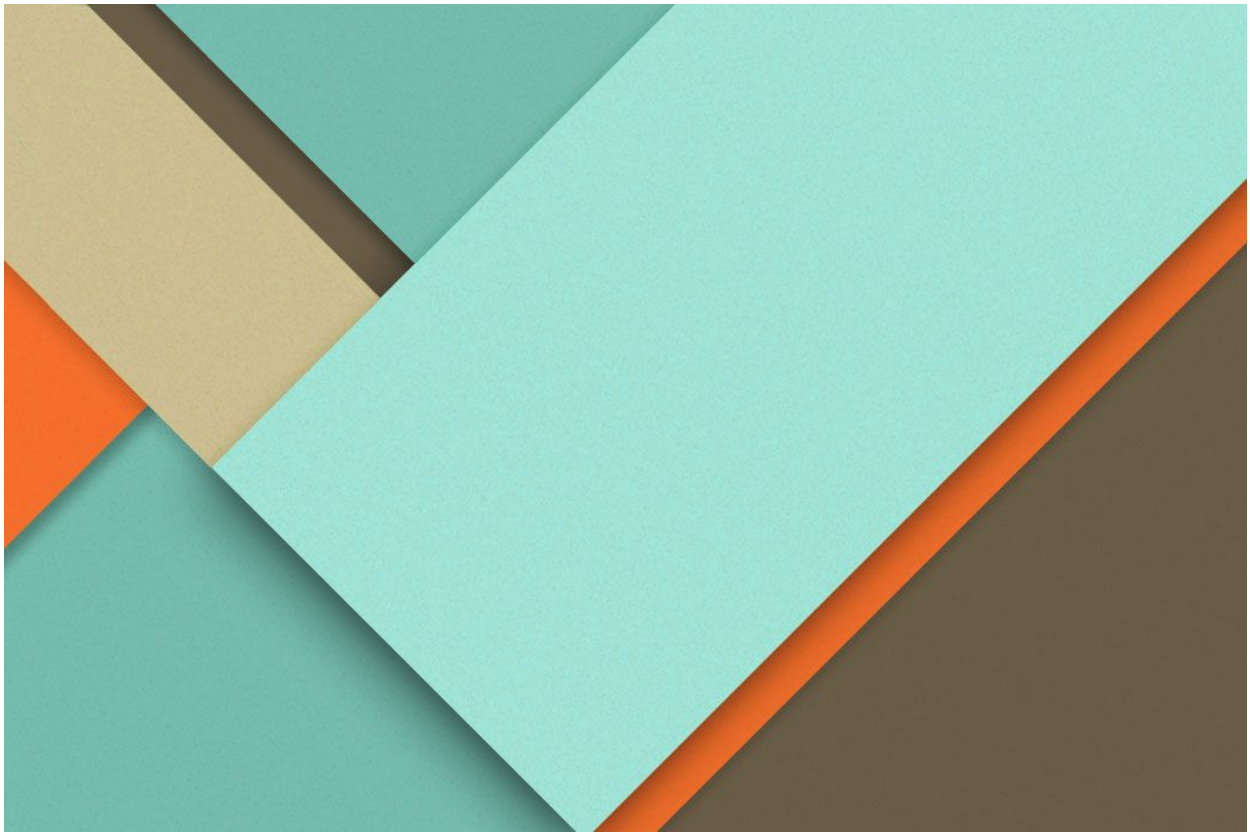

Soil Moisture Sensing

Team 37

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Developers Project Document

Problem Statement

To measure and monitor the soil moisture conditions around a plant that is watered regularly and the soil away from it to understand the variations spatially.

Purpose of the System

The purpose of this system is to collect and analyse the soil moisture data and to provide some useful insights.

1. The data can be used to water the plants/ trees efficiently.
2. If we need to plant some flowers/plants, then by analysing the moisture readings we can predict which flowers will be suitable under this water condition.
3. If the water content of the soil is low then dust particles escape the soil and affect the air quality. So we can prevent this by watering when required.
4. By collecting data over different areas, we can analyze the soil moisture data at different distances from the trees.

Overview of the System

The system basically consists of a MCU collecting soil moisture data via 4 sensors and sending it to server. There the data can be analyzed and operated on.

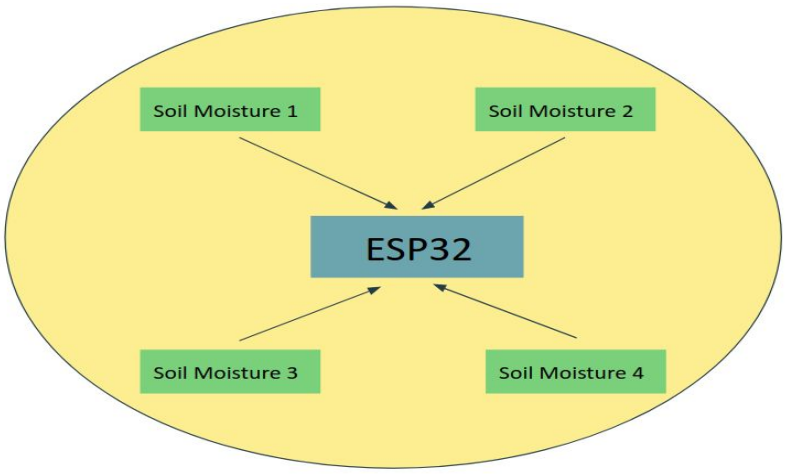


Fig.Showing the MCU and sensors

System Requirements

The system specifications include -:

I. An ESP32 board

For the purpose of this project a micro-controller board is required having at least 4 analog input pins and wifi connectivity. Hence ESP32 board is used.

II. Soil Moisture Sensors

Soil Moisture Sensor seno-0114 was used for measuring soil moisture.Almost all the sensors will suffer from corrosion when exposed to the media which it is supposed to sense, in the particular case of the soil moisture sensors, the water plus other compounds present in the soil, can corrode the electrodes, at some point affecting the measurements and/or the operational lifespan of the device itself. To prevent this the sensor has a fine layer of gold to minimize corrosion also we can stop power to the sensor when is not used and instead of constantly taking inputs, take input after a time interval so as to minimize oxidation.

III. A Power Source

The MCU requires a 5V constant power supply.

IV. Wifi Connection

A wifi connection is required to connect to the ONEM2M server and send the sensor outputs, so that the data can be analyzed

V. Onem2m Server

The ONEM2M server hosted by IIIT is used to get the data from the MCU via WIFI.

VI. Enclosure

Water and dust proof enclosure is used to protect our circuit from rain and dust.

Stakeholders

College Administration

The data from the sensors can be used by the college administration to control the watering of plants and this can also be used by some labs for research work.

Design Entities

Main components of our project are -:

ESP32

The sensors are connected to this board and MCU is connected to ONEM2M server via WIFI connection, the board collects data from the sensors on a specific interval and sends it to onem2m server.

Soil Moisture Sensor

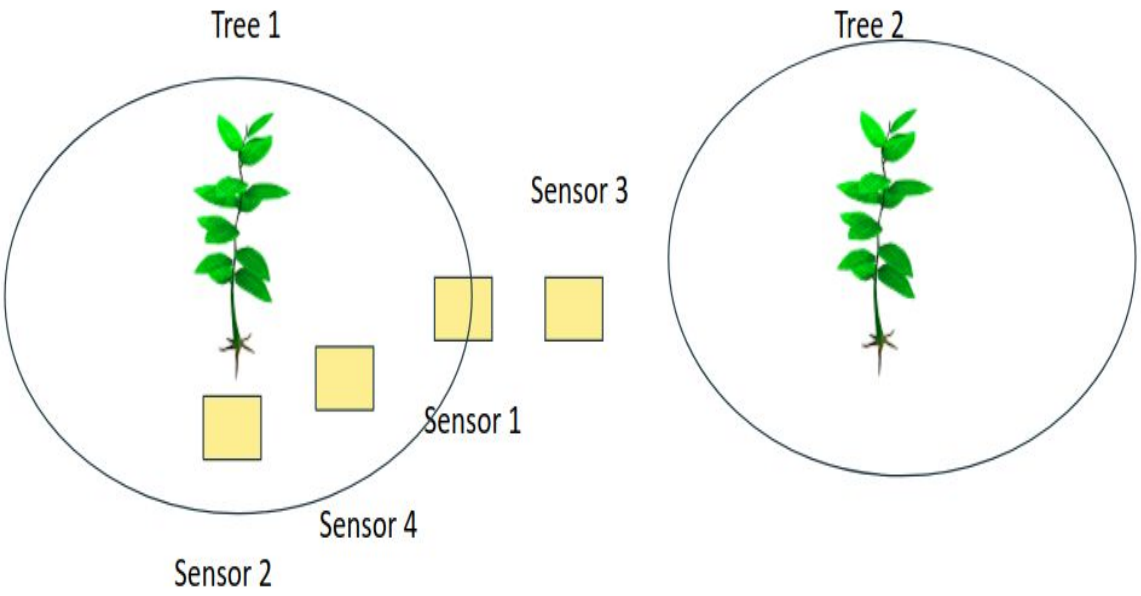
Soil Moisture Sensor seno-0114 was used for measuring soil moisture.Almost all the sensors will suffer from corrosion when exposed to the media which it is supposed to sense, in the particular case of the soil moisture sensors, the water plus other compounds present in the soil, can corrode the electrodes, at some point affecting the measurements and/or the operational lifespan of the device itself. To prevent this the sensor has a fine layer of gold to minimize corrosion also we can stop power to the sensor when is not used and instead of constantly taking inputs, take input after a time interval so as to minimize oxidation.

Onem2m Server

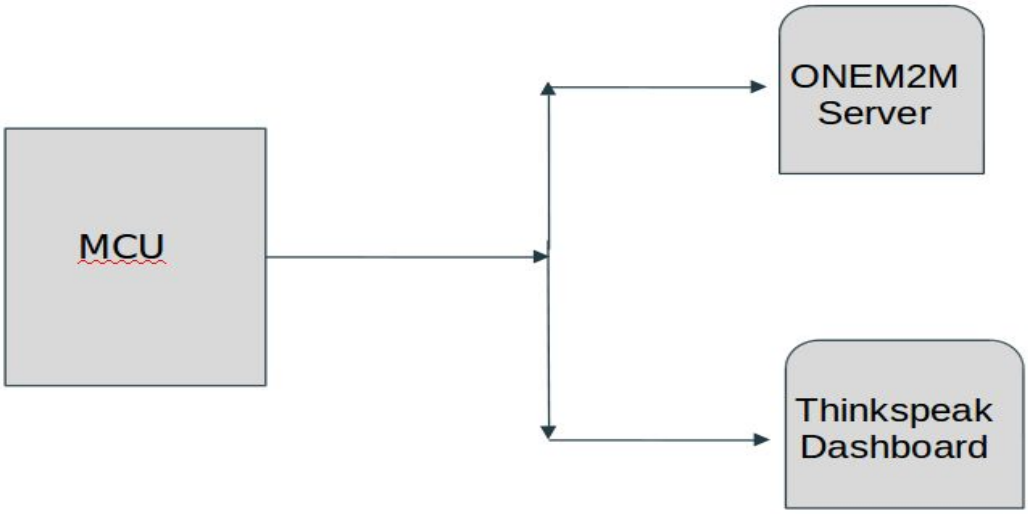
The ONEM2M server hosted by IIIT is used to get the data from the MCU via WIFI.

Design Details

Conceptual Flow



As shown in the above diagram sensors are deployed near the plants/trees and away from them.



Entity Interaction

Sensors senses the soil moisturel and sends the measured value to esp32 board. ESP32 reads the data of sensors from Analog read Pins and then sends the data to server in the form of a string containing 4 values which represents the values of soil moisture measured by four different soil moisture sensors respectively.

Operational Requirements

System Needs

The basic system requirements include MCU, 4 soil moisture sensors, a power source, onem2m server and a WIFI connection. As the project is deployed outside a strong enclosure is also required so as to protect the System components from the outside environment(rain, dust etc).

UI Design & Analytical System

Graphical Analysis is done on Thingspeak by sending data from board to it.

User or Operational Document

Objective

To measure and monitor the soil moisture conditions around a plant that is watered regularly and the soil away from it to understand the variations spatially.

Scope

The data will be used to water the plants efficiently.

By analysing moisture readings, we can predict which flowers will be suitable under this water condition.

If the water content of the soil is low then dust particles escape the soil and affect the air quality. So we can prevent this by watering when required.

Product Operational Requirements

Operational Environment

Arduino IDE

The Arduino Integrated Development Environment (IDE) is a cross platform application that is written in functions from C and C++ to write and upload programs to Arduino compatible boards.

ESP32

ESP32 is a series of low-cost, low-power system on a chip microcontrollers with integrated Wifi and dual-mode Bluetooth

Sensors

Soil Moisture Sensor seno-0114 was used for measuring soil moisture.Almost all the sensors will suffer from corrosion when exposed to the media which it is supposed to sense, in the particular case of the soil moisture sensors, the water plus other compounds present in the soil, can corrode the electrodes, at some point affecting the measurements and/or the operational lifespan of the device itself. To prevent this the sensor has a fine

layer of gold to minimize corrosion also we can stop power to the sensor when is not used and instead of constantly taking inputs, take input after a time interval so as to minimize oxidation.

Server

OneM2M Server hosted by IIITH connected to ESP32 board through Wifi

Power

5V power supply through AC/DC Adapter

Dashboard

Graph Analysis on ThingSpeak.

Two graphs are made, one calibrated in Moisture Unit and other in percentage.

System Working Model

Base State

1. 24/7 electricity: This is a major requirement. However, given the fact that 24*7 power is not always available, it is recommended to connect the mains to a power bank and then further connect that power bank to the esp board. This will help ensure backup power in case of power cuts.
2. Wifi : This is another major requirement owing to the sheer amount of data exchange that is taking place between the board, server , onem2m , bot and sparky.

Working State

The easiest way to ensure that the circuit is working as expected is to use the notification system, or simulate soil moisture conditions by watering the soil. If it is working, the user should be able to see the peak in the graph.

IOT Project Component

Hardware Specifications

Sensor Used

Soil Moisture Sensor seno-0114

Specifications of Sensor

- Power supply: 3.3v or 5v
- Output voltage signal: 0~4.2v
- Current: 35mA
- Pin definition:
    - Analog output(Blue wire)
    - GND(Black wire)
    - Power(Red wire)
- Size: 60x20x5mm
- Value range:
    - 0 ~300 : dry soil
    - 300~700 : humid soil
    - 700~950 : in water

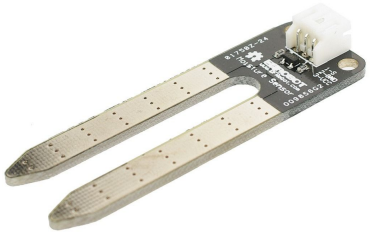


Fig.Soil Moisture Sensor

Microcontroller Used

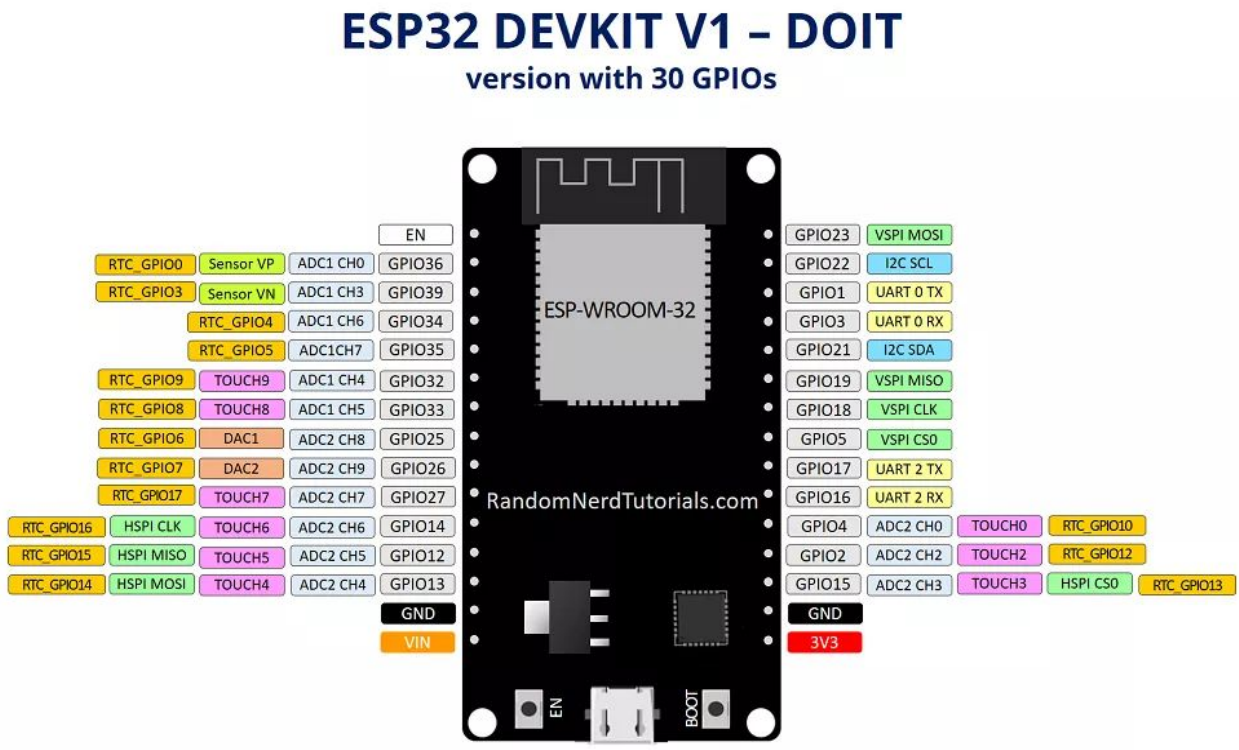
ESP32 is a series of low-cost, low-power system on a chip microcontrollers with integrated Wifi and dual-mode Bluetooth.

Fig.ESP32 Board

Specifications of Board

Specifications - ESP32 DEVKIT V1 DOIT	
Number of cores	2 (Dual core)
Wi-Fi	2.4 GHz up to 150 Mbit/s
Bluetooth	BLE (Bluetooth Low Energy) and legacy Bluetooth
Architecture	32 bits
Clock frequency	Up to 240 MHz
RAM	512 KB
Pins	30
Peripherals	Capacitive touch, ADCs (analog-to-digital converter), DACs (digital-to-analog converter), I^2C (Inter-Integrated Circuit), UART (universal asynchronous receiver/transmitter), CAN 2.0 (Controller Area Network), SPI (Serial Peripheral Interface), I^2S (Integrated Inter-IC Sound), RMII (Reduced Media-Independent Interface), PWM (pulse width modulation), and more.

Pinout Guide



Communication

Soil Moisture Sensor senses the moisture of soil and sends the measured value to esp32 board. ESP32 reads the data of sensors from Analog read Pins and then sends the data to server in the form of a string containing 4 values which represents the values of soil moisture measured by four different soil moisture sensors respectively.

Software Specifications

Arduino IDE

Arduino IDE was used to compile code for operating and reading values measured from sensor.

Thingspeak

Data from board is sent to Thingspeak where a visualization of data(Soil Moisture vs time) is shown through graphs.

Onem2m

Data from board is also sent on onem2m server provided by IIIT.

Data Handling Model

Four sensors are deployed at various distances from a tree and at various depths to analyze the soil moisture data at various positions. First sensor was deployed at the boundary of the tree, second sensor deep inside the roots of the tree, third sensor in the space between two trees and fourth sensor midway between roots and boundary of the tree. Then data can be analyzed like what is the value of soil moisture at various positions in the soil like soil moisture is expected to be higher deep inside the roots of the tree and less in the space between the trees.

Integration Framework

ESP32 board has inbuilt wifi connectivity. The data measured by MCU is sent to onem2m server and Thingspeak using WIFI connection provided by IIIT.

Data Visualization

We are sending data measured from sensor on Thingspeak from our ESP32 board where we are showing the data in the form of the graph (Soil Moisture VS time) for all sensors