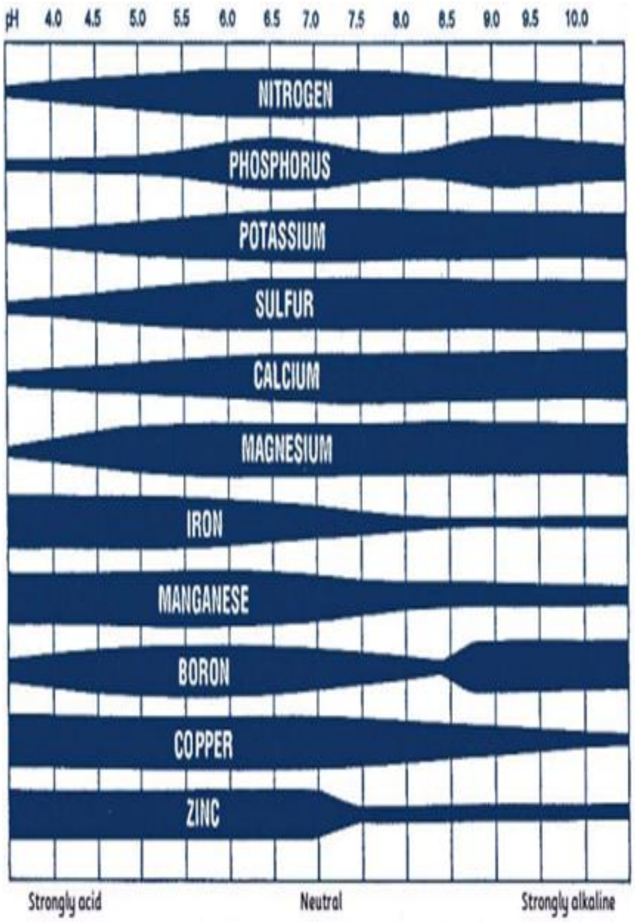

Figure 1.1- Nutrient availability and soil pH

II. Methodologies

Real time embedded based soil analyzer (RTEBSA) measures the pH value of soil and electrical conductivity (EC. .Soil pH value is used to identify the solutions or mixture acidity or basicity. Soil pH values start from the 0 to 14.The range of pH value below7 becomes acidity, above 7 becomes basicity and pH value7 is the neutral value.

In the soil pH measurement, soil sample is mixed with the distilled water. After mixing, soil pH value calculated with help of the pH sensor. Soil's most common pH value range is from 4 to 10.

RTEBSA's another calculating parameter is EC, measurement of the electrical conductivity shows the level of ability in the soil water has to carry an electrical current. The EC levels of the soil water are a good indication of the amount of nutrients available for the crops to absorb. In this system an EC sensor is used for Electric Conductivity measurement.

III. System Architecture

The overall RTBSA system architecture is shown in figure 3.1 which includes Microcontroller Unit, Signal conditioning, Sensors, Display, Thermal Printer and Power supply.

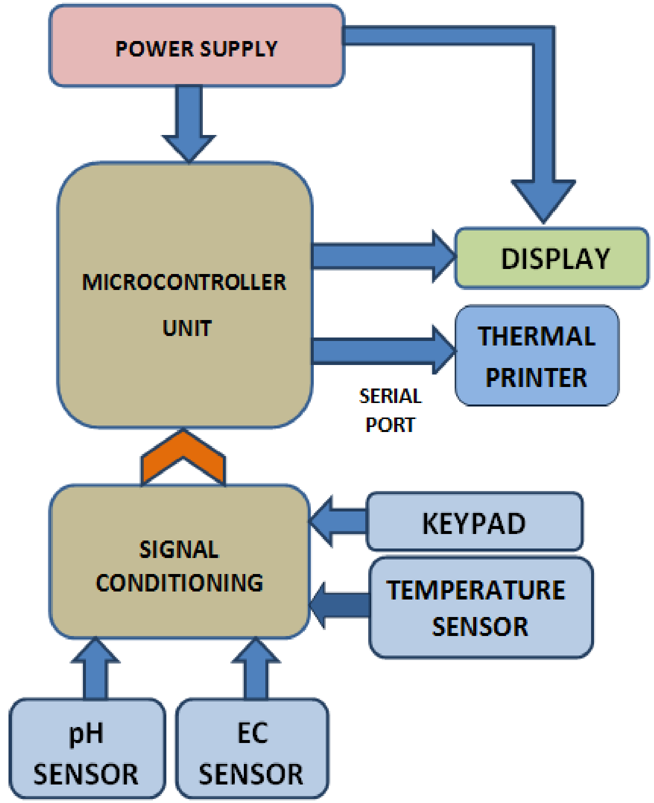

Figure 3.1-Overall RTBSA System Architecture

A. Measurement of Soil pH Value

Soil pH is measured from soil solution using pH electrode. pH electrode has an output in mill-volts depending upon the pH value. pH electrode basically measures the hydrogen ion [H+] activity. Measurement of pH with pH electrode is based on the principle that potential is developed when two solutions of different pH comes in contact through a thin glass membrane.

Figure.3.2 shows the main parts of the pH electrode. PH electrode consists of glass electrode, a reference electrode and a metallic electrode [6].

pH is determined by measuring the potential between the two electrodes. At the tip of the sensor there is a thin membrane capable of ion exchange. The pH sensitive glass membrane of electrodes has an extremely low alkaline error and low electrical resistance thus ensuring fast and accurate response. We can supply these electrodes for pH range of 0-14.The Electrode is available KCL (Potassium Chloride Solution) filled versions and is supplied with one meter long cable and BNC plug. This electrode can be supplied with almost all makes of international and domestic meters. pH electrode model CA-11 provide by Toshniwal Company. For neutral solutions, i.e. at pH of 7 the output of pH electrodes is 0mV when ideally.

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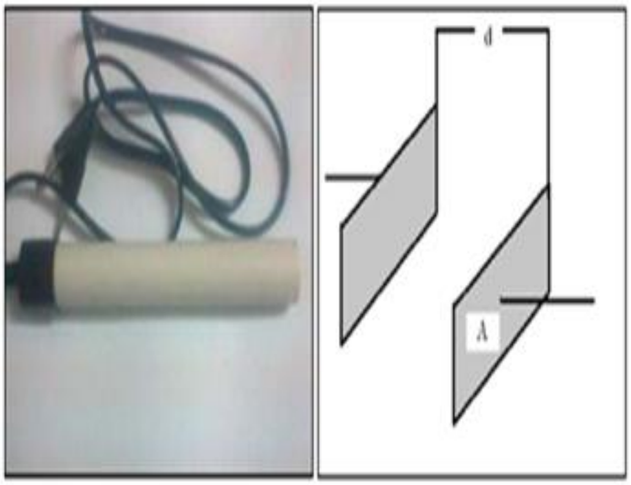

Figure 3.2 Main parts of pH Electrode

The output pH electrode is connected to the microcontroller. The signals generated by the sensors are sent to the ADC of inbuilt PIC18F microcontroller.
The PIC18F accepts the signal and computes the soil pH. Microcontroller displays the three parameters of the soil on the LCD.
These parameters are used to interpret the properties or quality of soil, treatment to be given to soil to make it suitable for plant growth.

B. Salinity/Conductivity of Soil

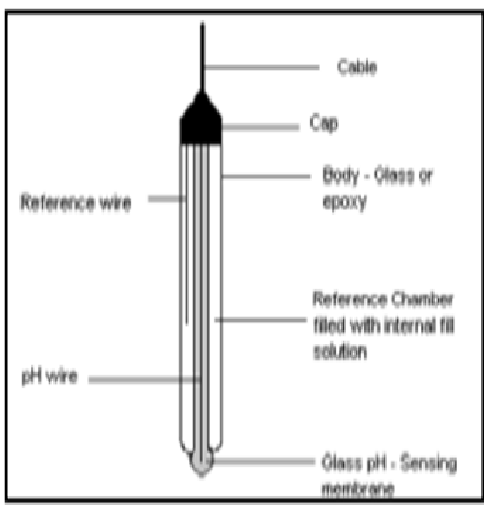

Figure 3.3 EC Conductivity Sensors

Ions are transported in soil through decomposition of minerals present in the soil, irrigation water, fertilizers or they may migrate upward in the soil from underground water. But when the rainfall is insufficient leach away the salts from soil or drainage system is poor, the salts accumulate in the soil. If this condition prevails over a long period, the result is excessive concentration of salts in soil and this excessive concentration/accumulation of salts in soil is termed as soil salinity. High soil salinity has a negative effect on plant growth. The main effect of soil salinity is osmotic effect. Different plants have different response to soil salinity.
When soil salinity exceeds the plant's limit to handle salinity level, the growth of plants is reduced. Excessive accumulation of salts on the surface of the soil also results in the loss of soil permeability to air and water.
Different plants have different response to soil salinity. Some plants are highly tolerant to soil salt concentration; some are moderately tolerant while some of the plants are very sensitive to soil salinity.
They are able to absorb the water from soil with higher salt concentration in soil while salt sensitive plants have limited ability to adjust to soil salinity.
The effect of salinity is less at emergence of plant as compared to mature plant. Soil salinity can be calculated with the help of electric conductivity sensors which is given in Fig 3.3.

IV. HARDWARE OPERATIONS

Figure 4.0 shows RTEBSA's Hardware setup.pH Sensor and Electrical conductivity (EC) Sensors are connected in PORTA of the PIC18F458.

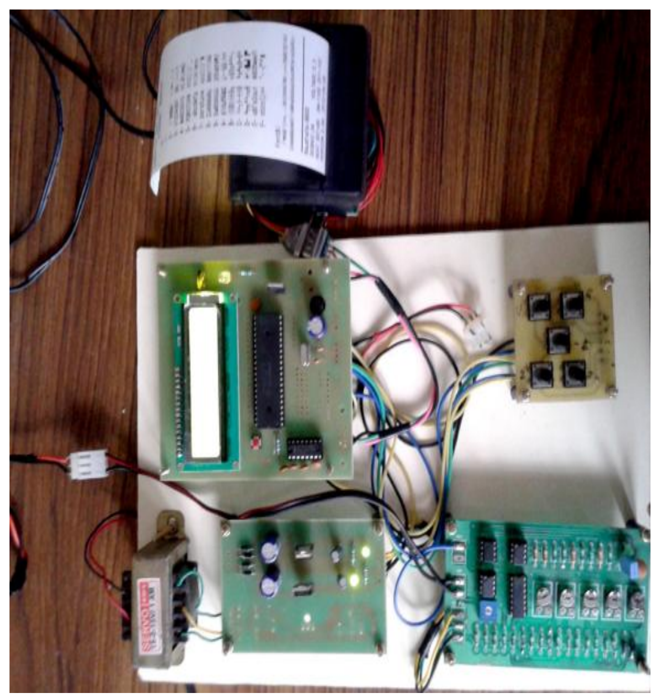

Figure 4 - Hardware setup

Output from pH sensors and EC sensor are analog in nature to process these analog signals to RTEBSA system A/D converters are used.
PIC18F458 Microcontroller has the inbuilt analog to digital converter and no need to connect the external A/D converter for the system. In the RTEBSA keypad is used to connect the user and the system.

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A.User Input

RTEBSA will work depends the user input, here five types of the inputs and functions in the system.

KeyPad-1 - RTEBSA system will display the soil sample's pH value.
KeyPad-2 - RTEBSA System will display the Soil samples EC Value.
KeyPad-3 - RTEBSA System Will display the Availability Nutrients in the sample soil with the help of pH value.
KeyPad-4 - RTEBSA System Will display various crops.

KeyPad-5- RTEBSA System Enter Into function, it gives the result of Selected Crop suitable or not for particular soil.

KeyPad-6- RTEBSA System Enter Into function, it gives the Hard copy of printed result for particular soil.

V. SAMPLE RESULTS

A. pH Value:

Figure 5.1 shows the pH value of Sampled soil.

Figure 5.1 pH Value

B. Availability of the Nutrients

Figure 5.2 Availability of the Nutrients

Figure 5.2 pH value and the availability of various nutrients

C.Crop Selection

Figure 5.3 Shows the Crop selection and Based on the nutrient availability, recommendation for cultivating a particular crop.

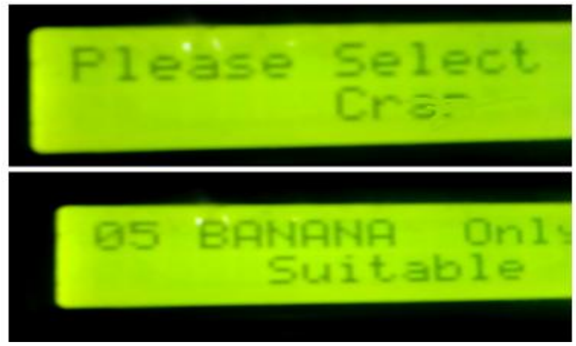

Figure 5.3 Crop Selection

The accuracy of the RTEBSA is measured by giving more number of soils sampled at different conditions. By comparing the results with soil testing organization, accuracy level is ± 10

VI. CONCLUSIONS

In this project, Real time embedded based soil analyzer (RTEBSA) is used to do analysis of various soil nutrients parameters with the help of the pH value and the, soils Electrical Conductivity (EC). Depends on the pH value, The availability of various nutrients is calculated. Based on the nutrient availability, recommendation for cultivating particular crop is also done. Expansion of Hardware implementation of Real Time Embedded Based Soil Analyzer (RTEBSA) will be done in hard copy of report generation and also fertilizer recommendation for the particular crop will be given.

REFERENCES

[1] A Hameed., M Goddal. , Z.H. Yamini., A.H.Yahya, "Significance of pH Measurements in photo catalytic splitting of water using 355nm UV laser", Journal of Molecule catalysis A: Chemical, 227,241.(2005)
[2] R.Vamanan, K.Ramar, "Classification of Agricultural Land Soils a Data Mining Approach", International Journal on Computer Science and Engineering, ISSN: 0975-3397, Vol. 3. (2011)
[3] P.Bhargavi.,S.Jyothi. , "Soil Classification Using Data Mining Techniques: A Comparative Study", International Journal of Engineering Trends and Technology- July to Aug Issue, ISSN: 2231-5381. (2011)
[4] D Ashadev. , Pro.K .MalakondAia.,M.SureshBab.M, "Measurement of Potassium Levels in the Soil Using Embedded System Based Soil Analyzer" International Journal of Innovative Technology & Creative Engineering (ISSN: 2045-8711)Vol. .1No.1. (2011)
[5] Department of Agriculture & Cooperation Ministry of Agriculture Government of India, "Methods Manual-Soil Testing in India". (2011)
[6] Dr. Maria Silveira, "Soil acidity and its relationship with nutrient use Efficiency", The Florida Cattleman and Livestock Journal (March Edition-2013)
[7] www.agric.gov.ab.ca/app21/rtw/index.jsp
[8] http://agritech.tnau.ac.in/agriculture/agri_nutrientmgt_nutrientavailibility.html
[9] http://en.wikipedia.org/wiki/Soil_test
[10] http://en.wikipedia.org/wiki/Ion_selective_electrod.