

IDENTIFICATION OF SOIL FERTILITY USING OPEN HARDWARE(ARDUINO)

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Abstract:The sustained cropping without any testing of soil and measurement of nutrients present cause less yield in the agricultural sector. It is paramount for the healthy growth of the crop and also in producing high yield. Here, Soil plays a crucial key role in the yield of crop. The amount of nutrients obtainable to the roots is the chief factor limiting the yield of the crop. Nitrogen, Phosphorous and Potassium are macro nutrients, where as the micro nutrients are Iron, copper and zinc. To preside over the quality of the soil, here the electrochemical sensor is used with Arduino microcontroller..It's principle is based on the absorption of the ions present in the soil and by showing the measurements of soil from the aqueous solution.

Index Terms- Nitrogen, Phosphorous, potassium,electrochemical sensor, Arduino.

I. INTRODUCTION

Conventionally, for a crop the roots absorbs the water as well as required amount of the nutrients. The supplying of nutrients from outside of the soil for the root environment is known as Fertilization. If there is no enough supply of nutrients to the soil, automatically less yield of crop is produced and scant development of crop. Before any land usage, the soil is to be tested because if the soil fertility is more it helps in increase of agricultural land. If there is no fertility, it can be used for other purposes. The information regarding the fertility of soil after testing is to be sent to higher authorities to save the land for agriculture. Fertile soil produces high yield crop. These days soil quality is decreasing due to many reasons. some of they are soil pollution and soil acidity and decline in organic matter status. Scarce in micro and secondary nutrients in soil lead to mineral deficiency disorders.

However a certain proper distribution is necessary for a good crop production. In some of the places in our country we can see the traditional system where there is no exculpation of soil. Soil testing should be done time to time. In the coming years we can see there is an intensify demand for the food production. The improper use of fertilizers or nutrients can damage the crop, which results the destitute(poor) quality of food products. Technology plays a crucial role for the furtherance of food production in a hygiene way. Wireless sensor networks are extensively used in farming lands to develop or increase the productivity. Different types of sensors are used which performs disparate tasks like water monitoring, soil moisture monitoring, in determining temperature, depth of soil, pH value of the soil. Gathering the samples of soil also plays an important role. It had got a exceptional significance in agricultural for the future monitoring of soil nutrient standing of various locality.

II. LITERATURE SURVEY

Plants extract nutrients that they need for their growth from the soil. Which are classified as macronutrients and micronutrients. Macronutrients are those that are needed in large amounts, while those needed in small amounts are called micronutrients[1].The Macro nutrients are essential elements used by plants in relatively large amount for plant growth are Nitrogen (N), Phosphorous (P), Potassium (K). Calcium (Ca), Magnesium (Mg) and Sulphur (S)[2].Geographic information system(GIS) is a powerful tool which helps to integrate many types of spatial information such as agro-climatic zone, land use, soil management, etc[3].Different types of lands are used in yielding different types of crop for example 1.clay land for cabbage, broccoli and not for root vegetables.2.sand soil for root based vegetables 3.Loam soil provides best necessary elements 4.

Silt is a very fertile soil 5.Peat soil used for root crops ,cabbage ,spinach.[4].The electrochemical sensor have the potential to be produced in batches to very small size by using MEMS-based micro fabrication technology at low costs[5].Land-use changes associated with increased urbanization will alter soil temperature and moisture regimes due to the urban heat island effect and modified hydrology[6].Plants extract nutrients that they need for their growth from the soil. Which are classified as macronutrients and micronutrients. Macronutrients are those that are needed in large amounts, while those needed in small amounts are called micronutrients[6]. Technology plays an expedient role for the improvement of environment and for achieving the economic goals. Precision Agriculture (PA) - based geo-spatial technologies, such as global positioning system, geographical information system, remote sensing, geo-statistics and variable rate applications can be used for obtaining efficient nutrient management in crop fields[7].There are many methods to test soil for example optical transducer for NPK soils detection and is formed by the integration of light transmission system and light detection system[8].

IoT has many applications, and it can use in many fields. One of the field is agriculture, for smart farming. The IoT contributes significantly towards innovating farming methods[9]. The sensors convert the chemical information to electrical signal that will be used as an input of a microcontroller in interpreting the data [10]. The nutrients of the soil are detected using electrochemical sensor and data is displayed in the LCD display. The sensor measures the values those values are collected by the microcontroller and later values are displayed.[11].

III. DESCRIPTION OF PROPOSED SYSTEM

Ion selective electrode(ISE) and ion selective field effect transistors(ISFET) are the most commonly used potentiometric electrochemical sensors for soil nutrient detection. Using Arduino communication software it will be programmed. Then the program will be compiled and converted into the machine language. Then the code file is dumped into Arduino board. Ultimately the FIA analysis will be carried inside the Arduino controller and the output will be displayed on the LCD screen.

IV. EXPERIMENTAL SETUP

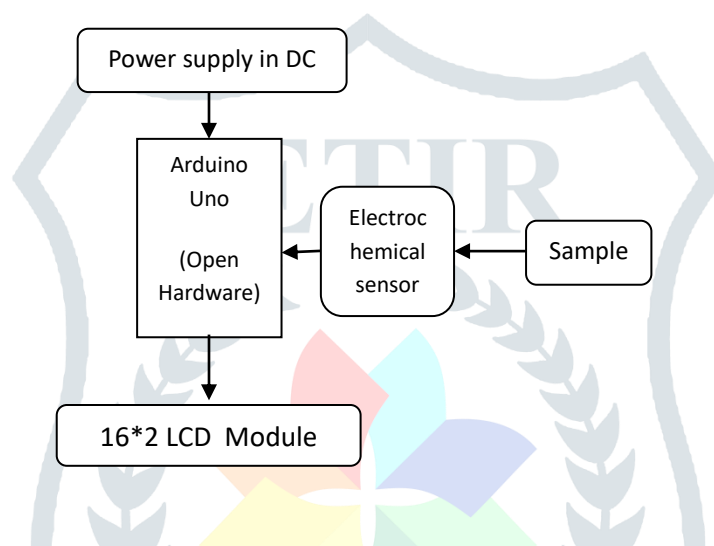


Fig 1: Identification of Soil Fertility Using Open Hardware-Arduino.

ARDUINO UNO

An Arduino is actually a microcontroller based kit which can be either used directly by purchasing from the vendor or can be made at home using the components, owing to its open source hardware feature. It is basically used in communications and in controlling and operating many devices. It was founded by Massimo Benzi and David cuartielles in 2005. The Arduino board embedded with power USB, Power Jack, Voltage Regulator, Crystal Oscillator, Arduino reset power supply pins, Analog pins, digital pins ,main micro controller, ICSP pin, Power LED indicator, Txnd Rx LEDs ,AREF(analog reference).

ELECTROCHEMICAL SENSOR

Mostly the electro chemical sensors are used for continuous determination of soil nutrients. It consists of two electrodes. The electrodes system work based on flow injection analysis(FIA) technique for nutrients determination. The two electrodes respond to the required(targeted) ions in the soil sample and convert them into electrical signals. The two electrodes in the sensor are sensing electrode and a counter electrode. Here the oxygen diffuses into the cell and adsorbs on to the electrodes. This results a constant potential between the two electrodes in which a little current flows. The above electrochemical sensor used is based on ISFET technology. Here the sensor is connected to the analog input port of Arduino board and the LCD is connected to the Arduino output port. The two electrodes in the electrochemical sensor is dipped into the soil sample, where the taken soil is a bit little wet dry. The current passes through the circuit when the power supply is ON. When the current passes through the electrodes, oxygen diffuses into the cell and absorbed by both the electrodes. From the Electrochemical sensor the Arduino get the analog input signal. Then the FIA will be processes

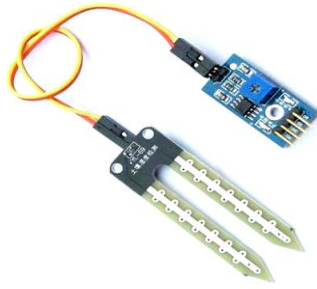


Fig 2 : Electrochemical Sensor

COMPARISON OF NUTRIENTS BETWEEN THREE SOIL CATEGORIES.

CLASSES	AVAILABLE			CONTENT IN TERMS OF PERCENTAGE		
	N	P	K	N	P	K
LOW	<280	<10	<118	10.31	82.93	10.85
MEDIUM	280 – 560	10 – 25	<118 - 280	35.84	17.07	36.91
HIGH	>560	>25	>280	53.85	-	52.24

Table 1: Comparison of Nutrients Between Three Soil Categories

V. EXPERIMENTAL ANALYSIS:



FIG 3: RED SOIL

SOIL COMPOSITION

pH	5.5 to 7
Potassium	very low
Phosphorous	0.09%
Nitrogen	0.08%
Moisture	29.2 to 30

Table.2: RED SOIL

The Red soil chemical composition is mainly non-soluble material 90.47%,iron 3.61%, aluminum 2.92%, organic matter 1.01%, magnesium 0.70%, lime 0.56%, carbon dioxide 0.30%, potash0.24%, soda 0.12%, phosphorus 0.09% and nitrogen 0.08%.These soils have thin layers and are less fertile. This soil is suitable for growing bajra,cotton,wheat,potato,pulses,tobacco,jowar,linseed,millet and fruits.



Fig.4 BLACK SOIL

SOIL COMPOSITION

pH	5.5 to 7.5
Potassium	8.0
Phosphorous	7 to 0
Nitrogen	0 to 14
Moisture	0.01N to 0.1N

Table.3 BLACK SOIL

The chemical composition of this soil is there will be more proportion of iron, lime, calcium, potash ,aluminum and magnesium carbonates. This soil is considered to be quite fertile. Crops like groundnut ,tobacco, cotton ,mustard ,linseed and udad are grown in this soil.

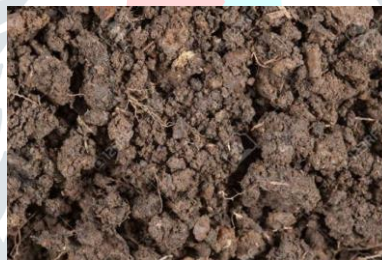


Fig.5 PEAT SOIL

SOIL COMPOSITION

pH	4.4
Potassium	23.007ppm
Phosphorous	25.6%
Nitrogen	75%
Moisture	0.3 to 23%

Table.4 PEAT SOIL

Peat soil is found in million parts of the world. It is also used as fuel. This soil has more fertility. The chemical composition of peat soil is phosphorous, potassium and nitrogen.

In this experimental analysis, the electrochemical sensor is dipped into the ground up to certain level where the soil restricts he sensor to go further in. There the sensor collects the nutrients information f the soil and after on after detecting the exact value of the particular nutrients the sensor transmits the signal the Arduino board, here it has some seconds delay in

between transmission and receiving. At last the board gets the information of the soil and can proceed for further remedies, measures to increase of fertility of soil. Which leads in high yield production.

CONCLUSION

The main aim is the future endeavor to improve and maintain soil fertility in order to increase the production. To study the influence of nutrients present in the soil. The above paper would greatly benefit resource for farmers who are currently struggling to produce high yield crop due to deficiency of nutrients in soil. The study presented above is concentrated on the scenarios soil fertility, high yield crop and nutrients present in the soil. This is holistic approach over the problems facing by the farmers and lack of nutrients in soil. Based on the results of this initial study it was decided to make proper usage of technology in the field of agriculture.

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