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Real Time soil fertility analyzer using IOT

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Abstract:

Agriculture plays a vital role in our country. Over fertilization may leads to the inferior quality of the crop production. The measurement of Soil nutrients is greatly required for better plant growth and fertilization. A key in soil testing is to determine the amount of nutrients present in soil. PH is commonly measured to monitor the soil fertility. PH is also one of the most important and informative soil parameter to detect the soil fertility. In the proposed system an electrochemical sensor has been developed to determine the percentage of soil nutrients i.e., Nitrogen, Phosphorous and Potassium and also determine the crops which are suitable for the particular soil type. It will analyze soil nutrient content present in soil at real time and it will also suggest the crops based on determined PH of soil. This system is proposed to help the farmers to increase the production and the suggestions are made through the mobile application.

Keywords: **Nitrogen (N), Phosphorus (P), Potassium (K), electrochemical sensor and Nutrients**.

1. INTRODUCTION

All types of farming activities like watering fields; cultivating crops with required fertilizers etc. are involved in conventional farming practice are performedmanually. [1] Crop production is mainly depends on the soil and properties of plant interaction. It is a valuable tool for a farmer which determines the soil fertility for better and economical crop production. A proper soil testing will helps to decide the amount of fertilizer to get the proper results of the crop based on the nutrients already present in the soil. A complete nutrient management plan is done by using the soil testing. Major nutrients present in soil are Nitrogen (N), Phosphorus (P) and Potassium (K).Based on relation between the pH and macro nutrient concentration of soil, we decide the fertility of soil. Depending upon the minerals available in the soil, we can estimate the plant rate of nutrient absorption.

Due to the insufficient rate of nutrients there is degradation in the production of crops. The major requirement of the nutrients for necessary plant growth is known as Macro nutrients. However the better amount of fertilizer is required for better growth. Over fertilization leads to the reduction in harvest production rate. Even today some areas follow the manual fertilization. This type of manual fertilization becomes the soil condition is error prone. Day to day the demand of food production increases rapidly. The misuse of fertilizers results into inferior quality in crop production. Depending upon the type of crop and on plant growth status, the quantity will be decided. Measuring the nutrientsconcentration present in the soil is to get the soil nutrients to be provided and select the suitable crop for multiple times of cropping in the same land. Nutrients and technology plays a crucial role for getting the sustainable agriculture and reducing the environmental impacts and economic losses.

2. EXISTING SYSTEM

The existing system mainly deals with two types of soil testing methods.

- Soil testing in laboratory
- Mobile soil testing

The first method involves soil testing in laboratory but it is a time consuming process. It may take weeks or days to test the fertility of soil. It involves the people take the soil sample and sent to the laboratories for soil testing. By using chemical analysis they detect the NPK values of the soil [9].The mobile soil testing involves people came and do the soil testing then give the suggestions regarding the fertilizers but it will done in once per crop. So, this method is not suitable for effective crop production and it does not give the accurate results. Later those three methods are used for detecting the soil fertility. Those are spectroscopy, conductivity and electro chemical sensor methods. But those are cost effective and not giving the accurate results.[7]

3. PROPOSED SYSTEM

In proposed system, the traditional farming method of testing soil fertility is replaced by the automated remotely monitored fertility technique. With this system the farmer can able to get current status of soil fertility in land at real time. By using the sensors, quality of soil is determined to calculate the soil nutrient concentration i.e. NPK. The electrochemical sensor method is used to test the soil for multiple times [4]. To determine the approximate fertility of total land the result of each test is averaged and the result will be displayed on the display screen. The important parameter used in this system is PH sensor to know the soil fertility. Based on PH values the nutrient values and suggestions about crop are displayed on android application. The application provides list of suitable crop and the required fertilizer for the crop.

3.1 Block Diagram

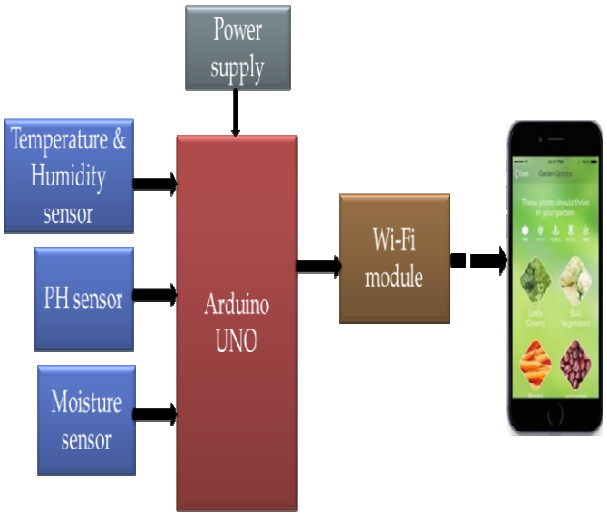


Figure 4.1 Block Diagram

4. BLOCK DIAGRAM DESCRIPTION

The proposed system consists of temperature and Humidity sensor, Arduino UNO board, moisture sensor, PH sensor, cable connector, and regulated power supply and soil sample.

4.1Arduino UNO Micro controller

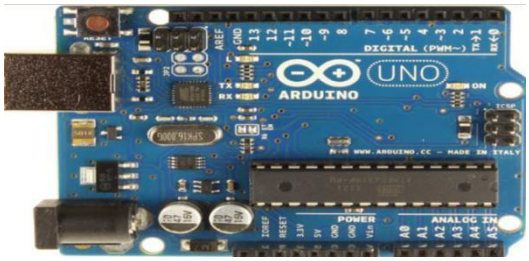


Figure: Arduino Uno Micro controller

Arduino is open source computer hardware. It is used to manufacturing and designing the micro controller based kitsfor building devices which are digital and interactive objects those can control and sense objects in physical world. This Arduino includes sets of digital and analog input output

pins, USB port for dumping the programs from the PC, serial communication interfaces. For programming of micro controllers, it has a feature of IDE I.e., integrated development environment based on processing project which supports programming languages of C, C++, and Java. The main features involves ICSP header, 1KB of EEPROM,power jack, 6 analog I/O pins, At mega 328, operating voltage is 5v, 32 KB of flash memory of which 0.5 KB used by boot loader, 2KB of SRAM, 16MHz clock speed, 6 pulse width modulation output pins, and it's input voltage is 7-12v.[5]

4.1 Moisture Sensor

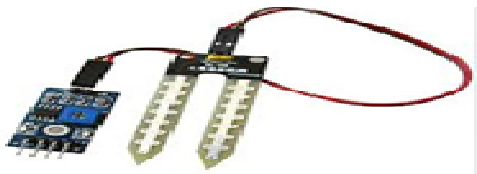


Figure 4.1 Moisture sensor

This Moisture Sensor can be used to detect the soil moisture around the sensor, which is ideal for monitoring the soil moisture in your garden or the indoor plants. it can be easy to use, just insert the sensor into the soil then read the values. It uses the two probes which passes current through the soil, and getting the moisture level by reading the resistance. It conducts electricity better when soil has more water, while conducts electricity is poor when the soil is dry.

Specification

- Power supply: 3.3v or 5v
- Value range:
  0 ~300: dry soil
  300~700: humid soil and
  700~950: in water
- Output voltage signal: 0~4.2v
- Current: 35mA

4.2 Temperature and humidity Sensor

The DHT11 is a ultra-low-cost and basic digital temperature and humidity sensor. It uses a thermistor to measure the surrounding air, a capacitive humidity sensor and spits out a digital signal (no need of analog input pins) on the data pin. This sensor is simple to use, but requires some time to grab the data. The only real downside of the DHT11 sensor is for every 2 seconds only we can get new data from it, so when we using the libraries, readings of sensor can be up to 2 seconds old. When we compared to the DHT22, this sensor is less accurate, less precise and works in a smaller range of temperature/humidity, but it is less expensive and smaller [2].

Figure 4.2 Temperature and humidity sensor

Specification

- Low cost
- 3 to 5V power and I/O
- 2.5mA max current use during conversion (while requesting data)
- Body size 15.5mm x 12mm x 5.5mm & 4 pins with 0.1" spacing
- Good for 0-50°C readings of temperature and ±2°C accuracy
- Not exceed more than 1 Hz sampling rate (once every second)
- Good for 20-80% humidity values with 5% accuracy

4.3 PH Sensor

A pH sensor is used to measure the concentration of hydrogen ions in the soil and also measure the water quality, also indicates whether the soil is alkalinity or acidic. It

measures the electrical potential difference between a reference electrode and pH electrode. Sometimes the meter is referred as a "potentiometric meter". The difference gives the acidity or pH of the solution. Here using soil PH sensor which is specially designed for Arduino and it has built in features. If it is programmed, we will get the PH values.

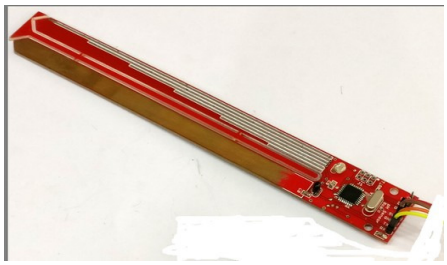


Figure 4.3 pH sensor

4.3 Wi-Fi module

Here we are using an esp8266 Wi-Fi module. it is a low cost Wi-Fi module with full TCP/IP stack which interfaces to any micro controller and easily configured as web server. it is not backward compatible but frequently updated. A good example is how older versions used 57600-115200 baud rates, while newer versions use 9600 baud rate. [3]

The Wi-Fi module takes commands via a simple serial interface and gives response with the outcome; it will send acknowledgment whenever the new request is made. For setting up this we need to use the commands and libraries of esp8266 by using this link.

https://nurdspace.nl/ESP8266#AT_Commands

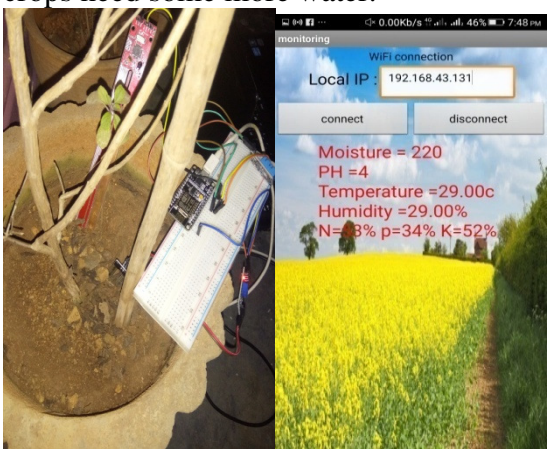
5. Circuit Description

Here the electrochemical sensors are connected to the Arduino output port. The electrochemical sensor electrodes are dipped into sample of the soil, where the soil sample is taken as little wet and dry. When power supply is ON, the current passes through the electrode, oxygen diffuses and absorbs by the electrode then Arduino get the input signal from the sensor, where the electrochemical senses the nutrient present in the given sample and sends to the Arduino. It will be programmed by using Arduino software. After programming, the code file will be dumped on to the Arduino board. Finally the output will be displayed on android application through the serial communication.

6. EXPERIMENTAL RESULTS

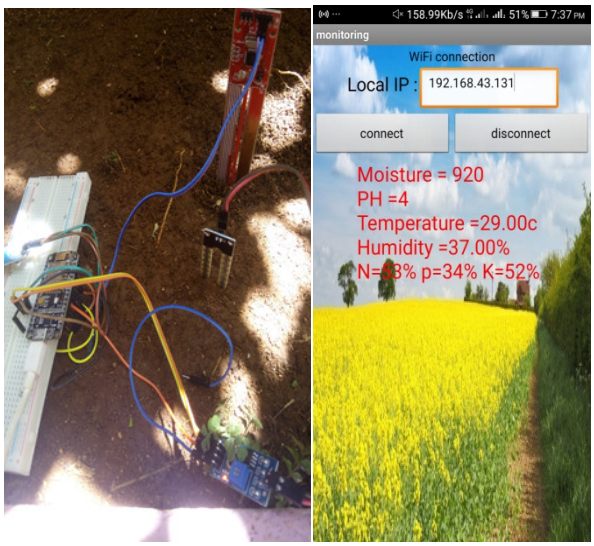
6.1 Dry soil:

The output which is displayed on android application shows the nutrient concentration in dry soil. The suitable crops for this soil are tomato, potato, corn etc. but for remaining crops need some more water.



6.2 Wet soil

The output which is displayed on android application shows the nutrient concentration in wet soil. Leafy vegetables are more suitable for this land. By planting these types, we get good results.



The output which is displayed shows the nutrient content present in the sultry soil. Carrots, beans and rice varieties are suitable for this land. Those nutrients are the accurate values present in soil. Not only shows the nutrients but also display the soil parameters such as temperature, humidityetc.

7. CONCLUSION

Time is the precious one for detecting the soil nutrients since the soil nutrient levels are varied. Due to chemical analysis and complex soil testing, it is time consuming process. Electrochemical sensor responds to concentrated ions in soil, and then detects the nutrients. The advantages of these electrochemical sensors are having the potential for automatic detection of soil nutrients. The advanced engineering technologies provided new approaches for soil testing isto follow the principle named as KIS (Keep It Simple) to treat the complex soil testing procedures at a lower cost.

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