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Estimation of micro and macro nutrients in the soil of remote areas

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ABSTRACT

This paper focuses on analyzing the content of micro nutrients and macro nutrients present in the soil. Soil is vital resources in which proper use depends on the country and the socio-economic development of its people. The amount of nutrients available to plant roots is the main factor limiting the yield of crops. Depending on the soil type, climate and crops grown during previous years the fertilizer requirements vary within a field and throughout the year. The Macronutrients (Nitrogen, Phosphorus and Potassium) and Micronutrients (Iron, Zinc and Copper) are essential for healthy plant growth. Macronutrients are needed in large amounts and Micronutrients are needed in smaller amounts. Both micronutrients and macronutrients are naturally obtained by the roots from the soil. Before years soil has been carried for research. In the present system, the kit is placed deep in the soil with GPS and GPRS and the results are being analyzed. This simulation part is designed using PROTEUS software.

Keywords: Micronutrients, Macronutrients, Proteus software**.**

INTRODUCTION

Soil is a natural body covering earth. Surface with biological, chemical and physical properties that give the ability to support plant growth. Moreover, they are the natural beds for houses, factories, roads; a natural and limited resource for plant production and a food source for animal and human being. Soil, according to its composition, is divided into two categories: mineral soils, and organic soils. Soils, formed in bogs and such wet areas, and containing more than 12-18 % organic carbon are called as organic soils. They consist of living microbes such as bacteria, fungi and living macro organisms such as plant roots, earthworms, insects and remains of dead macro organisms as well as the finally divided non-living organic materials. There are basically three types of soil. They are Clay, Sandy and Silt. This diagram is shown in Fig.1. Clay soil particles are very small and compact. Gardens with these types of soil particles don't work well because the air has a hard time getting to the roots. The soil absorbs and holds water and creates a drainage problem. This adversely affects healthy root and plant growth. Sandy soil particles are large. The water and nutrients (particularly nitrogen) quickly drain away from the plant root zone. Sandy soil is the opposite of clay soil. Silt soil is made up of fine particles. Like clay the soil holds water but doesn't have good aeration around the roots.

Fig.1.Images of soil

Many factors influence the nutrient requirements for optimum yield and quality of a given vegetable crop are given in [8]. Original source of soil particles, textural classification, caution exchange capacity, organic matter content, and drainage are important soil properties that influence the rates of nutrients applied to vegetables. In addition, rainfall amounts and distribution, irrigation types and management, and soil and air temperatures during the growing season can alter the retention, availability, and uptake of nutrients. Varieties of the same crop species often differ significantly in their nutrient requirements. Growers are encouraged to test soils to determine the kinds and amounts of pre plant fertilizer nutrients required for optimum production. During the growing season, sap and tissue testing should be used when they have been shown to be effective to adjust nutrient applications to current growing conditions and the nutrient status of the

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crop. There are two types of Nutrients. They are Micro and Macro Nutrients. Micro nutrients are Iron (Fe), Zinc (Zn), Copper (Cu), Boron(B), Manganese (Mn) and Molybdenum . Macro nutrients are Nitrogen (N), Phosphorus (P), Potassium(K), Sulphur, Calcium and Magnesium (Mg) [5]. All the Micro and Macro nutrients are shown in Fig. 2.

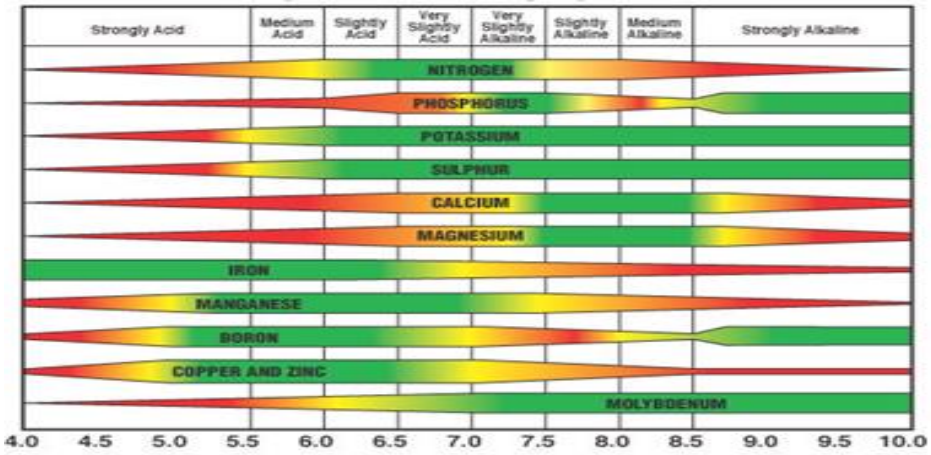


Fig.2.Image of Micro and Macro Nutrients

In this project, we are using ATMEL for the simulation process, while ATMEGA is used for hardware realization, as ATMEGA is advantages over ATMEL in the ways of storage capacity and fast processing time. The Micro and Macro nutrients are being sensed in the soil with the help of sensor. The sensed data will be transferred from the farming field to the test center using GPRS system. The latitude and longitude position of above soil are being determined with the help of GPS.

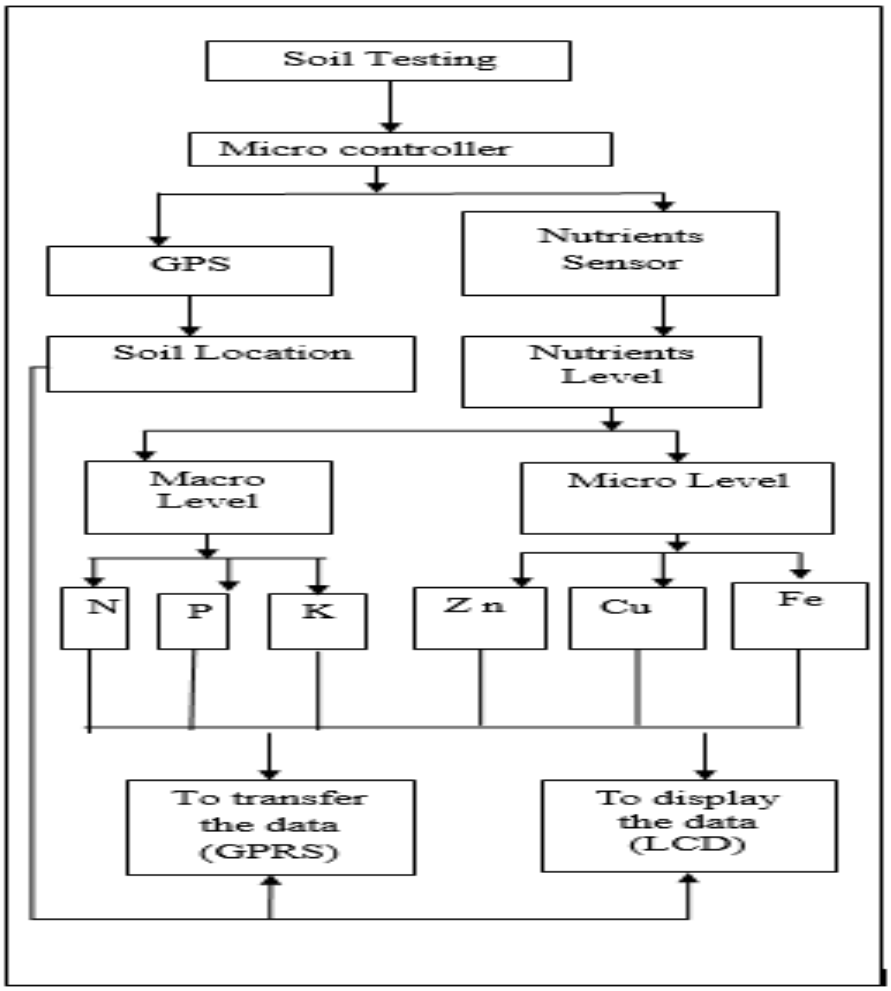
PROPOSED SYSTEM

In the proposed technology we analyze the micro nutrients and macro nutrients content present in the soil. A soil fertility test evaluates the nutrient-supplying power of a soil. The results of the test are used to predict if, or how much fertilizer is required for optimum plant growth. Soil fertility categories include Deficient, Optimum, and Exceeds crop needs. Deficient is divided into Subcategories very low, low, and medium. These soil fertility categories estimate the probability of a beneficial response to the addition of a given nutrient (assuming that other factors such as temperature, moisture and disease are not limiting growth).

The critical factor is the soil test level; below which a crop response to a nutrient application may be expected, and above which no crop response is expected. Crop yields may decrease at very high soil test nutrient levels. A portable kit is used to collect the micro and macro nutrient contents in soil. The Flow chart of portable kit is shown in above Fig. 3. It's also used to send the collected data to the destination through GPRS.GPS is also used to find the location of soil. The simulation for analyzing the system will be carried using the PROTEUS software. The hardware part will be done in this phase. The Block diagram of portable kit is shown in Fig. 4.

SYSTEM CONFIGURATION

Atmel 89c51 microcontroller: AT89C51 is an 8-bit microcontroller and belongs to Atmel's 8051 family. ATMEL 89C51 has 4KB of Flash programmable and erasable read only memory and 128 bytes of RAM. It can be erased and program to a maximum of 1000 times. This pin description shown in Fig. 5.In 40 pin AT89C51, there are four ports designated as P_1, P_2, P_3 and P_0. All these ports are 8-bit bi-directional ports. They can be used as both input and output ports. Except P_0 which needs external pull-ups, rest of the ports have internal pull-ups. When 1s are written to these port pins, they are pulled high by the internal pull-ups and can be used as inputs. These ports are also bit addressable and so their bits can also be accessed individually.



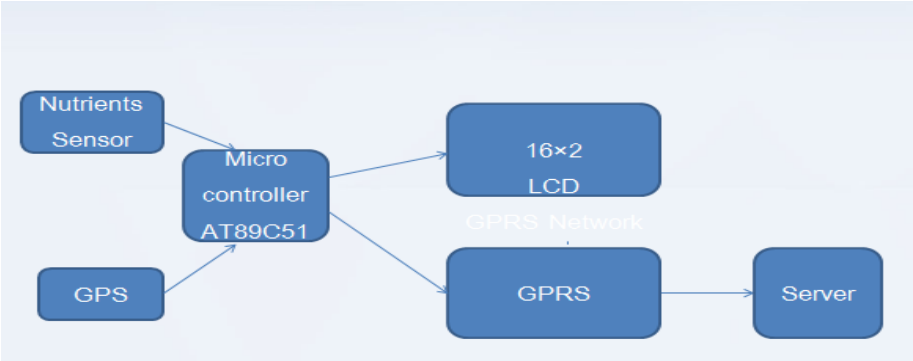


Fig.4.Block Diagram of Portable kit

GPS: The Global Positioning System is a space-based satellite navigation system that provides location and time information in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four ormore GPS satellites. The system provides critical capabilities to military, civil and commercial users around the world. It is maintained by the United States government and is freely accessible to anyone with a GPS receiver. This architecture is shown in Fig. 6.

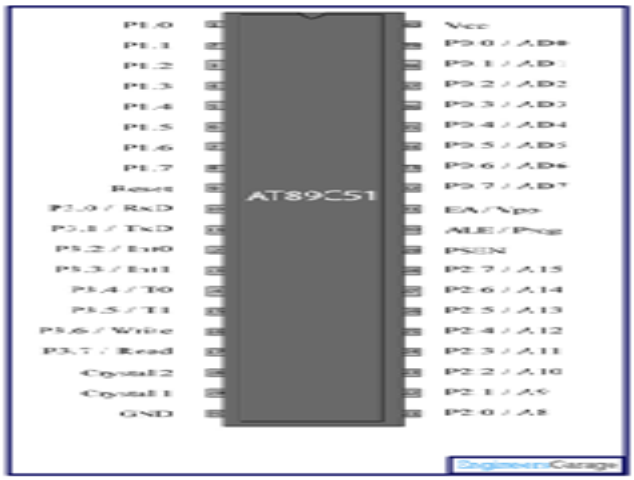


Fig.5.Pin Description

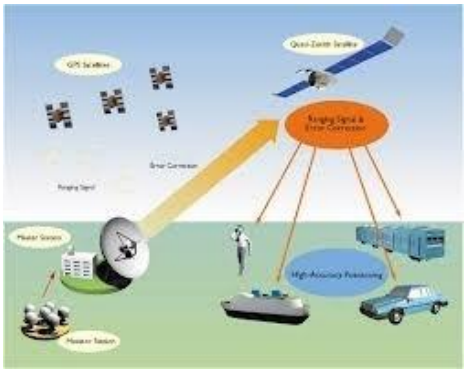


Fig.6.GPS

GPRS: General Packet Radio Services (GPRS) is a packet-based wireless communication service that promises data rates from 56 up to 114Kbps and continuous connection to the Internet for mobile phone and computer users. The higher data rates allow users to take part in video conferences and interact with multimedia Web sites and similar applications using mobile handheld devices as well as notebook computers. GPRS is based on Global System for Mobile (GSM) communication and complements existing services such circuit-switchedcellular phone connections and the Short Message Service (SMS).This architecture is shown in Fig. 7.

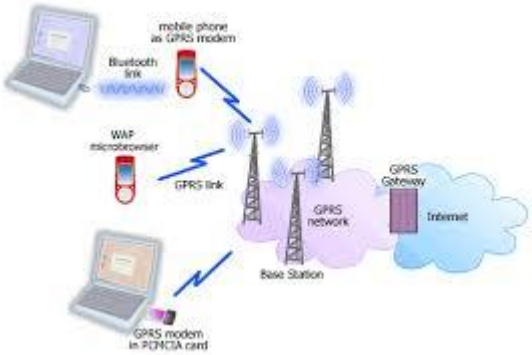


Fig.7.GPRS

LCD: liquid crystal display is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images or fixed images which can be displayed or hidden, such as preset words, digits, and 7-segment displays as in a digital clock.

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This LCD has two registers, namely, Command and Data. The Command register stores the command instructions given to the LCD. The data register stores the data to be displayed on the LCD. This diagram is shown in Fig. 8.

Fig.8.LCD

Design and estimation ofmicro and macro nutrients:

General micro nutrients level for all crops:

Table.1.Micro Nutrients level for all Crops

Type of micronutrients	Amounts (ppm)
Zinc(Zn)	1.2
Copper (Cu)	1.2
Manganese (Mn)	2.0
Iron(Fe)	3.7
Molybdenum(Mo)	0.5

The above Table: 1 is micro nutrients level for all crops. Micronutrients are those elements essential for healthy plant growth which are needed in only very small (micro) quantities.

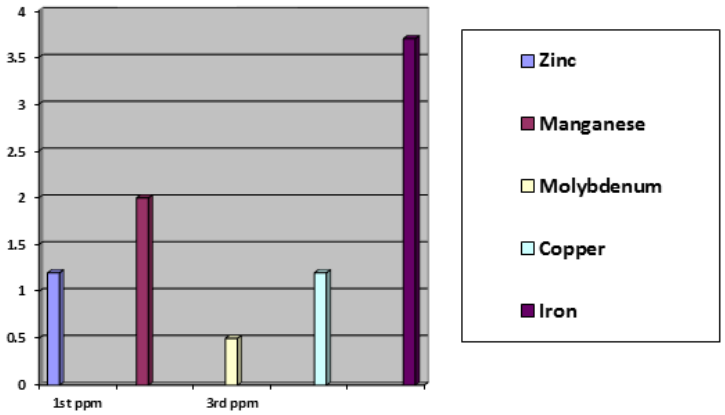


Fig.9.Micro nutrients level for all crops

General macro nutrients level for paddy

Table: 2 Macro Nutrients level for Paddy

Type of macro nutrients	Low Kg/acre	Medium Kg/acre	High Kg/acre
Nitrogen (N)	<113	114-186	>187
Phosphorous (P)	<4.5	4.5-9	>10
Potassium	<48	<49-113	>114

The above Table: 2 is macro nutrients level for all crops. Macro nutrients are those elements essential for healthy plant growth which are needed in large amounts.

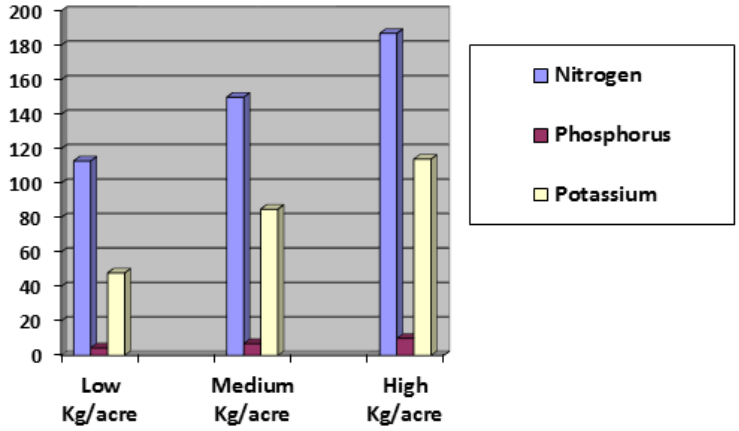
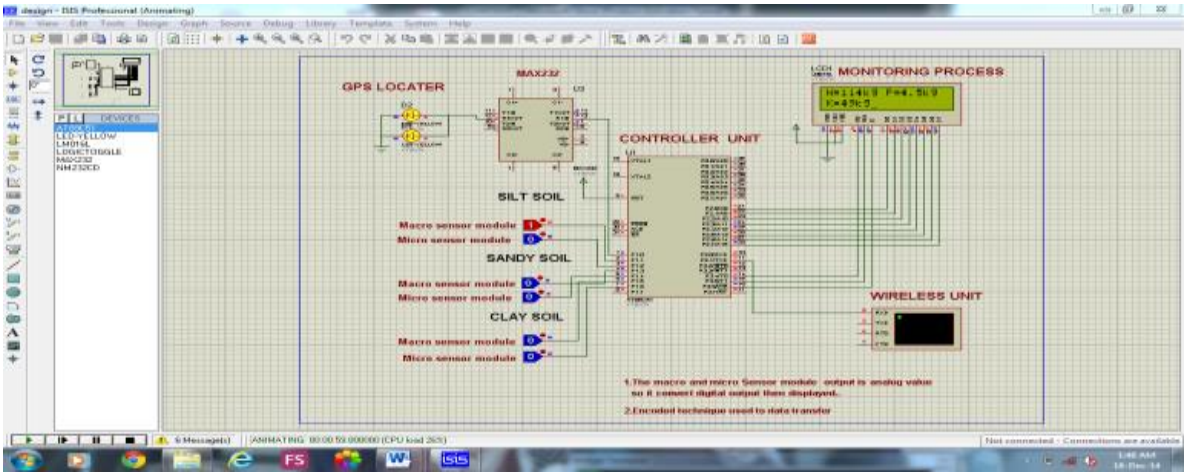


Fig.10.Macro Nutrients level for Paddy

The above levels are the minimum and maximum levels of micro and macro nutrients. The crop must be provided with the nutrients above the min level. Any maximum level can be accepted.

SIMULATION AND RESULTS

This snapshot is overall design of my project using PROTEUS software. Display the micro and macro nutrients level using LCD. GPS is used to find the location of soil. GPRS is also used to transfer the collected data to the destination.



Components: AT89C51 Microcontroller; LCD display; Switch; LED; Virtual terminal

Function

- These components are connected and verify the output by using the simulation software Proteus 7.7 Sp2
- Here microcontroller acts as a processing unit.
- LCD display is used to display the macro and micro nutrients level of the soil.
- In simulation design the sensor cannot be place, so instead of using sensor here i prefer to use switches to indicate the type of soil.
- Led blinking represents the transmission of signal from the GPS.
- Virtual terminal is used to represent the date transfer.
- For this circuit the programming can be done in Keil software by using embedded C language.
- Then after program we have create a hex file.
- Finally run the simulation design by damping the hex file program created in the Keil.

CONCLUSION

In the existing system AWS has been used to estimate the value of pH, temperature and humidity. In those days soil has been taken from a place to research centers. This proved a disadvantage. In today's scenario a kit is constructed to determine the micro and macro nutrients in soil by means of sensors. It is used; in cases if the content is being reduced in soil due to this the nutrients can be added if reduced. The simulation and results have been carried out using PROTEUS software.

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