Compact Soil Tester

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Abstract

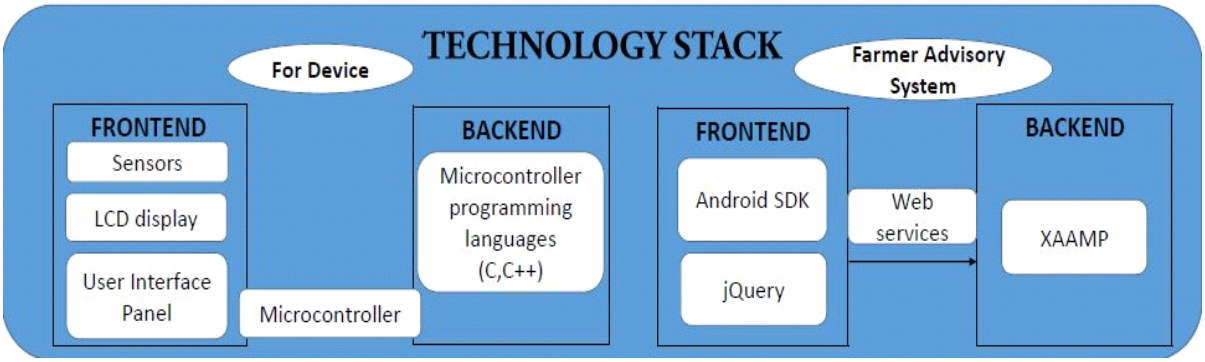
Farmers often visit soil testing laboratory to get their soil tested for effective crop yield. If a compact soil tester is available to them, it will decrease their testing time and expenditure, as testing can be done individually by them in their farm. Compact soil tester will be a light weight and portable device which will test soil fertility and provide results in real time. This will be a microcontroller based device which will use different types of sensors such as electrochemical sensor for detecting NPK , pH sensor for measuring pH , Electrical Conductivity(EC) sensor for detecting conductivity , soil moisture sensor for detecting soil moisture , temperature sensor for detecting temperature and process this data in real time. In order to test the soil sample, take considerable amount of soil in a vessel, dip the tester into soil. When soil comes in contact with sensor it measures various soil parameters present in soil with the help of microcontroller and the soil fertility report will be displayed on LCD screen provided with the device. In addition to this the device will be designed to be cost effective, easy to use and battery operated. Furthermore, we also propose to provide a multilingual farmer advisory app. This app will have provision to interface with servers, so that Government agencies can aggregate information about soil quality from different regions of the state.

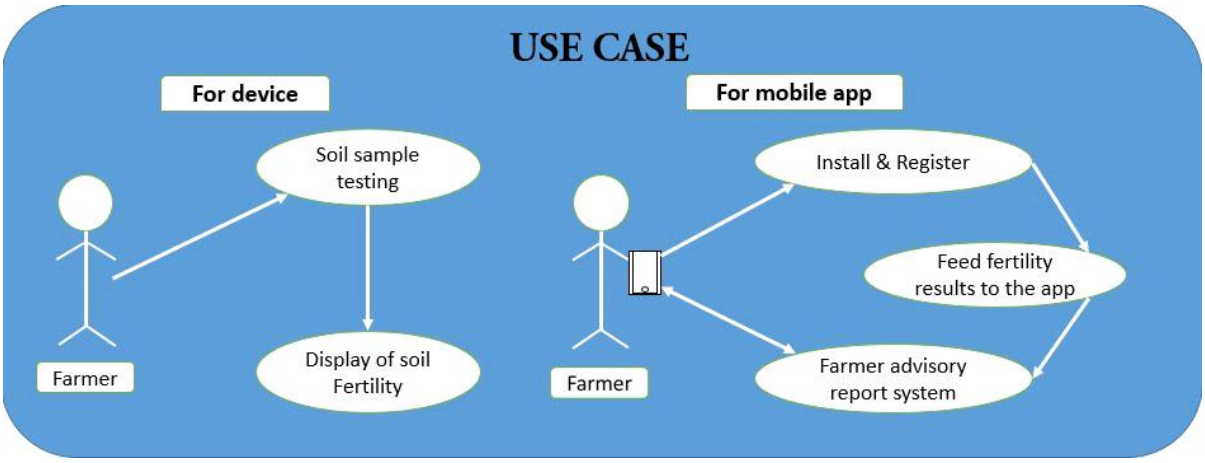
Keywords: Nitrogen, Phosphorous, Potassium, pH, Electrical Conductivity (EC), Arduino control board, multilingual app.

Introduction: Assessment of soil fertility involves an estimation of its available soil nutrients parameters such as Nitrogen, Phosphorous, Potassium, pH, Soil moisture, Electrical conductivity, Temperature. This process commonly known as soil testing. Soil analysis is a valuable tool as it determines the essential nutrients contents of the soil and also determines deficiency of any soil nutrients which is required for proper growth of crops. A proper testing will help ensure the application of enough fertilizers to meet the requirements of the crop while taking advantage of the nutrients already present in soil.

Existing System: The existing system deals with the detection of NPK by the use of chemicals. This system works on the colorimetric principle which deals with the measurement of color intensity. A small amount of Soil sample is taken and for testing sample is mixed with particular chemical and it gives a color after reaction which is to be matched with the color chart and hence presence of soil nutrients is determined. The sensor output is calibrated in terms of deficient component as values per the standard color chart. Results are not accurate and it requires more time.

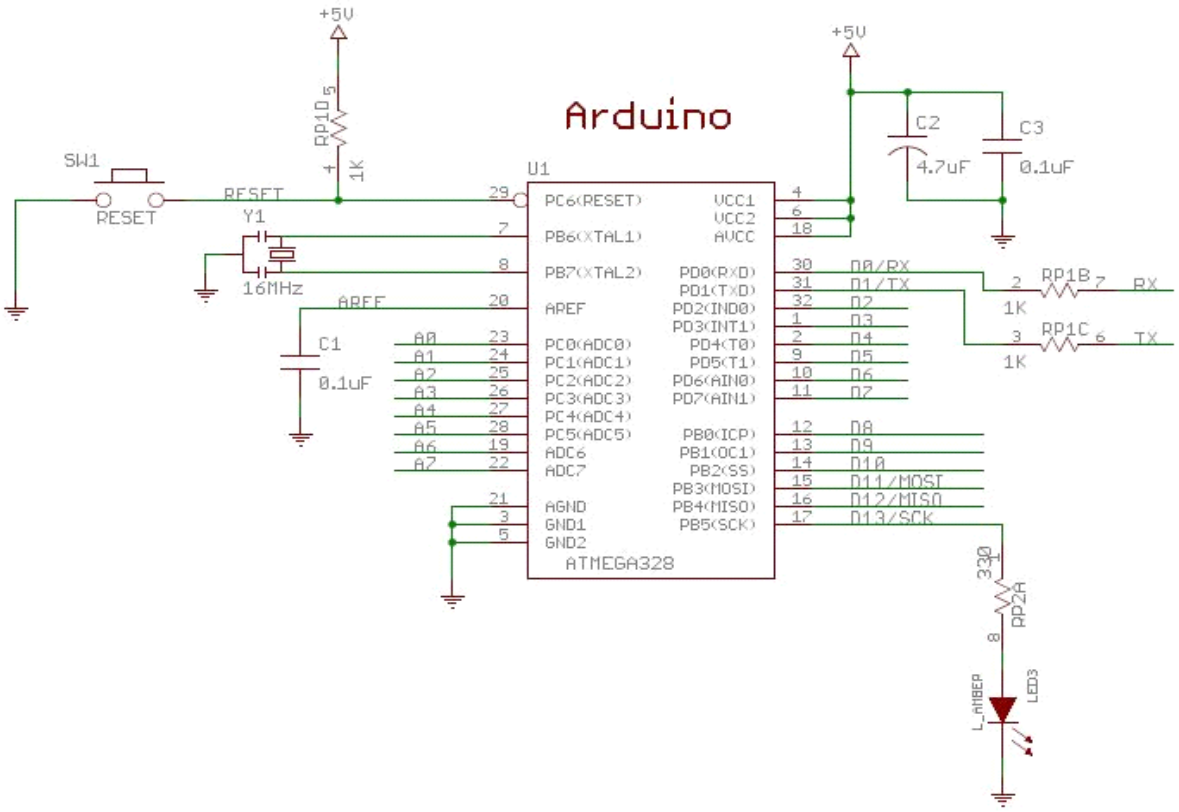
Proposed System: The system will consist of Arduino control board, electrochemical sensors, pH sensors, soil moisture sensor, Electrical conductivity sensor and temperature sensor. Arduino control board will collect data from different sensors and display the message on LCD screen. For getting brief advice about fertilizers we will make a farmer advisory app.



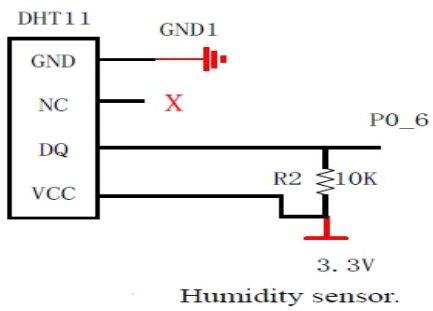


Hardware implementation of Arduino control board and sensors:

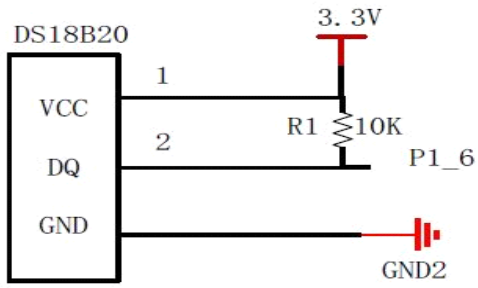
Arduino: Arduino is an open source hardware control platform with its own Integrated Development Environment (IDE). The system will use the architecture unit of Arduino Nano, a small, complete and bread board friendly based on the ATmega328P with easy programmable features. The Arduino Nano can be powered via the mini-B USB connection, 6-20V unregulated external power supply (pin 30), or 5V regulated external power supply (pin 27). Arduino can sense the environment by receiving input output from variety of sensors and can affect its surroundings by controlling lights, motors and other actuators.



Temperature and Humidity sensor: It consist of a humidity sensing component, a NTC temperature sensor (or thermistor) and an IC on the backside of the sensor. Humidity sensing component consist of two electrodes with moisture holding substrate between them. So the conductivity changes as the humidity changes or the resistance changes. This change in resistance is measured and processed by IC so that reading and processing becomes easy for microcontroller. Temperature sensing component uses NTC temperature sensor or a thermistor (which is a variable resistance that changes its resistance with change in temperature). This sensors are made of semi-conductive materials such as ceramics or polymers to provide large resistance for a small temperature variation**.**

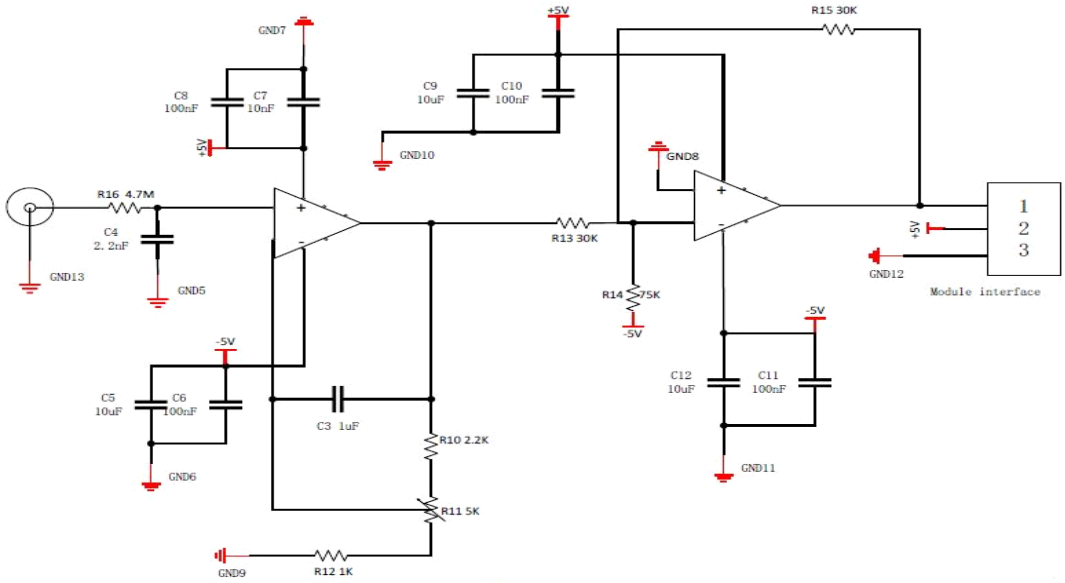


Humidity sensor.



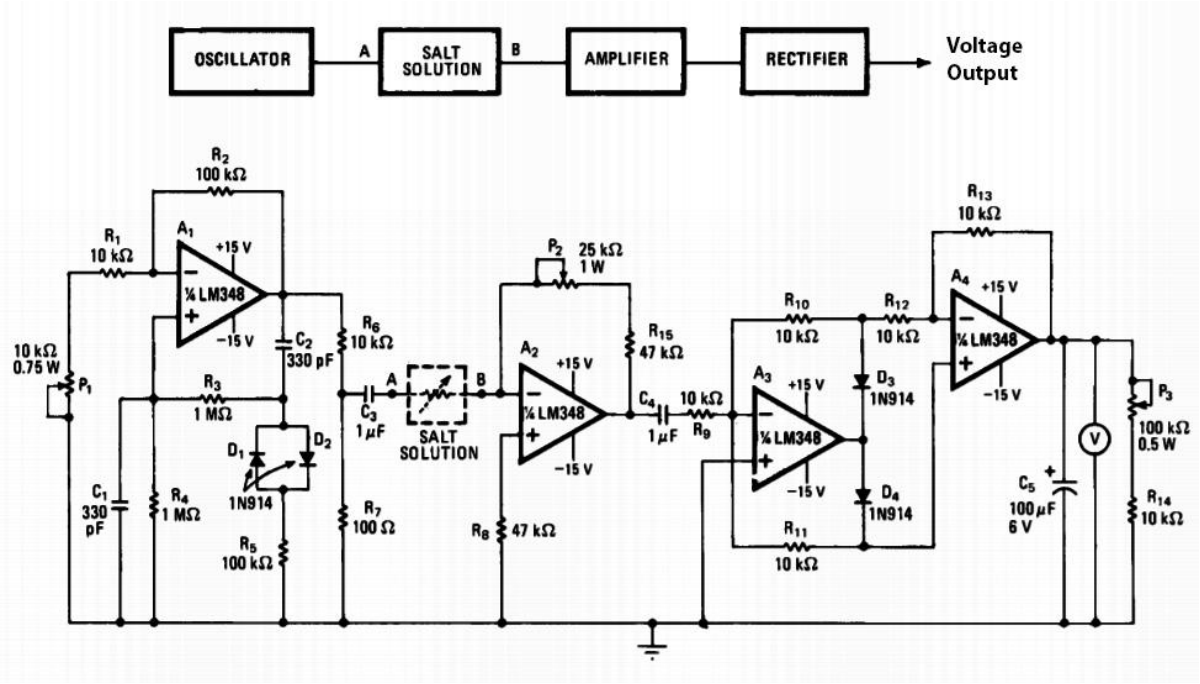
Temperature sensor.

pH sensor: It consist of an LED which works as the power indicator, a BNC connector and PH 2.0 sensor interface. It is accurate up-to ±0.1 pH (25 degree Celsius) and pH measuring range 0-14. It is specially designed for Arduino controllers and has built in simple, convenient and practical connection. pH sensors can be connected with BNC connector and plug the PH 2.0 into any analog input on Arduino controller to read the pH reading easily.



The schematic diagram of pH measuring circuit.

Electrical conductivity sensor: This sensor is designed for continuous monitoring of conductivity. It measures conductivity of water and provide analog 0-5V from full scale to Arduino. Calibration can be done with known conductivity solution or if electrical conductivity of water is known. Insert senor into soil and give few minutes to it to take the reading. Turn calibration trim pot with small flat screw driver to desired value.



Electrical conductivity circuits

Electrochemical sensor: It consists of two electrodes which responds to targeted ion and transform a reactions to detectable electrical signals. The electrochemical sensor is connected to the analog input port of Arduino controller board and the LCD module is connected to the Arduino output port. The sensor with two electrodes is dipped into wet soil sample. When the power is ON the current passes to the circuit. When the current passes through the electrode, oxygen diffuses into the cell and absorbs by both electrodes the Arduino get the analog input signal from the electrochemical sensors and hence nutrients (such as **NPK**) present in the soil can be detected.

Conclusion: This system is designed for testing various soil parameters in an efficient way. Farmer Advisory System and its interface with Government servers has been designed in current study. To test the soil, the sensor is to be dipped in wet soil which will send electrical signals to Arduino and hence it will display the soil fertility report on LCD screen. This system will be simple in operation, cost effective and of high application value. It can be used both in farming and fishery. Furthermore, it will help Government agencies to aggregate information about soil quality from different regions of the state.

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