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Smart Soil Monitoring System

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Abstract: *Soil monitoring can be used in a greenhouse to detect the water content of the soil. This kind of system is really helpful for farmers to get the exact amount of water present in the soil. The main advantage of this project is that this is a low-cost soil moisture measurement project.*

The efficient irrigation management practices on the monitoring of the soil moisture in the soil provide a great benefit for the appropriate amount of water applied to the field. It helps in problems related to the growing of crops in which irrigation is required at an irregular interval. It also helps in monitoring the soil moisture in sports turfs.

Parameters getting monitored are- Soil temperature, moisture/humidity, and soil pH.

Key Words: **Soil Moisture/humidity, soil temperature, soil pH.**

1. INTRODUCTION

In this project for measurement of soil moisture and temperature, we used an SHT10 sensor manufactured by Sensiron Company which is a surface mountable humidity sensor.

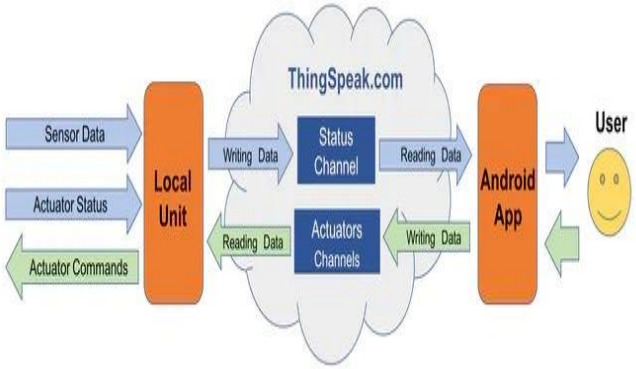
SHT10 sensor:- This sensor is excellently reliable and having long term stability, sensors are seamlessly coupled to a 14-bit-analog-to-digital converter and a serial interface circuit sensor is manufactured by a unique method known as CMOSens technology in which the Product is characterized by a fusion of sensor element and signal conditioning electronic components on single silicon CMOS (Complementary Metal Oxide Semiconductor) chip. It measures both soil moisture and temperature, the capacitive sensor element is used for measuring relative humidity, while the temperature is measured by a band-gap sensor.

PH Sensor:-To measure a pH of soil analog pH sensor it is used which works on 5v supply with an accuracy of +/- 0.1 pH its operating temperature is about 0-60 degree Celsius.

METHODOLOGY

1.1 Proposed System

In the proposed system soil moisture sensor is measuring moisture at a particular area where the sensor is inserted, it can give a soil temperature at the same time and this is connected to Node MCU and all these values are shown on display. The need for this system is to optimize the consumption of water, excess dose of water to the soil can make soil saline, which increases the salinity of soil which harms the higher crop yield. In cultivating grapes if the quantity of the water given to the crop is exceeded, then it will contents of grapes inappropriate amount, so this system helps farmers to realize them when there is a need for circulation of water. The proposed system measures the moisture contents and temperature too. And pH of soil while cultivating grapes plays a significant role, many a time because of inappropriate pH farmers are not able to export grapes to help them we combine the moisture and pH in one system.



1.2 Circuit Description

1.2.1. SHT 10:- The sensor is essentially just a Sensirion SHT-10 with the 4 data/power wires brought out so any SHT-1X code for a microcontroller will work. The sensor works with 3.3 or 5V logic. The 1-meter long cable has four wires. Humidity readings have 4.5% accuracy, the temperature is 0.5°C accuracy. For interfacing, a microcontroller is required. The sensor is not washed after reflow and is rehydrated according to datasheet requirements. This sensor having weatherproof metal housing, but it allows air to pass through it to measure the humidity of outside air, this results in superior signal quality, a fast response time, and insensitivity to external disturbances (EMC).

Figure 1. SHT10 (Soil Moisture & Temperature sensor)

1.2.2. NodeMCU (ESP 8266):- NodeMCU is an open-source IOT based system that uses Lua-based firmware especially characterized for ESP 8266 Wi-Fi in the build model. It has a 32 bit 10 Silica processor it also contains antenna switches RF balun standard digital peripheral interfaces, power amplifier, power management modules, and different filters this all circuit included in a small package so it defines its compactness. faster response than other Arduino also having 16 general purpose analog and digital input & output pins with 64KB SRAM,4MB ROM. It also consists of with external SPI flash port (SD1, CMD, SD0, and CLK). Works on a 3.3v-5v supply powered by a USB port. NodeMCU has a micro USB jack for data and power purposes with an I to C interface in it. Apart from this NodeMCU has a full TCP/IP stack and it works like a microcontroller rather than this it consumes it has low power consumption with a combination of several technologies. Node MCU having 3 different power-saving modes for long-term working i.e., Active mode, Sleep mode & Deep-sleep mode. ESP 8266 Has a wide operating range. Apart from this ESP8266 Wi-Fi module is a self-contained SOC with TCP/IP protocol stack that gives any microcontroller access to your Wi-Fi network with radio consist of a 2.4 GHz receiver, 2.4GHz transmitter, high-speed clock generator, and crystal oscillator it also includes real-time clock bias and regulator with power management system 2.4 GHz receiver down-converts the radio frequency signal to quadrature baseband signals and converts them to the digital domain with 2 high-resolution analog to digital converters, And also The 2.4GHz transmitter up-converts the quadrature baseband signals to 2.4GHz, and drives the antenna with a high powered CMOS power amplifier. +19.5dBm average power for 802.11b transmission and +16dBm for 802.11n transmission by use of digital calibration to improve the linearity of the power amplifier.

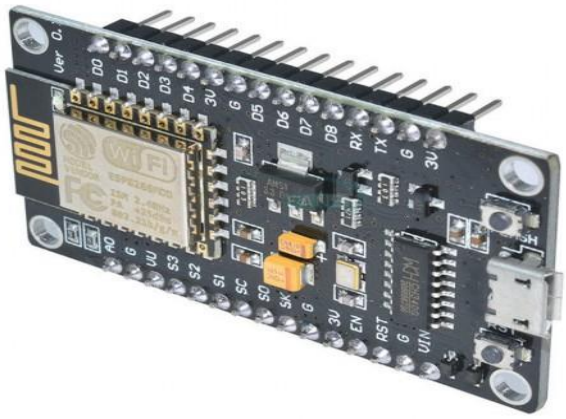
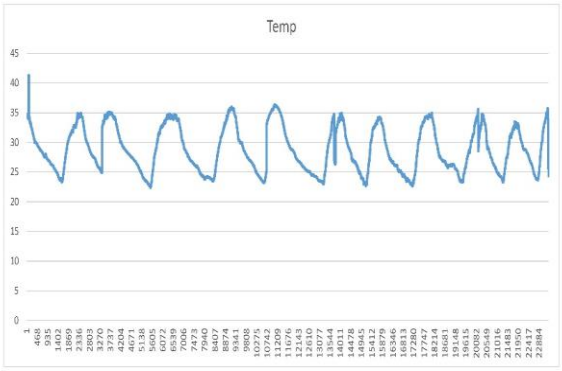


Figure 3. NodeMCU (ESP8266)

1.2.3. MQTT Protocol: - MQTT stands for Message Queuing Telemetry Transport, it is a lightweight messaging protocol developed by IBM. This protocol runs on TCP/IP nonetheless any network protocol that provides ordered, lossless, bi-directional connections can support MQTT. Generally, it is used for data exchange between constrained devices and applications related to servers, for sending high volumes of sensor messages to the cloud platform and analytics platform MQTT is widely used. It is a machine-to-machine protocol. In our system we used this protocol to send the moisture sensor data to the cloud platform so that farmers can access it any time y simply click on the app, it reduces efforts of mounting display and related circuitry. We monitor that data on the mobile application, and any device that can access the internet.

We access that data on thing speak application by using MQTT protocol are as follows:

It shows soil moisture, soil temperature in the form of a graph which shows current reading and previous reading as well. By using this type of system we stored near about 72000 values of moisture and temperature using MQTT (Message Queuing Telemetry Transport) protocol. In case the sensors wire is misplaced it shows sudden pea in reading so by observing the graph we can understand that there is a connection problem between the sensor and ESP8266



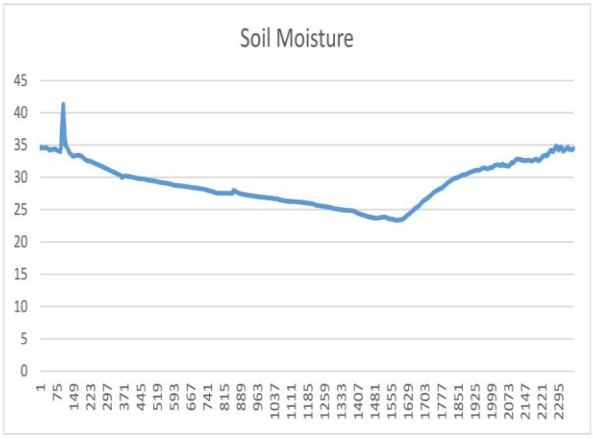


Figure 4. Soil temperature and moisture graph using ThingSpeak

2. Soil Monitoring System: - We developed a system which monitors Soil moisture, temperature, and soil pH simultaneously it gives reading on display and also shows a graph of previous data plus current data it gets updated after every 30 minutes. The system we have developed is given below which is its initial stages.

Figure 5. Field mounted system

3. CONCLUSIONS

By developing this proposed system, the result of this soil moisture measurement can be applied in the real world. By using this project the desired situation can be forecasted in farming as well as an irrigation system. Using this model students can handshake with real-life application and they can understand the working of moisture sensor, LCD display with Arduino.

Students are going to know the actual control behind the process and this project help in compensating the gap between theory and practical.

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