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Automated Soil Testing System for Agriculture (Using IOT)

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ABSTRACT: Agriculture is the main occupation of our country and it plays a vital role in our country. Using too much of fertilizers may lead to the inferior quality of the crop production. So the measurement of soil nutrients is greatly required for better plant growth. Determining the amount of nutrients in the soil is the key function. pH value is also one of the most important and informative soil parameter to detect the soil fertility and it is measured to identify the soil fertility.

KEYWORDS: soil moisture, PH, Node MCU, DHT 11, Monitoring.

I. INTRODUCTION

Watering fields, cultivating crops with required fertilizers etc. are the farming activities involved in conventional farming. These practices are performed manually. [1] Crop production mainly depends on the soil and properties of plant interaction. The farmer uses this as a valuable tool. This determines the soil fertility for better and economical crop production. Soil test helps to decide the nature of the soil whether it is acid or base and which crops will give maximum productivity. Depending upon the minerals available in the soil, we can estimate the plant rate of nutrients absorption. There is degradation in the production of crops because of insufficient rate of nutrients. Macro nutrients are the major requirement of the nutrients necessary for plant growth. Correct usage of fertilizer is required for better growth. Over usage of fertilizer leads to the reduction in harvest production rate. Manual fertilization is still followed in some parts of India. This type of manual fertilization makes the soil condition error prone.

II. RELATED WORK

CASE STUDY ON AGRICULTURE SOIL TESTING USING WIRELESS SENSOR NETWORK [1]

This paper summarizes the overall scope of agriculture as well research and development taken place in agriculture expert system. An overview is also presented on the research endeavours to apply on field sensor development, wireless sensor network (WSN), remote sensing application and internet technology for agriculture expert system.

AUTOMATED SOIL DETECTION USING SENSOR. S. Kamble, P. Gottiparthi, A. Thool, P. Ghadge. 2018 [2]

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.

AN AUTOMATIC FLUIDIC SYSTEM FOR THE RAPID DETECTION OF SOIL NUTRIENTS, Miao Zhang 2016 [3]

worked on detecting soil nutrients using the automatic fluidic system.

DETERMINING SOIL NUTRIENTS AND PH USING IMAGE PROCESSING AND ARTIFICIAL NEURAL NETWORK. John Carlo Published A modelling approach in Agriculture Systems 2013 [4]

It involves colorimetric that measures a qualitative number of primary macronutrients and it also includes the pH level of the soil where it determines whether the soil is acidic, neutral or basic.

AUTOMATIC IRRIGATION SYSTEM written by Shagun Agarwal, Suyash. Pandey [5]

They have said that 'We are doing development of low-cost water monitoring system in soil consisting of soil moisture level sensor.

THE SOIL SAMPLING TECHNIQUES WERE LEARNED FROM THE STUDY WHICH DISCUSSES ABOUT CHARACTERIZING AND RECOGNIZING SOIL SAMPLING STRATEGIES by Prof C. H. Chavan, Mr. P. V. Karande [6]

The research objective is “Monitoring agricultural environment for various factors such as soil moisture, temperature, and humidity along with other factors can be of significance”. LM35 temperature sensor is used for their prediction.

A SURVEY ON APPLICATION OF DATA MINING TECHNIQUES TO ANALYZE THE SOIL FOR AGRICULTURE. Hemageetha[7]

This paper explores various proposed algorithms for analysing soil using data mining techniques.

QUALITATIVE DATA ANALYSIS USING REGRESSION METHOD FOR AGRICULTURAL DATA Pallavi V. Jirapure, Prarthana A. Deshkar[8].

The focus of this paper is to provide and build agricultural based information system for Customer and Farmer interaction where scalability, reliability and integrity of information can be access through cloud based technology.

SOIL TESTING AND ANALYZING USING AVR MICROCONTROLLER. Mohammad Junaid Khan[9]

Soil pH, Fertilizer and conductive give a lot of information.

THE OBJECTIVE OF THE STUDY IS TO MONITOR THE LEVEL OF THE SOIL WATER CONTENT [10].

However, the study says that the researchers are using the EC-5 moisture sensor for moisture analysis and low powered nRF24L01 wireless transceiver with MPC82G516A microcontroller. Here, they test the pH by making a liquid soil mixed solution, which is a complicated mechanism Automated Soil Tester. The objective of the study is to monitor the level of soil water content.

The digital compass and an efficient GPS module have been used in some GPS guided Automated Soil Tester. Therefore, the digital compass is used in the proposed system for further enhancement of navigation.

ON-THE-GO SOIL SENSORS FOR PRECISION AGRICULTURE. V.I. Adamchuk a, J.W. Hummel b, M.T. Morgan c, S.K. Upadhyaya d a Biological Systems Engineering Department, (2009) [11].

The absolute value depends on a number of physical and chemical soil properties, such as texture, organic matter, salinity, moisture content, etc.

THE SOIL SAMPLING TECHNIQUES THE ALGORITHM FOR PLANNING FOR THE MOVEMENT OF ROBOTS is published by Yuksel and Sezgin in 2005 [12].

The soil sampling techniques were learned from the study which discuss about characterizing and recognizing soil sampling strategies.

A STUDY ON CROP YIELD FORECASTING USING CLASSIFICATION TECHNIQUE R. Sujatha ; P. Isakki Published in: International Conference on Computing Technologies and Intelligent Data Engineering [13].

We have demonstrated to estimate the crop yield, choose the most excellent crop, thereby improves the value and gain of the farming area using data mining techniques.

III. METHODOLOGY

Automated soil testing device is an electronic device which can be used for four different types of soil measure moisture, humidity, temperature PH values to ensure that when soil is dry so motor automatically start the fertility off soil in the field of agriculture to select the suitable crop and also the type of fertilizer to be used. The main component of this system is microcontroller. The Node MCU with ESP8266 Wi-Fi shield is the micro - controller, sensors like temperature, soil moisture are used for the proposed system. The system is cost effective and easy to handle.

3.1 SYSTEM ARCHITECTURE WORKING

- The Node MCU with ESP8266 Wi-Fi shield is the micro - controller, sensors like temperature, soil moisture are used for the proposed system. The system is cost effective and easy to handle. The data is collected from sensors and it is uploaded to server and by using WLAN.

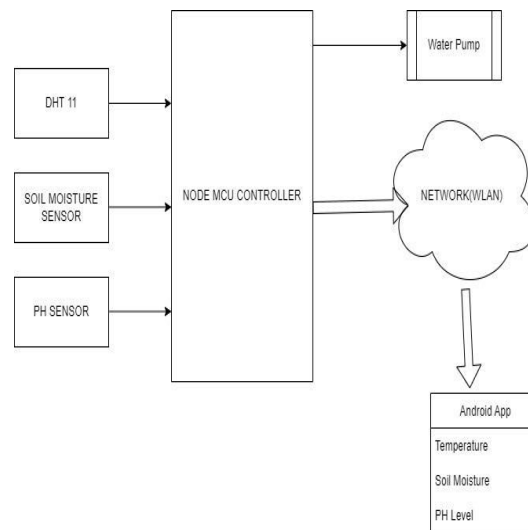


Fig 1 block dig

1. Soil moisture sensor

Soil moisture sensors (or “volumetric water content sensors”) measure the water content in soil, and can be used to estimate the amount of stored water in a profile, or how much irrigation is required to reach a desired amount of saturation.

2. PH sensor

The pH sensor functions as a soil pH meter. The node MCU controller functions as a controller, receiver and processor of data from the DHT11 sensor and the pH sensor, the results of the DHT11 sensor measurement.

3. Temp/Humidity Sensor

The DHT11 is a basic, ultralowcost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed). There are three pins in the DHT-11 sensor out of which two are for power and one is for the output data transmission.

3.2 ALGORITHM

Path finding. The automated soil tester has to visit alloverthe location of a selected agricultural land and need to collect many numbers of samples to make the accurate result.

Obstacles Avoidance. There may be possibilities for obstacles in the land such as stones, blocks or plants while the automated soil tester navigates.

- Sensors of the Soil Parameters. After reaching each given point, the soil tester's arm pulls and fixes the sensors into the soil (land).

- This sensor measures temperature from -55°C to +125°C and the accuracy is ± 0.5 °C for reading from -10°C to +85°C. Thermometer resolution is user selectable from 9 to 12 bits. It converts the temperature to 12-bit digital word within 750 ms. It can be powered from the data line, and the power supply range is 3.0V to 5.5 V. DS18B20 gives an accurate result compared to an LM35 temperature sensor.

3.3 FRONTEND/BACKEND

- Frontend: Android Application
- Backend: Android IDE

3.4 FLOW CHART

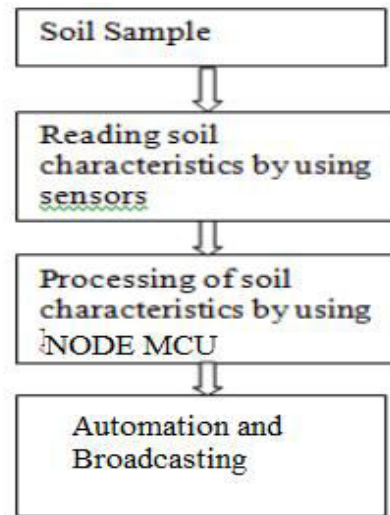
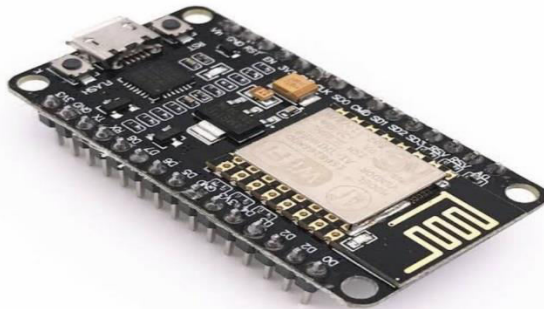


fig no 2.flow chart

3.5 SYSTEM REQUIREMENTS

- Node MCU8266

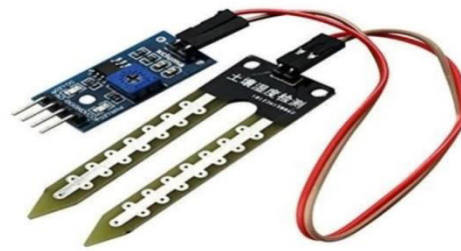
NodeMCU is a low-cost open source IoT platform. It initially included firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which was based on the ESP-12 module. Later, support for the ESP32 32-bit MCU.



Node MCU

- Soil Sensor

Soil moisture sensors (or “volumetric water content sensors”) measure the water content in soil, and can be used to estimate the amount of stored water in a profile, or how much irrigation is required to reach a desired amount of saturation.



soil sensor

- PH Sensor

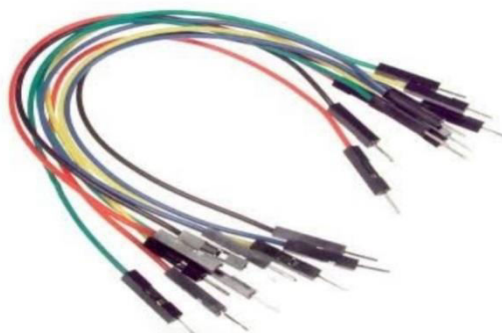
The pH sensor functions as a soil pH meter. The node microcontroller functions as a controller, receiver and processor of data from the DHT11 sensor and the pH sensor, the results of the DHT11 sensor measurement.



PH Sensor

- Jumper wire

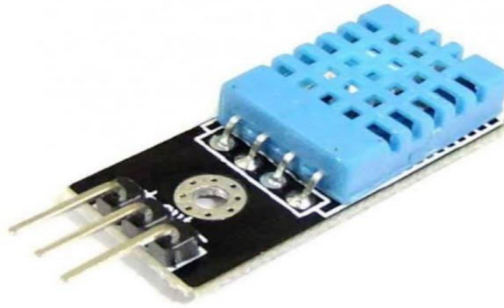
A jump wire (also known as jumper, jumper wire, jumper cable, DuPont wire or cable) is an electrical wire, or group of them in a cable, with a connector or pin at each end (or sometimes without them – simply "tinned"), which is normally used to interconnect the components of a breadboard or other prototype or test.



Jumper wire

- Dht11

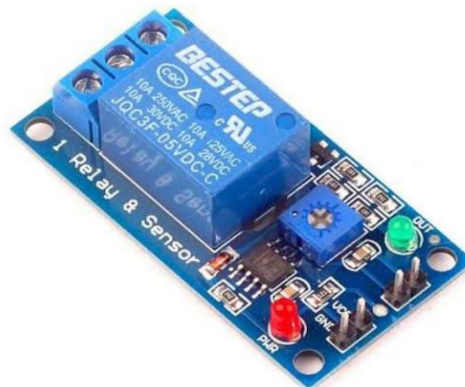
The DHT11 is a basic, ultralow cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (analog input pins not needed). There are three pins in the DHT-11.



Dht11

- Relay

Relays are switches that open and close circuits electromechanically or electronically. Relays control one electrical circuit by opening and closing contacts in another circuit. NodeMCU board contains an ESP8266 Wi-Fi enabled chip. A relay: An electromagnetic switch operated by a relatively small electric current that can turn on or off a much larger electric current.



Relay

- Water Pump

Water A mini submersible water pump is a centrifugal water pump, which means that it uses a motor to power an impeller that is designed to rotate and push water outwards.



Water Pump

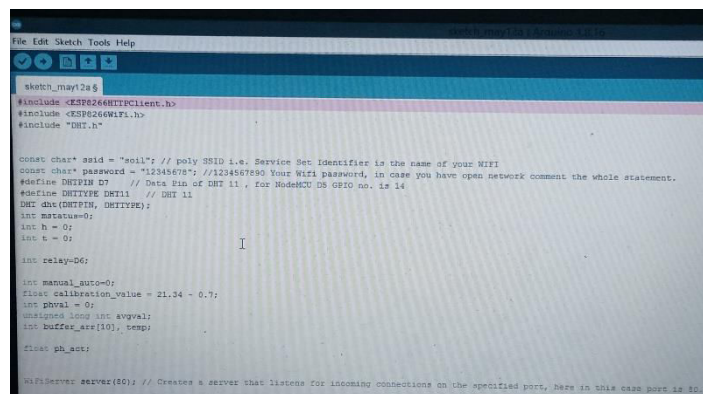
3.6 Software Specification

- Arduino IDE

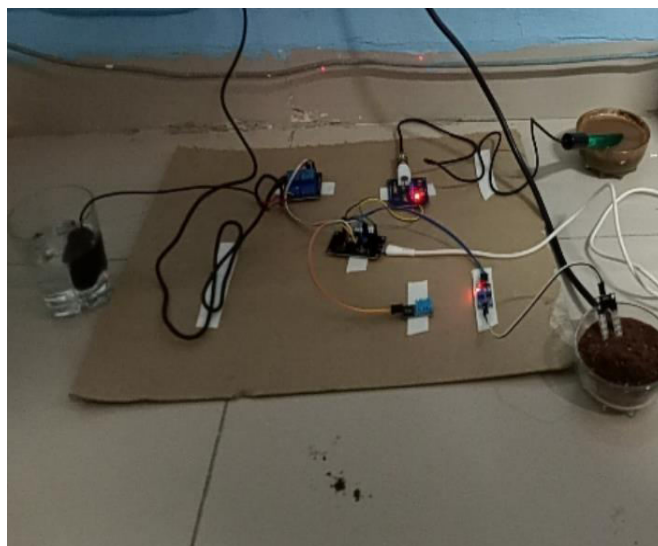
The Arduino Integrated Development Environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards, but also, third-party cores other vendor development boards. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main() into an executable.

- Android Studio

Android App is a software designed to run on an Android device or emulator. The term also refers to an APK file which stands for Android Package.



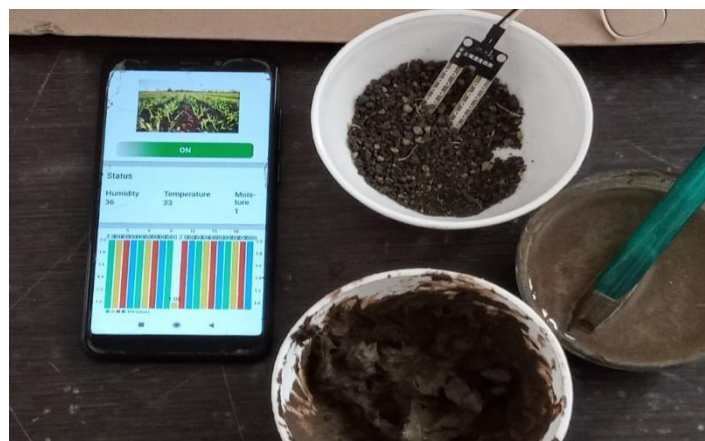
IV. EXPERIMENTAL RESULTS



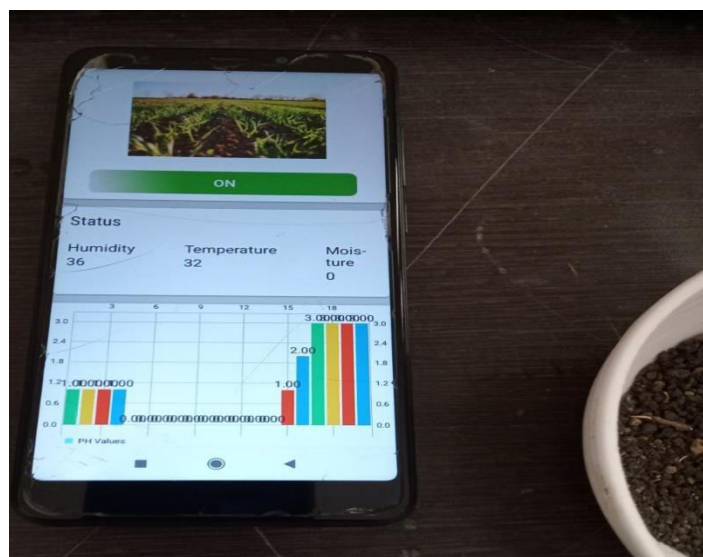
Automated Soil Testing Model 1



Automated Soil Testing Model - 2



ANDROID APPLICATION SETUPTO TEST DIFFERENT TYPE OF SOIL



V. CONCLUSION

In this system, takes readings from soil moisture sensor and humidity sensor and store it in a MySQL server and graph is drawn as per the variations in soil moisture, temperature and humidity level of the soil which we can see on Arduino IDE. The sensors and microcontroller are successfully interfaced with the server through WLAN. The data is stored successfully and can be accessed remotely. All observations and experimental set up proves that this is a complete solution to test the soil health parameter. User can have access to the data and can know if there are any deviations with respect to pH value and soil moisture.

VI. FUTURE WORK

IOT Based Weather Informative System will be proposed to Real Time Applications. It doesn't need any data center physically because we are creating a data server in cloud so that it doesn't require any datacenter further. So it reduces the cost of equipment.

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