IoT based data logger for soil tester

Atharva Walawalkar , Nikhil Shinde and Prajwal Thokal
Electronics and Telecommunication Engineering Department
Of Pimpri Chinchwad College Of Engineering
Sector no.26, Pradhikaran Nigdi Pune- 411044, india.

atharva.walawalkar20@pccoepune.org

nikhil.shinde20@pccoepune.org

prajwal.thokal20@pccoepune.org

Abstract:

Agriculture is the livelihood of approximately 58% of Indians. According to Inc42, the Indian agricultural sector is predicted to increase to US$ 24 billion by 2025. Indian food and grocery market is the world's sixth largest, with retail contributing 70% of the sales(with rice being a $ 6.12 billion and sugar being a $ 2.78 billion dollar industry) .The rising income levels in rural and urban areas, which have contributed to an increase in the demand for agricultural products across the nation. In accordance with this, the market is being stimulated by the growing adoption of cutting-edge techniques including blockchain, artificial intelligence (AI), geographic information systems (GIS), drones, and remote sensing technologies, as well as the release of various e-farming applications. A compact and wireless solution using IoT is given by this project. Humidity, Temperature and moisture of the soil can be measured using this device. A ESP8266 Node MCU, a SEN-13322 hygrometer and DHT11 sensor are interfaced for the reading of various parameters. Measured Output of all three parameters is then displayed on the LCD as well as the app.

Keywords: Humidity, Soil Moisture, Temperature, ESP8266, IoT

Introduction:

In this world can be challenging to locate rich soil with a sufficient moisture content in today's world of rising global warming and declining water levels. Agriculturists and other farmers. Therefore, before planting seeds or spending money on agricultural fertilizers, it is important to assess the value of soil moisture.
Soil moisture, temperature and humidity are 3 basic parameters which decide cropping patterns. Traditionally these were measured by hand, inefficient tools or assumed which left a lot of room for error. The main objective of this project is to minimize the guessing part and giving the farmers a accurate reading of these parameters. In this project IOT is introduce for storing the data over cloud. It is will get comes under automation . Automation is a process that is carried out without human involvement. Automation may lighten human workloads and make jobs more efficient and straightforward. A wide range of automation techniques are used by many sectors to effectively produce products with zero defects. Agriculture only receives a small portion of computer science's contributions. The foundation of human survival is agriculture. Humanity must always maintain a satisfactory level of food production. A significant issue, though, is that human engagement in agriculture has been steadily declining over time . One way to solve this issue is through automation. The island is covered with a variety of soil types, including chalky, peaty, sandy, clay, silty, and loamy. 45% of the soil is made up of minerals, 25% of it is water, 25% of it is air, and 5% of it is organic. Crop to crop, different soil types are appropriate. An essential phase in agriculture is choosing the ideal soil for the crop. To identify the kind of soil in each field and choose the ideal crop based on the learnt parameters, random samples of the soil must be analysed . To improve cultivation quality and maximise output, soil testing is essential. Agriculture relies heavily on automated soil testing, as opposed to traditional methods that address these types of issues. The computer scientist must make sure that computer science contributes to agriculture in the same way that it does to production, service, and other economic fields. One of the major agricultural chores that can be handled utilising automated techniques and computational methodologies.

Methodology:

The soil moisture sensor works on a resistance scale logic where the soil moisture is inversely proportional to the resistance of the hygrometer soil moisture sensor.
The soil moisture has a scale of 1000 ohms broken down in 100 percent. The volumetric amount of water in the soil is calculated using two probes. Following the passage of current through the probes and the soil, the moisture content is determined using the available resistance. More water causes the soil to become more conductive, which lowers resistance. The moisture value displayed is higher as a result.

Specification table:

Sr.no	Technical Specification	Values
1	I/p Voltage	3.3–5 V
2	O/p Voltage	0–4.2 V
3	I/p Current	0.035A
4	O/p Signal type	analog & digital

In soil moisture sensor has four pins: VCC (this is power pin with approximately 5v), A0 is Analog Output ,D0 is Digital Output ,GND is Ground.

The equation between resistance of sensors and soil water potential is provided in equation

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where S is the soil water potential (kPa), T is the soil temperature (degrees Celsius), and R is the resistance (k). When compared to other soil moisture sensors, the sensor's response time is minimal, and the data it produces is more accurate and trustworthy. In addition to the watermark sensor, a soil temperature sensor is essential for calculating the soil water tension in real time. The system will be prepared to store the data in a permanent memory for long-term usage once the computation of soil water tension has been finished using a series of mathematical formulas. To reduce the complexity of further analyses, this data will be kept with the appropriate date and time. Irrometer The Watermark 200SS is a resistive type sensor that can measure the resistance of the water tension in the soil. The range of resistance values that correspond to the water tension in the soil have been specified by the manufacturer. We have tracked the resistance out to a distance of 20 km. The relationship between soil temperature and soil water tension will have an impact on the amount of water in the soil.

Fig 1(Soil moisture sensor)

The DHT11 is a basic, ultra low-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 (no analog input pins needed). It's fairly simple to use but requires careful timing to grab data. It shows a percentage value for both temperature and humidity. On the back of the sensor unit, there is a humidity measuring module, a thermistor, and an integrated circuit. Two electrodes make up the humidity measurement module.
A moisture-retentive substrate is positioned in-between the two electrodes. The conductivity of the moisture-retaining substrate changes with changes in humidity, which also affects resistance. The change in resistance is then processed by the integrated circuit, and the humidity level is determined. On the other hand, a temperature change alters the thermistor's resistance, which the integrated circuit processes to produce a temperature measurement through calibration.

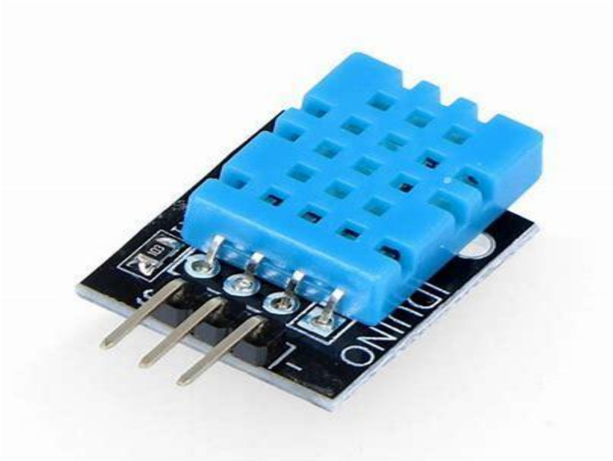

Fig 2(DHT 11)

The node MCU works as an IC and a wi-fi modem here establishing a connection for IoT and computing the signals input by the two sensors. Node MCU is a development board and open-source Lua-based firmware that is specifically designed for Internet of Things (IoT) applications. It has hardware based on the ESP-12 module and firmware that runs on E-spress if Systems' ESP8266 Wi-Fi SoC. It has 7 pins Micro-USB, 3.3V, GND, Vin(NodeMCU can be powered through the USB port) , EN, RST

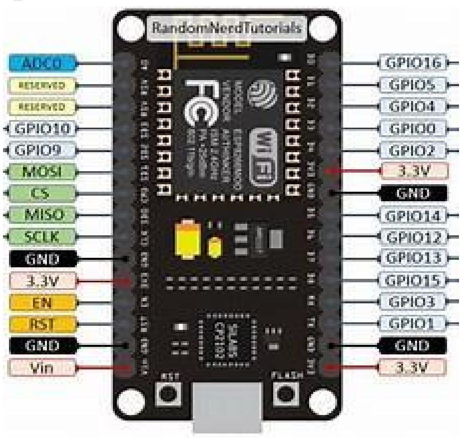

Fig 3(ESP 8266)

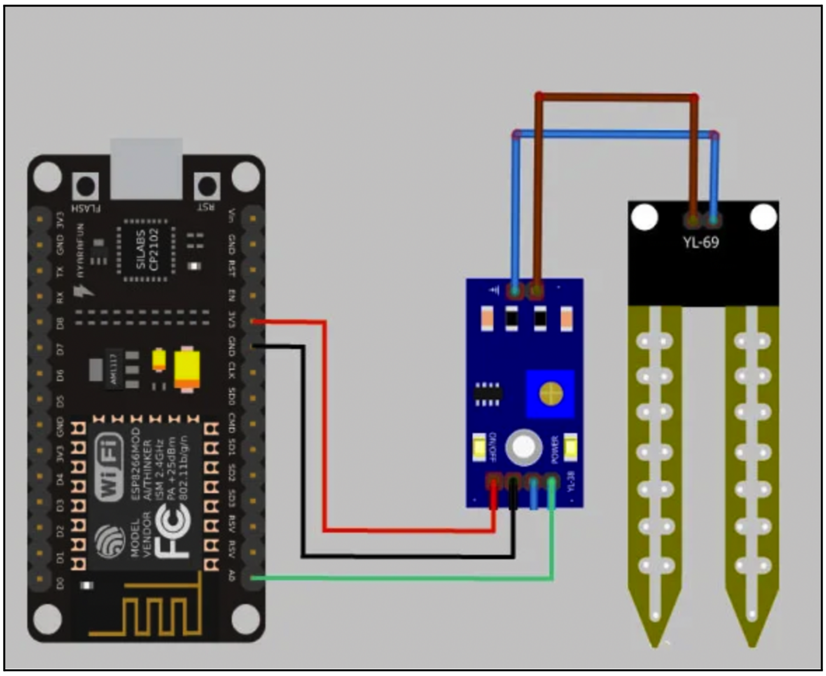

Fig 4(Circuit diagram of the ESP8266 and Soil moisture sensor interfacing)

Results and Discussion:

The primary goal of this project was to create a tool that would allow farmers and cultivators to assess if environmental conditions were suitable to promote the growth of crops effectively to obtain the highest yield feasible.
In compared to pricey soil testing equipment, this project provides readings that are surprisingly precise. The way the readings are mapped using the code, however, determines the primary outcomes. The model is transportable and may be brought anywhere. It does not need to be reprogrammed every time it is used once the code has been uploaded to the board. With the same technology, we can create a number of larger projects. We can appropriately adjust the temperature and irrigate our soil by measuring the values of humidity, soil moisture, and temperature.
To make the soil fruitful, fertilizers and other compost materials can be applied appropriately.
The various characteristics can be used to study plant chemistry.
From above discussion knows the soil moisture and temperature required for different crops.

Temperature (Celsius)	Soil moisture	Predicted Crop
22-32	Deep clayey and loamy soil	Rice
10-15	Well-drained fertile loamy and clayey	Wheat
21-27	Deep rich loamy soil	Sugarcane
22-29	Alluvial	Cotton
25-28	Sandy loam	Maize
26-30	Sandy loam	Sorghum
10-25	Sandy loam	Mustard

Table 2

Conclusions:

This project is useful and advance tool for farmers. It is a positive use of computer programming for Interaction between software and hardware. It is IOT based project it is basically hybrid of software and hardware. The use of programming is growing in fields like agriculture and so forth. How pre-made boards help many elements, like as
different modules and sensors. Arduino projects are comparable to slow. There are countless options for creativity and need in the realm of Arduino projects. That’s why internet of things is quickly taking over. Temperature measurements were made using a manual thermometer and an automatic soil tester. There aren't any noticeable differences between the mo-meter readings, which are roughly the same. The laboratory results and the moisture reading are slightly different. Both the time it took to get the material to the lab and any environmental factors that can have an impact on the manual reading could be contributing factors in this problem.

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