Automated Soil Nutrient Detection & Fertigation System

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***Abstract*—Soil is a thin layer of earth's crust which serves as a natural medium for the growth of plants. It is a vital, living component of the environment–a component that can be manipulated to affect crop performance. Soil contains vital nutrients, NPK (Nitrogen, Phosphorous and Potassium) contents and pH which are necessary for successful growth of plants. Nitrogen helps plant foliage to grow strong, Phosphorous helps roots and flowers grow and develop and Potassium (Potash) is important for overall plant health. Automated soil testing device (ASTD) is an electronic device which can be used to measure 'NPK' (Nitrogen Phosphorous potassium) and 'pH' values to ensure fertility of soil in the field of agriculture to decide to grow a particular crop and also the type of fertilizer to be used. ASTD is a portable device which can be used in 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 located in district headquarters. ASTD is a simple and user-friendly device so that any person can test the soil without the presence of an operator. Also, it is an economical device and thus a poor man can easily afford it.**

***Keywords*—ASTD(automated soil testing device),ph, NPK.**

I. INTRODUCTION

Agriculture is backbone of India. Agriculture plays a key role in the growth of country's economy. Soil is one of the most valuable resources in this field. Testing of soil is very much important in this regard for selection and maintenance of crop. Though there are soil testing laboratories but their availability is very low and unfortunately many farmers skip this process for this reason or do this process only once and repeatedly grow the same crop. Also, once planting is done it should be monitored and maintained with proper environmental factors needed for the crop. Hence there is need to implement modern science and technology in this field for increasing the yield. In this paper, an automated system is designed and built for implementation of soil testing for agricultural farm using this system; a farmer can program and accurately understand the soil health and fertility. The main aim of our work is to develop a testing system which can be used for soil testing, which in term helps the farmers to cultivate and produce the proper crop. Presently two-third of the Indian population depends directly on agriculture for its livelihood. Agriculture productivity mainly depends on quality of soil which is dependent mainly on factors like soil texture, soil water holding capacity, soil pH value, soil conductivity and soil mineral contents. Soil testing is also a requirement for farms that must complete a nutrient management plan. Major nutrients: Nitrogen (N), Phosphorus (P) and Potassium (K) 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. The major components which are necessary for growth of plant are: nitrogen phosphorous and potassium. (Nitrogen) is most important element in soil which helps in growth of leaves and vegetation. In similar way P (Phosphorus) is key element for root and physical growth. K (Potassium) keeps regulation of water and nutrient in plant cell, flowering, fruiting. If we maintain the proper ratio of all these components then this will maintain the quality of soil and improve the growth of crop.

Quantity of NPK is dependent on crop type and on plant growth status. How much quantity of fertilizer to be used is further dependent on present contents of NPK nutrients in the soil. Researchers in agriculture are looking for ways to optimize plant yield while minimizing the consumption of fertilizer. Since these macro-nutrients vary even on a small scale throughout a cultivated field, numerous researchers have attempted to develop the sensors to map these nutrient contents. Integrated crop management systems have been designed to study spatial and temporal behaviour of NPK. Continuous monitoring of these along with humidity and pH of soil is leading to automation in agricultural areas to improve crop productivity

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II. METHODOLOGY

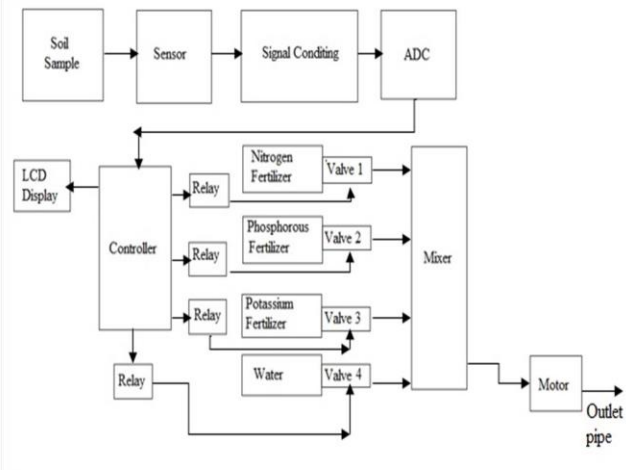

Fig 1: Proposed System Block Diagram

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. The microcontroller is the main control unit which is programmed to perform the various functions. First, the parameters of the soil are sensed and the gathered information is processed by the microcontroller. Based on the analysis, the type of crop and fertilizer can be determined precisely.

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 microcontrollers; 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 theoutput of signal conditioning, which is inanalog, 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 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. *I/O Interface*

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

III. HARDWARE DETAILS

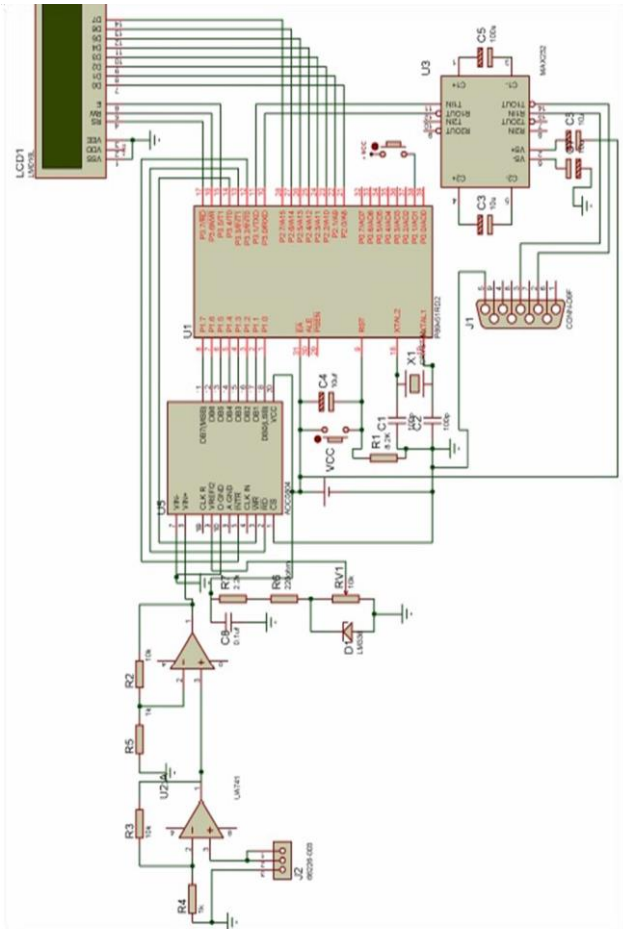

Fig 2: Main Circuit Diagram

In main circuit diagram, the sensor output is connected to signal conditioning circuit to produce strong signal. The signal conditioning circuit output is connected to ADC at pin number 6 and the output of ADC is interfaced to microcontroller using port 1. LCD is interfaced to microcontroller by using port 2 and switch is connected to the port 0^1 of microcontroller. Whenever a farmer wants to analyse the soil fertility, he needs to take the soil sample of about 150 g and 60 ml of water should be added to the soil sample and allow the sample to settle down. The sensor will be placed in the sample. The sensor measures the organic content of the soil and the information being sensed by the sensor is then converted into 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.

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IV. SOFTWARE DETAILS

A. *Keil Software*

The KEIL 8051 Development Tools are designed to solve the complex problems facing embedded software developers. In this paper KEIL software of version 8.08 is selected, because it provides Device Database and the µVision IDE sets all compilers, assembler, linker, and memory options. Numerous example programs are included in this software and also the KEIL µVision Debugger accurately simulates on-chip peripherals (I²C, CAN, UART, SPI, Interrupts, I/O Ports, A/D Converter, D/A Converter, and PWM Modules) of 8051 devices.

Simulation helps to understand hardware configurations and avoids time wasted on setup problems. When testing the software application with target hardware, use the MON51, MON390, MONADI, or FlashMON51 Target Monitors, the ISD51 In-System Debugger, or the ULINK USB-JTAG Adapter to download and test program code on target system.

B. *Flowchart*

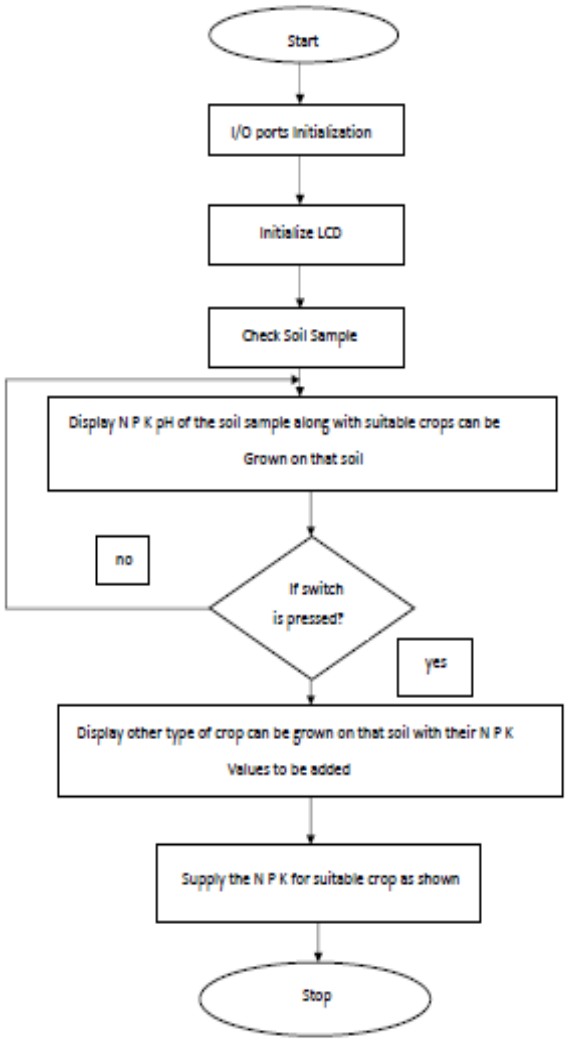

Fig 3: Flow Chart

V. RESULTS

Step 1: Soil Testing System

Testing the Soil Sample, Displays N P K, pH and Temperature Values

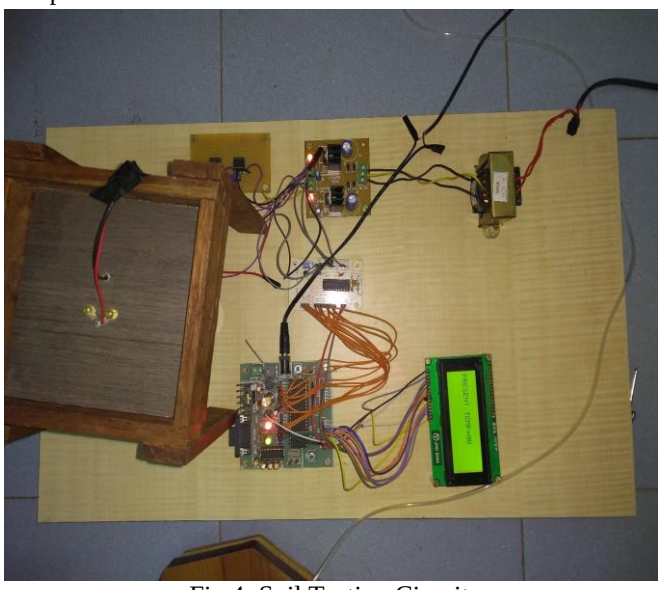

Fig 4: Soil Testing Circuit

Step 2: Dispensary System

Flow of fertilizer from storage compartment to the mixer and then Mixer to the Agri-field through Drip Pipes using Water pumping DC Motor

Fig 5: Arrangement of circuit components in the Soil Testing and Dispensary System

VI. CONCLUSION & FUTURESCOPE

A. *Conclusion:*

Automated soil testing device has been developed for soil testing of agriculture farm .The NPK & pH values vary from one type of soil sample are measured in real time and compared with the pre-stored values received from the agriculture department. The system also provides the information about the crops that can be grown in respective soils & if any crop is selected the required quantity of fertilizer for that crop will be displayed. Wireless communication system has been incorporated for interacting

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with the experts. Hence by using portable soil fertility testing system can help the farmer for a proper planned farming. It supplies the suitable N P K to the crops through Drip-irrigation.

B. Future Scope:

- Soil fertility is an important factor to measure the quality of the soil as it indicates the extent to which it can support plant life. The fertility of soil is measured by the amount of macro and micronutrients, water, pH etc.

- Soil nutrients are depleted after every harvest and hence must be replenished. To maintain nutrient levels in the soil in case of deficiency, fertilizers are added to soil. Most of the farmers choose to approximate the amount of fertilizers and add them manually. However, addition of fertilizers in right amount is a matter of great.

- Data base management system - The value recorded as soon as the farmer test his soil sample, can be stored in his name in master station as a database using wireless technology so that it might be helpful in future.

- Analysing the various methods adopted the tradition method uses colour change based test which is both time consuming for the labs and the farmer. Before the results are obtained the harvesting, season may be at its verge.

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