Automated Soil Testing Device

D S Suresh, Jyothi Prakash K V & Rajendra C J

Department of ECE, CIT, Gubbi, Tumkur, India
E-mail : sureshtumkur@yahoo.co.in, jyothiprakash_kv@yahoo.co.in, rajendracj@yahoo.com

***Abstract* – In country like India the economy is mainly based on agriculture, still we are not able to make optimal, profitable and sustainable use of our land resources. The main reason is the lack of knowledge regarding the soil analysis for the growth of crops. In every state around 9 to 10 lakhs soil samples have been received in laboratories and it is very difficult to test all the soil samples in time by the laboratories. By the time test reports are generated, harvesting is on the verge of completion. Hence there is a need for soil analysis to be made available to the farmer. The main objective of our work is to develop a testing system which can be used for soil analysis, which in term helps the farmers to cultivate and produce the proper crop. The wireless communication system has been incorporated to interact with the experts.**

Keywords – Microcontroller, wireless Trans–receiver, Sensor, ADC, LCD

I. INTRODUCTION

Automated Soil Testing Device is an electronic device, which can be used to measure N (Nitrogen) P (Phosphorous) K (Potassium) & pH (Potenzy hydrogen) values to ensure the fertility of soil in the field of agriculture to select the suitable crop and also the type of fertilizer to be used. The ionic particles present in the soil sample are sensed by the sensor and the out put of the sensor is processed by signal conditioning circuit. The Microcontroller is used to compare the pre-stored value with the actual values and the measured values are displayed on the LCD. The wireless trans-receiver transmits the data to a remote location or designated authority in the agriculture department for further analysis & suggestions.

Automated Soil Testing Device is a portable device which can be used either in laboratories or on the identified spot selected for farming so that the farmer need not take the pain of visiting the soil testing laboratories which are normally located in district headquarters. Automated Soil Testing Device is a simple & user friendly device so that any person can test the soil without the presence of an operator, it is an economical device & thus a common man can easily afford it.

II. MICROCONTROLLER BASED SYSTEM

A microcontroller based system was developed and tested satisfactorily. The schematic diagram of the system is shown in fig.1.the system consists of sensor, wireless trans-receiver, microcontroller kit.

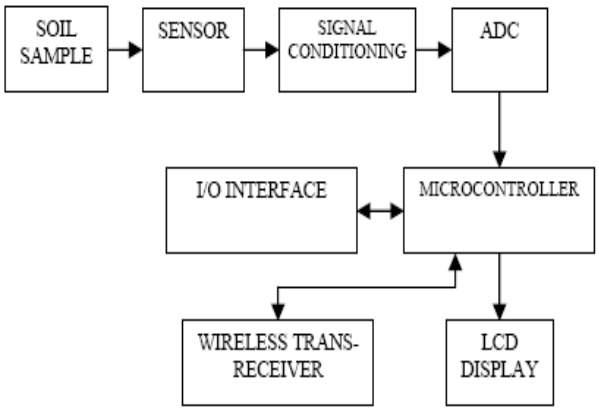

Fig.1: Schematic of Microcontroller based system for Automated Soil Testing System for Agriculture

A. Microcontroller

The microcontroller used is P89V51RD2 operates at 11.0592 MHz at 5V D.C. The microcontroller plays a key role in processing data received from the sensor, where it compares the data already pre-stored with the sensor output signal.

B. Liquid Crystal Display

A Liquid Crystal Display is a low cost, low power device capable of displaying text. The LCD controller receives control words from the microcontroller; it decodes the control words and performs the corresponding actions on LCD. Once the initialization sequence is done, it displays the soil parameters.

C. ADC

Microcontroller requires input in digital form for this Purpose analog to digital converter is used to convert the output of signal conditioning, which is in analog, to digital signal.

D. Signal Conditioning

Signal conditioning converts output signal from the sensor, which is a weak signal, in to a strong signal.

E. Sensor

Sensors are hardware devices that produce a measurable response to a change in a physical condition like temperature or pressure. Here copper electrodes are used as sensor which measures the ionic particles present in the soil and converts it in to electrical signal.

F. Wireless Trans-receiver

A wireless transceiver is a device comprising both a transmitter and a receiver which are combined and share common circuitry or a single housing. Here GSM is used to transmit the obtained soil parameters to the designated authority in the agriculture department for further analysis & suggestions.

G. I/O Interface

A switch is interfaced to controller. Whenever this switch is interrupted it sends signal to the controller to generate address.

III. WORKING PRINCIPLE

Whenever a farmer wants to analyze the soil fertility, he needs to take the soil sample of about 150g and 60ml of water should be added to the soil sample, and allow the sample to settle down. The sensor will be placed in the sample. Here copper electrodes are used as sensor which measures the ionic particles present in the soil and converts it in to electrical signal. The electrical signal is amplified using signal conditioning and this amplified signal is sent to microcontroller in the form of digital signal from ADC. The microcontroller plays a key role in processing data received from the sensor, where it compares the data already pre-stored with the sensor output signal. The microcontroller after comparison gives the output and the values are displayed on the LCD display. The output not only provides the information on fertility present in the soil but also suggests crops to be grown on that soil. . The wireless trans-receiver transmits the data to a remote location or designated authority in the agriculture department for further analysis & suggestions. The electrical parameters that are obtained during testing of this device for different type of soil samples are shown in table 1.

Soil Type	Electrical Parameter (ADC Values)
Coorg	3-6
Andra Pradesh (Karnool)	9-12
Bijapur	10-12
Kerala	12-14
Tumkur (Hirehalli)	12-13
Tumkur (Gubbi)	12-16
Mandya	14-16

Table 1: Electrical Parameters

IV. APPLICATION SOFTWARE

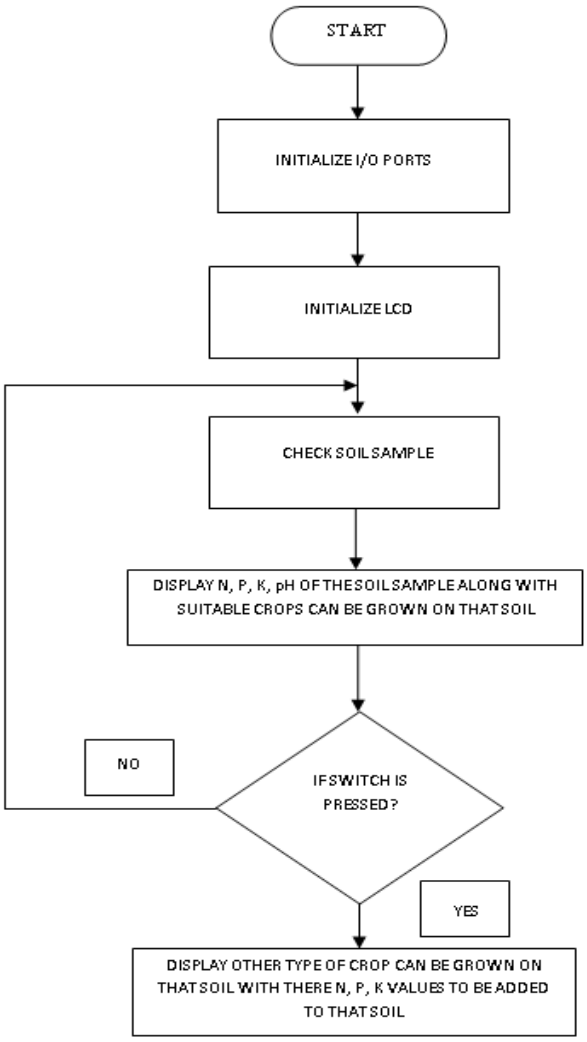

Fig.2: Flow Chart for the basic operation of the system

The application software was developed in c language using KEIL software of version 8.08.The basic operation of the system is shown as flow chart in fig.2.

V. RESULTS

Sl. No.	*Soil Type*	*N,P,K & pH Values (Per Acre) (Lab results)*	*N,P,K & pH Values (Per Acre) (Experimental results)*	*Suitable Crops*
01	Coorg	N=0.25 Kg	N=0.28 Kg	Coffee, Pepper, Onion
		P=11 Kg	P=13 Kg	
		K=115 Kg	K=112 Kg	
		pH=6.9	pH=6.7	
02	Karnool (A.P)	N = 0.48 Kg	N = 0.56 Kg	Citrus, Cotton, Onion, Chillies, Brinjal
		P = 21 Kg	P = 22 Kg	
		K = 120Kg	K = 122Kg	
		pH = 6.4	pH = 6.5	
03	Bijapur	N = 0.85 Kg	N = 0.89 Kg	Citrus, Cotton, Onion, Chillies, Brinjal
		P = 19 Kg	P = 21 Kg	
		K = 105 Kg	K = 103 Kg	
		pH = 7.1	pH = 7.0	
04	Kerala	N = 0.40 Kg	N = 0.43 Kg	Coconut, Arekanut, Rice
		P = 17.6 Kg	P = 18 Kg	
		K = 162 Kg	K = 164 Kg	
		pH= 5.5	pH = 5.6	
05	Tumkur (Hirehalli)	N = 0.7 Kg	N = 0.75 Kg	Coconut, Arekanut, Rice
		P = 16.5 Kg	P = 16.8 Kg	
		K = 85 Kg	K = 84 Kg	
		pH= 7.7	pH = 7.8	
06	Tumkur (Gubbi)	N = 0.75 Kg	N = 0.78 Kg	Coconut, Arekanut, Rice
		P = 18.7 Kg	P = 18.9Kg	
		K = 162 Kg	K = 160Kg	
		pH = 7.5	pH = 7.6	
07	Mandya	N = 1.08 Kg	N = 1.1 Kg	Coconut, Arekanut, Rice
		P = 20.9 Kg	P = 21.2Kg	
		K = 86 Kg	K = 88 Kg	
		pH = 8.3	pH = 8.4	

Table 2: Lab and experimental results.

In this project various soil samples taken from different places and they were tested and obtained results from laboratory. The same samples were tested using automated soil testing device and results were nearer to the one of lab results. The lab and experimental results of the system are shown in table 2.

VI. USER INTERFACE

The system setup with different sub unit is shown in fig.3.

Fig.3: Microcontroller system with subunits.

A. Initial Display

Automated Soil Testing System for Agriculture

B. Input

Dip sensor into the soil sample.

C. LCD

Displays the N P K & pH Values of the soil sample along with the crops can be grown for the obtained N P K & pH. If switch is pressed it displays other type of crop can be grown along with the amount of N P K to be added.

VII. CONCLUSION

'Automated Soil Testing Device', has been developed for soil testing of agricultural farm. The N P K & pH values vary from one type of soil to others. N P K & pH values of soil sample are measured in real time and compared with the pre-stored values received from the agricultural department. The system also provides the information about the crops that can be grown in respective soils. Wireless communication system has been incorporated for interacting with the experts.

VIII. REFERENCES

[1] Soil Testing in India", Department of Agriculture & Co-operation, Ministry of Agriculture, Government of India, New Delhi, January, 2011.

[2] "Soils of Karnataka", Booklet No. 361, Soil Science:SSS-6.

[3] "Soil Electrical Conductivity - a tool for precision farming", Journal of the Instrument Society of India, March 2012, Vol. 42, No. 1.

◈◈◈