IOT Based Automatic Weather Station for Smart Agriculture

Project Report submitted in partial fulfilment of the requirements for the Degree of

BACHELOR OF TECHNOLOGY

In

ELECTRONICS AND COMMUNICATION ENGINEERING

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FUTURE INSTITUTE OF TECHNOLOGY

2022

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

FUTURE INSTITUTE OF TECHNOLOGY

KOLKATA-700154

2022

CERTIFICATE

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The matter presented in this thesis has not been submitted for the award of any other degree of this or any other Institute/University.

I wish them all success in life.

Date:

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ACKNOWLEDGEMENT

I would like to express our special thanks of gratitude to my Co-workers, Mentor as well as Head of the Department, Prof. Amit Kumar Majumdar, who gave me the golden opportunity to be a part of this wonderful project on the topic IoT based Weather Station application for helping Agriculture System ,which also helped me in doing a lot of Research and I came to know about so many new technologies.

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DATE:

PLACE: Garia, Kolkata

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Gunjan Das Chowdhury (University Roll No.: 34200318029)

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ABSTRACT

Automatic weather station is an automated version of the traditional weather station, either to save human labor or to enable measurements from remote areas.It typically consists of a weather-proof enclosure containing the data logger, rechargeable battery and sensors. The system may report in several different ways. It uses high accuracy sensors for the measurement of wind speed, wind direction, air temperature, humidity, rainfall, soil moisture, and other parameters. The IOT based Weather Monitoring and Reporting System project is used to get Live reporting of weather conditions. It will Monitor temperature, humidity, moisture and rain level. Suppose Scientists/nature analysts want to monitor changes in a particular environment like volcano or a rain-forest. And these people are from different places in the world. In this case, SMS based weather monitoring system has some limitations. Since it sends SMS to few numbers. And time for sending SMS increases as the number of mobile numbers increases. In order to know the information about weather of a perticular place then they have to visit that particular sites. Where everyone can see it.

Chapter-1

INTRODUCTION

Climatic change and environmental monitoring have received much attention recently. Man wants to stay updated about the latest weather conditions of any place like a college campus or any other particular building. Since the world is changing so fast so there should be the weather stations. Here in this report we present a weather station that is very helpful for agriculture as well as any other fields. This weather station is based on IOT (internet of things). It is equipped with environmental sensors used for measurements at any particular place and report them in real time on cloud. To accomplish this we used Node MCU and different environmental sensors like DHT11, soil moisture sensor and rain drop sensor.The sensors constantly sense the weather parameters and keeps on transmitting it to the online web server over a Wi-Fi connection. The weather parameters are uploaded on the cloud and then provides the live reporting of weather information

Chapter-2

STUDY OF SENSORS

2.1 TEMPERATURE SENSORS:

2.1.1 *DHT11*

2.1.1.1 Features

- The temperature range of DHT11 is from 0 to 50 degree Celsius with a 2-degree accuracy.
- Humidity range of this sensor is from 20 to 80% with 5% accuracy.
- The sampling rate of this sensor is 1Hz .i.e. it gives one reading for every second.
- DHT11 is small in size with operating voltage from 3 to 5 volts.
- The maximum current used while measuring is 2.5mA.

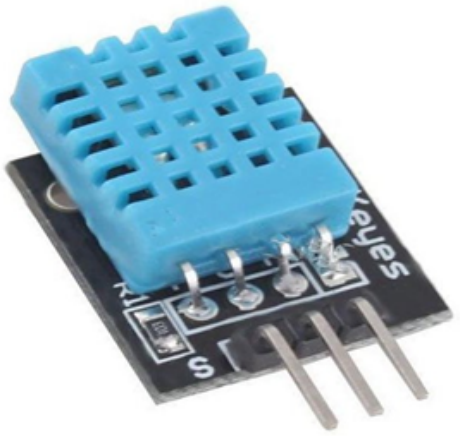


Figure 2.1.1

2.1.1.2 Working Principle

- DHT11 sensor consists of a capacitive humidity sensing element. The humidity sensing capacitor has two electrodes with a moisture holding substrate as a dielectric between them. Change in the capacitance value occurs with the change in humidity levels. The IC measure, process this changed resistance values and change them into digital form.
- For measuring temperature this sensor uses a Negative Temperature coefficient thermistor, which causes a decrease in its resistance value with increase in temperature. To get larger resistance value even for the smallest change in temperature, this sensor is usually made up of semiconductor ceramics or polymers.

2.1.1.3 PinOut

- DHT11 sensor has four pins- VCC, GND, Data Pin and a not connected pin. A pull-up resistor of 5k to 10k ohms is provided for communication between sensor and microcontroller.

2.1.2 *DHT22*

2.1.2.1 Features

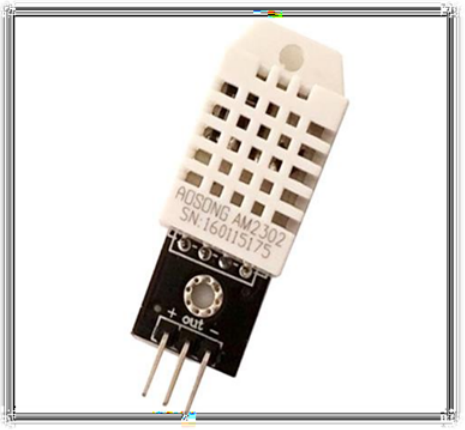


Figure 2.1.2

- Good for 0-100% humidity readings with 2-5% accuracy
- Good for -40 to 80°C temperature readings ±0.5°C accuracy
- DHT22 is small in size with operating voltage from 3 to 5 volts.
- The maximum current used while measuring is 2.5mA.
- The sampling rate of this sensor is 0.5Hz .i.e. it gives one reading for every two seconds.

2.1.2.2 Working Principle

- The DHT22 uses a capacitive humidity sensor.
- It uses a thermistor to measure the surrounding air temperature.
- It spits out a digital signal on the data pin (no analog input pins needed).

2.1.2.3 PinOut

- DHT22 sensor has four pins- VCC, GND, Data Pin and a not connected pin. A pull-up resistor of 4.7k to 10k ohms is provided for communication between sensor and micro- controller.

2.2PRESSURE SENSORS:

2.2.1 BMP180

2.2.1.1 Features

- The BMP180 sensor is mainly used to measure atmospheric pressure or biometric pressure
- High relative accuracy of ±0.12hPa
- Sampling speed: 3.4 MHz
- Pressure conversion time: 5msec

Figure 2.2.1

2.2.1.2 Working Principle

- It measures pressure with a barometric sensor.

2.2.1.3 PinOuts

Pin	Description
VCC	5V
GND	Connected to Ground
SDA	Serial Data pin (I2C interface)
SCL	Serial Clock pin (I2C interface)

2.2.2 BMP280

2.2.2.1 Features

- It has measuring range from 300 to 1100 HPa with an accuracy of 0.02HP

➢ BMP280 consists of IIR filter which will help in to minimize the disturbance in the signal the filter coefficient ranges from 0 to 16

2.2.2.2 Working Principle

➢ BMP is known as a barometer original sensor it measures the absolute pressure of the air around it.

Figure 2.2.2

2.2.2.3 PinOut

Pin	Description
VCC	5V
GND	Connected to Ground
SDA	Serial Data pin (I2C interface)
SCL	Serial Clock pin (I2C interface)

2.3 MOISTURE SENSORS:

2.3.1 HL69:

2.3.1.1 Features

➢ The sensor has a built-in potentiometer for sensitivity adjustment of the digital output (D0), a power LED and a digital output LED, as you can see in the following figure.

➢ The output can be a analog signal and so you'll get a value between 0 and 1023..l

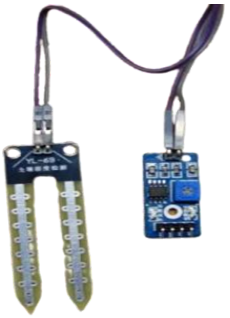


Figure 2.3.1

2.3.1.2 Working Principle

➢ The voltage that the sensor outputs changes accordingly to the water content in the soil.

➢ When the soil is:

- Wet: the output voltage decreases
- Dry: the output voltage increases

➢ The output can be a digital signal (D0) LOW or HIGH, depending on the water content. If the soil humidity exceeds a certain predefined threshold value, the modules outputs LOW, otherwise it outputs HIGH. The threshold value for the digital signal can be adjusted using the potentiometer.

2.3.1.3 PinOut

Pin	Description
A0	Analog Pin
D0	Digital Pin
GND	Ground
VCC	5V DC

2.3.2 Grove -Capacitive Soil Moisture Sensor

2.3.2.1 Feartures

➢ Capacitive Style
➢ Corrosion Resistant
➢ Built-in Amplifier

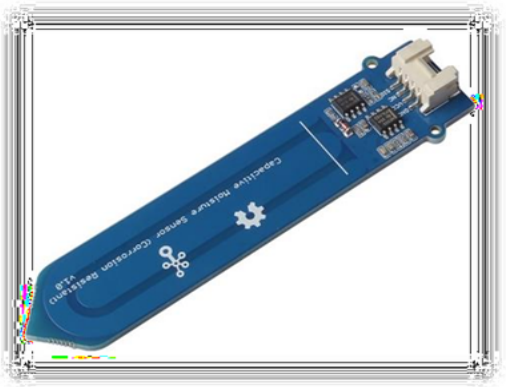


Figure 2.3.2

2.3.2.2 Working Principle:

➢ capacitive moisture sensor works by measuring the changes in capacitance caused by the changes in the Dieletric. It does not measure moisture directly (pure water does not conduct electricity well), instead it measures the ions that are dissolved in the moisture These ions and their concentration can be affected by a number of factors, for example adding fertilizer for instance will decrease the resistance of the soil. Capacitive measuring basically measures the dielectric that is formed by the soil and the water is the most important factor that affects the dielectric.

2.3.2.3 PinOut:

Pin	Description
VCC	+5V
GND	Ground
NC	Not connected to any pin
A0	Analog Output Pin

2.4 WIND SPEED & DIRECTION SENSORS:

2.4.1 *Cup anemometers*

2.4.1.1 Features

- Voltage Required: 7-24v DC
- Output: 0.4V to 2V
- Testing Range: 0.5m/s to 50m/s
- Start wind speed: 0.2 m/s
- Resolution: 0.1m/s
- Accuracy: Worst case 1 meter/s
- Max Wind Speed: 70m/s

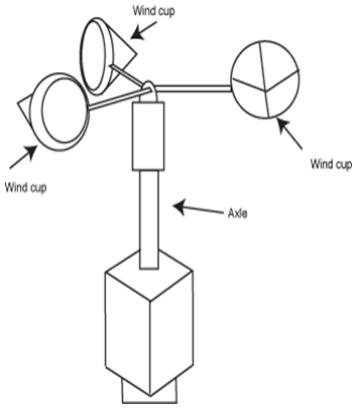


Figure 2.4.1

2.4.1.2 Working Principle

- The cup-type anemometer consists of 3 hemispherical cups mounted on horizontal arms, which were mounted on a vertical shaft. The airflow past the cups in any horizontal direction turned the shaft at a rate that was roughly proportional to the wind speed. Therefore, counting the turns of the shaft over a set time interval produced a value proportional to the average wind speed for a wide range of speeds.

2.4.1.3 PinOut

- Pin 1 – Power
- Pin 2 – Ground
- Pin 3 – Signal

2.4.2 *Vane anemometers*

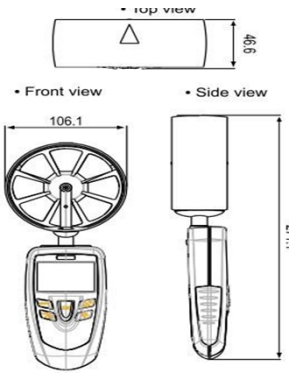


Figure 2.4.2

2.4.2.1 Features

- A Vane Anemometer is a type of wind meter that measures wind velocity and volumetric flow.Generally, they are small handheld devices comprising a turbine and a digital screen.The turbine (often referred to as a propeller, impeller or fan) can either be built into the device or supplied as a separate sensor plugin.

2.4.2.2 Working Principle

- Vane Anemometers work on the principle that a freely spinning turbine will rotate at a speed that is directly proportional to the wind speed.With a quick calibration, a device can then display a wind speed measurement.You measure wind velocity by first facing your Vane Anemometer towards the source of the wind.Wind speed is usually calculated on a vane anemometer by a rev counter on the wind turbine unit. If the cross-sectional area is known, you can use this to calculate volumetric flow.

2.4.2.3 PinOut

- Vane Anemometer is a complete unit with output display, so it doesn‘t require an additional MCU, so it doesn‘t have any external pin to connect.

2.4.3 *Hot-wire anemometers*

2.4.3.1 Features

- The hot-wire anemometer sensor is a very fine wire with a diameter of a few micrometers and length of a few millimeter
- Thiswireis connected to a measurement bridge and an electrical current is fed through the wire.

➢ The wire is heated to a temperature above the air temperature and the air velocity is determined by the cooling effect of the wire.

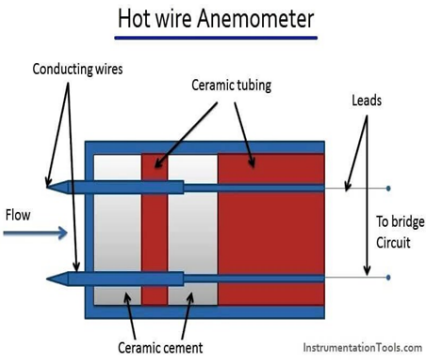


Figure 2.4.3

2.4.3.2 Working Principle

➢ The basic principle of hot-wire anemometer is a thin metal wire line in a fluid, through the current heating wire (hot wire), make its temperature is higher than the temperature of the fluid, when the fluid flows through the wire along vertical direction, will take away part of the wire heat are introduced to make wire temperature drop.

➢ The heats dissipating capacity is related to velocity, hot wire temperature change caused by the resistance resulting from heat dissipating capacity of the velocity signal into electrical signal.

2.4.3.3 Pinout

➢ As it is a complete unit, it doesn‘t require any external data passing. So it doesn‘t have any pin diagram.

2.5 Soil pH Sensor

2.5.1 *Gravity Analog pH Sensor*

2.5.1.1 Features

➢ SupplyVoltage: 3.3~5.5V
➢ 33BNC Probe Connector
➢ High Accuracy: ±0.1@25°C
➢ Detection Range: 0~14
➢ Operating Temperature Range: 5~60°C
➢ Zero (Neutral) Point: 7±0.5
➢ Easy calibration
➢ Internal Resistance: <250MΩ

2.5.1.2 Working Principle

➢ A small charge is placed on the electrodes and electrical resistance through the sensor is measured. As water is used by plants or as the soil moisture decreases, water is drawn from the sensor and resistance increases. Conversely, as soil moisture increases, resistance decreases.

Figure 2.5.1

2.5.1.3 PinOut

Pin	Description
VCC	5V DC
GND	Ground
Analog Data	Output

Chapter-3

STUDY OF IOT

The Internet of things (IoT) describes physical objects (or groups of such objects) that are embedded with sensors, processing ability, software, and other technologies that connect and exchange data with other devices and systems over the Internet or other communications networks.

3.1 Classification of IoT

Internet of Things can be classified in versatile categories. The categories are based on Users, Network, Communication Medium, Data Storage, Input types, Platform, Job etc.

3.1.1 Users: Internet of Things has huge users all over the world. People from all places use it for different purpose. With respect to Users we can classify Internet of Things in three types.

- *Individual*: IoT have captured all the world with it‘s applications. People get help from IoT in their daily life. They use it for making their work easier.
- *Enterprise*: Businesses use it to simplify their jobs in real life. They manage data, monitor jobs and so many other things.
- *Industrial:* Industries use IoT in their most jobs.

3.1.2 Platform: Based on platform, It can be classified into five different types.

- *Connectivity Management:* IoT Connectivity Management platforms are, as the name suggests, centred around the networking component of IoT systems. They provide users with the software, connectivity hardware, and data directing necessary for keeping your devices online. Their networks generally rely on existing carrier services and Wi-Fi, configuring the connection in a way that allows for easy IoT setup
- *Device Management*: IoT Device management platforms specialise in the grunt work involved with IoT devices. They ensure that everything is connected and secure, and keep you updated on the status of your devices. Device management platforms update the firmware, notify you of changes in your devices, report metrics, and patch security. This kind of IoT platform will help

you with the routine tasks associated with your devices, no matter how many you have.

- *Cloud:* IoT Cloud platforms provide users with the infrastructure required to create a cohesive IoT system. They're a central location for all of your backend processes and data to exist and operate. One of the biggest benefits of cloud platforms is their scalability; regardless of how small you start; a cloud platform can grow with you and your IoT system.
- *Application Enablement*: IoT Application enablement platforms are a one-size-fits-all approach that offers users everything they need to get an IoT system off the ground. They provide you with the devices, software, development, and deployment of IoT systems. They're a one-stop-shop for kickstarting your system, saving you from having to manage developers, network configuration, and hardware engineering yourself.
- *Advanced Analytics:* IoT Advanced analytics platforms are a great solution for data-driven IoT systems. Users looking for sophisticated IoT systems that utilise machine learning, artificial intelligence, statistical modelling, and mass data harvesting can use this kind of platform to interpret and act upon the gathered data. IoT systems that primarily work to ingest data, rather than perform tasks, will benefit the most from these platforms.

3.1.3 Network: Based on network, IoT can be categorized into four types.

- *Cellular:* Cellular networks use the same mobile networks as smartphones to allow IoT devices to communicate. Because these networks were originally designed for power-hungry devices like smartphones, they weren‘t always considered the best fit for IoT devices. Eventually, the cellular industry developed new technologies that were more appropriate for IoT use cases. Today, this type of wireless network is very popular, and is considered a reliable and secure method of IoT connectivity.
- *Local and Personal Area Networks (LAN/PAN):* Networks that cover fairly short distances are called personal area networks (PAN) and local area networks (LAN). PAN and LAN networks are considered to be fairly cost-effective, but the transfer of data can sometimes be unreliable.Wireless personal and local area network technologies that are commonly incorporated into IoT connectivity solutions are WiFi and Bluetooth. WiFi can be used for applications that run in a local environment, or in a distributed setting if there are multiple access points integrated into a larger network. One downside to WiFi is that it works only if the signal is strong and you‘re close to the access point. Also, WiFi is generally more power-hungry than people think, but it is possible to operate it in a way that‘s a little more power-efficient (for example, your device only connects periodically to send data, then goes back to sleep).

  Bluetooth Low Energy (BLE*)* is a more energy-efficient wireless network protocol—if you‘re not receiving data constantly, a single battery running BLE

could last up to five years. However, compared to WiFi it is slower to transmit and is more limited in the amount of data it is capable of sending. Both WiFi and Bluetooth are easy to connect in most cases, although WiFi does have some security challenges that may be difficult to overcome.

- *Low Power Wide Area Networks (LPWAN):* IoT devices that run on LPWANs send small packets of information infrequently and over long distances. This type of wireless network was developed in response to the early challenges of cellular connectivity. Proponents of LPWAN position it as longer-range than WiFi and Bluetooth, but using less power than cellular.
- *Mesh Networks*: Mesh networks are best described by their connectivity configuration—how the components communicate with each other. In mesh networks, all the sensor nodes cooperate to distribute data amongst each other to reach the gateway. (A star topology, in contrast, is where all sensor nodes communicate to a central hub.)

3.1.4 Communication Medium: Communication in IoT can be divided into two part.

- Wired Communication
- Wireless Communication

3.1.5 Data Storage: Based on storing the IoT application, it can be differentiated into two types.

- On Premise
- Off Premise

3.1.6 Input Type: For an IoT application, data can be of two type-

Historical Data and Real Time Data.Likewise, sources for above data, types of data is different.

3.1.7 Stored Data Input: This kind of data are stored in some storage unit(Cloud, Hard Drive etc.)

3.1.8 Real Time Data Input: This kind of data collected in real time from different sensors.

3.2 STUDY OF WIFI MODULES:

3.2.1 ESP8266

The ESP8266 is a really useful, cheap WiFi module for controlling devices over the Internet. It can work with a micro-controller like the Arduino or it can be programmed to work on its own.

3.2.1.1 Features

- It supports the 802.11 b/g/n protocol.
- It can connect to your router and work as a client or it can be an access point itself or both.
- It is IP addressable and can be a Web Server.
- The ―standard‖ version has 2 digital pins that can be used for input or output.E.g. to drive LED‘s or relays. These pins can also be used for PWM. Other versions have more pins exposed. For example the ESP-12, which is a good option if you need more pins. Either way the programming is still the same.
- Analog input is also available on the ESP8266 chip (ADC/TOUT) but it‘s not wired up on the ESP-01.
- It can be combined with an Arduino or it can be programmed to work on its own.
- There are various tools and development environments (IDE‘s) to program it.
- It is also available as an integrated Wi-Fi module with nodeMCU.

3.2.1.2 PinOuts

3.2.1.1.1	RX
3.2.1.1.2	VCC
3.2.1.1.3	GPIO0
3.2.1.1.4	RESET
3.2.1.1.5	CH_PD
3.2.1.1.6	GPIO 2
3.2.1.1.7	TX
3.2.1.1.8	GND

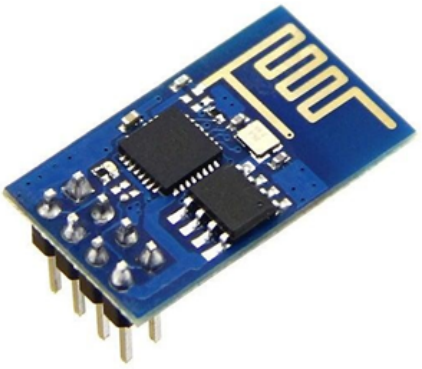


Figure 3.2.1

3.2.2 ESP32:

ESP32 is a series of low-cost, low-power system on a chip microcontrollers with integrated Wi-Fi and dual-mode Bluetooth. The ESP32 series employs either a Tensilica Xtensa LX6 microprocessor in both dual-core and single-core variations, Xtensa LX7 dual-core microprocessor or a single-core RISC-V microprocessor and includes built-in antenna switches, RF balun, power amplifier, low-noise receive amplifier, filters, and power-management modules. ESP32 is created and developed by Espressif Systems, a Shanghai-based Chinese company, and is manufactured by TSMC using their 40 nm process. It is a successor to the ESP8266 microcontroller.

3.2.2.1 Features

- Processors:
  - CPU: Xtensa dual-core (or single-core) 32-bit LX6 microprocessor, operating at 160 or 240 MHz and performing at up to 600 DMIPS
  - Ultra low power (ULP) co-processor
- Memory: 320 KiB RAM, 448 KiB ROM
- Wireless connectivity:
  - Wi-Fi: 802.11 b/g/n
  - Bluetooth: v4.2 BR/EDR and BLE(shares the radio with Wi-Fi)
- Peripheral interfaces:
  - 34 × programmable GPIOs
  - 12-bit SAR ADC up to 18 channels
  - 2 × 8-bit DACs
  - 10 × touch sensors (capacitive sensing GPIOs)
  - 4 × SPI
  - 2 × I²S interfaces
  - 2 × I²C interfaces
  - 3 × UART
  - SD/SDIO/CE-ATA/MMC/eMMC host controller
  - SDIO/SPI slave controller
  - Ethernet MAC interface with dedicated DMA and planned IEEE 1588 Precision Time Protocol support
  - CAN bus 2.0
  - Infrared remote controller (TX/RX, up to 8 channels)
  - Motor PWM
  - LED PWM (up to 16 channels)
  - Hall effect sensor
  - Ultra low power analog pre-amplifier

Figure 3.2.2

3.2.2.2 PinOuts

3.2.2.2.1 1 RST Reset Pin of the module

3.2.2.2.2 2 ADC Analog Input Pin for 10-bit ADC (0V to1V)
3.2.2.2.3 3 EN Module Enable Pin (Active HIGH)
3.2.2.2.4 4 GPIO16 General Purpose Input Output Pin 16
3.2.2.2.5 5 GPIO14 General Purpose Input Output Pin 14
3.2.2.2.6 6 GPIO12 General Purpose Input Output Pin 12
3.2.2.2.7 7 GPIO13 General Purpose Input Output Pin 13
3.2.2.2.8 8 VDD +3.3V Power Input
3.2.2.2.9 9 CS0 Chip selection Pin of SPI interface
3.2.2.2.10 10 MISO MISO Pin of SPI interface
3.2.2.2.11 11 GPIO9 General Purpose Input Output Pin 9
3.2.2.2.12 12 GPIO10 General Purpose Input Output Pin 10
3.2.2.2.13 13 MOSI MOSI Pin of SPI interface
3.2.2.2.14 14 SCLK Clock Pin of SPI interface
3.2.2.2.15 15 GND Ground Pin
3.2.2.2.16 16 GPIO15 General Purpose Input Output Pin 15
3.2.2.2.17 17 GPIO2 General Purpose Input Output Pin 2
3.2.2.2.18 18 GPIO0 General Purpose Input Output Pin 0
3.2.2.2.19 19 GPIO4 General Purpose Input Output Pin 4
3.2.2.2.20 20 GPIO5 General Purpose Input Output Pin 5
3.2.2.2.21 21 RXD0 UART0 RXD Pin
3.2.2.2.22 22 TXD0 UART0 TXD Pin

3.2 Application of Internet of Things

There are various types of application in IoT.

- **Consumer Application:** A growing portion of IoT devices are created for consumer use, including connected vehicles, home automation, wearable technology, connected health, and appliances with remote monitoring capabilities.
  Example: Smart Home, Elder Care

- **Organizational Application:** IoT allows organizations to replace their manual asset tracking systems with automated sensors. These sensors connect to

the internet with centralized systems for real-time monitoring of company assets. Moreover, IoT shows great promise for taking customer satisfaction to the next level.

Example: Medical and Healthcare, Transportation

- **Industrial Application:** Also known as IIoT, industrial IoT devices acquire and analyze data from connected equipment, operational technology (OT), locations, and people. Combined with operational technology (OT) monitoring devices, IIoT helps regulate and monitor industrial systems. Also, the same implementation can be carried out for automated record updates of asset placement in industrial storage units as the size of the assets can vary from a small screw to the whole motor spare part, and misplacement of such assets can cause a percentile loss of manpower time and money.

  Example: Manufacturing, Agriculture, Maritime

- **Infrastructure Application:** Monitoring and controlling operations of sustainable urban and rural infrastructures like bridges, railway tracks and on- and offshore wind-farms is a key application of the IoT. The IoT infrastructure can be used for monitoring any events or changes in structural conditions that can compromise safety and increase risk. The IoT can benefit the construction industry by cost-saving, time reduction, better quality workday, paperless workflow and increase in productivity. It can help in taking faster decisions and save money with Real-Time Data Analytics. It can also be used for scheduling repair and maintenance activities in an efficient manner, by coordinating tasks between different service providers and users of these facilities. IoT devices can also be used to control critical infrastructure like bridges to provide access to ships. Usage of IoT devices for monitoring and operating infrastructure is likely to improve incident management and emergency response coordination, and quality of service, up-times and reduce costs of operation in all infrastructure related areas. Even areas such as waste management can benefit from automation and optimization that could be brought in by the IoT.
- **Example:** Metropolitan Scale Deployments, Energy Management, Environmental Monitoring

Chapter-4

WORKING PRINCIPAL OF PROJECT

We can divide the project into 3 parts.

- Data Collection from Environment
- Data Store
- Data Fetching

Data Collection from Environment:

We are collecting data from 5 resources.

- Temperature
- Humidity
- Air Pressure
- Air speed
- Soil Moisture
- Soil pH

Data Store:

After getting the data, we need to format the data with proper units. Then we need to store these data in a data storage or a database, for that, we are using thingspeak.

Data Fetching and manipulation:

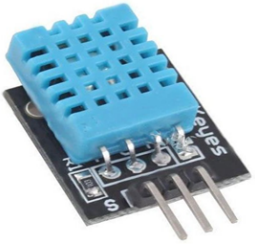
We collect and store data for further utilization. Here we can use these data for analysis,we can also display the data via some display module.

Chapter-5

COMPONENTS SELECTION

5.1 SELECTION OF SENSORS:

5.1.1 Temperature sensor:

		
Sensor Name	**DHT11**	**DHT22**
Measures	Temperature, Humidity	Temperature, Humidity
Temterature Range	0 to 50ºC	-40 to 80ºC
Humidity Range	20-80%	0-100%
Supply Voltage	3 to 5.5V DC	3 to 6V DC
Price	125 INR	519 INR

➢ **We choose DHT11 over other ones**

5.1.2 Soil Moisture Sensor:

		
Sensors	**Capacitive Soil Moisture**	**HL-69**
Measures	Soil Moisture	Soil Moisture
Maintenance	Less	More
Durability	Much Durable	Less Durable(Corrosion occurs)
Price	69 INR	149 INR

➢ **We choose HL-69 over other ones**

5.1.3 Pressure Sensor:

		
Sensors	**BMP180**	**BMP280**
Measures	Temperature, Pressure	Temperature, Pressure
Temperature range	-40-85C	-40-85C
Temperature Accuracy	+/- 1C	+/- 1C
Pressure Range	300-1100 hPa	300-1100 hPa

Pressure Accuracy	+/- 1hPa	+/- 0.12hPa
Price	69 INR	69 INR

➢ **We choose BMP180 over other ones**

5.1.4 Wind Speed & Direction Sensor:

			
Sensors	**Cup Anemometer**	**Vane anemometer**	**Hot-Wire Anemometer**
Measures	It is designed by using 3- 4 cups of cylindrical shape. For measuring wind speed.	The vane anemometer is an instrument designed to measure velocity utilising the kinetic energy of a flow.	Hot Wire anemometers used to measure the direction and velocity of the fluid stream by measuring the heat loss of the wire
Working Principle	The working principle is that cups are attached to the horizontal arms with the help of a vertical rod to rotate around the axis centrally.	Its main element is a vane with blades of different shapes. To measure velocity in the atmosphere, the blades are made in the form of hollow hemispheres with their concavity facing away from the flow	The working principle is based on the change in temperature of the wire, which is from high to low.

➢ **We choose Cup anemometer over other ones**

5.2 SELECTION OF WIFI MODULE:

		
Sensors	**ESP8266**	**ESP32**
Hardware /Software PWM	None/8 channels	None/16 channels
Working temperature	-40C-125C	-40C-125C
Ethernet Mac Interface	❌	✓
Typical Frequency	80MHz	160MHz
Bluetooth	❌	Bluetooth 4.2 and BLE
ADC	10 bit	**12** bit
Price	212 **INR**	395 INR

➢ **We choose ESP 8266 over other one**

Chapter-6

IMPLEMENTATION OF PROJECT

6.1 INTERFACING WITH NODEMCU

6.1.1 DHT11

- Input pin: D0
- Output pin: 3.3V, GND

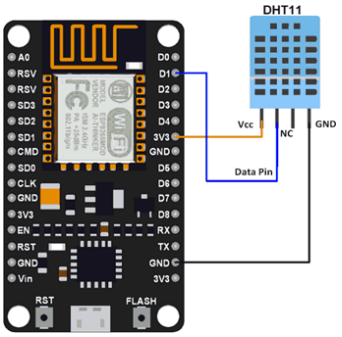


Figure 6.1.1

6.1.2 BMP180

- Input pin: SCL: D1, SDA: D2
- Output pin: 3.3 V, GND

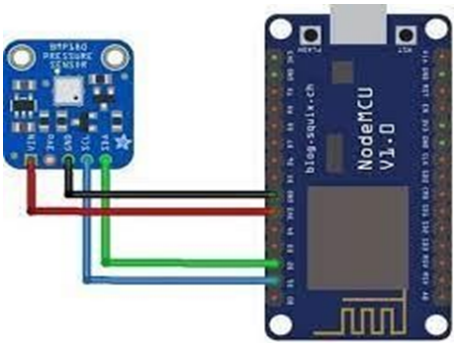


Figure 6.1.2

6.1.3 HL-69

- Input pin: A0
- Output pin: 3.3 V, GND

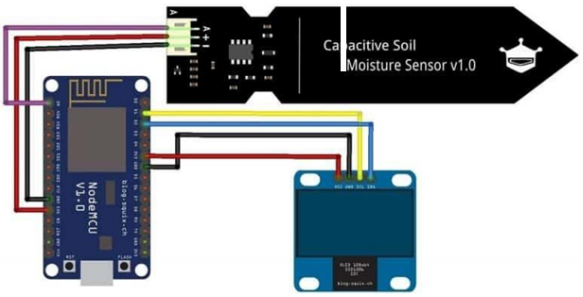


Figure 6.1.3

6.1.4 GRAVITY ANALOG pH SENSOR

- ➢ Input pin: A0
- ➢ Output pin: 5V, GND

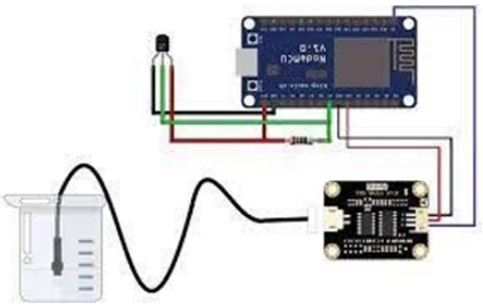


Figure 6.1.4

6.2 OUTPUT

6.2.1 Sample Outputs

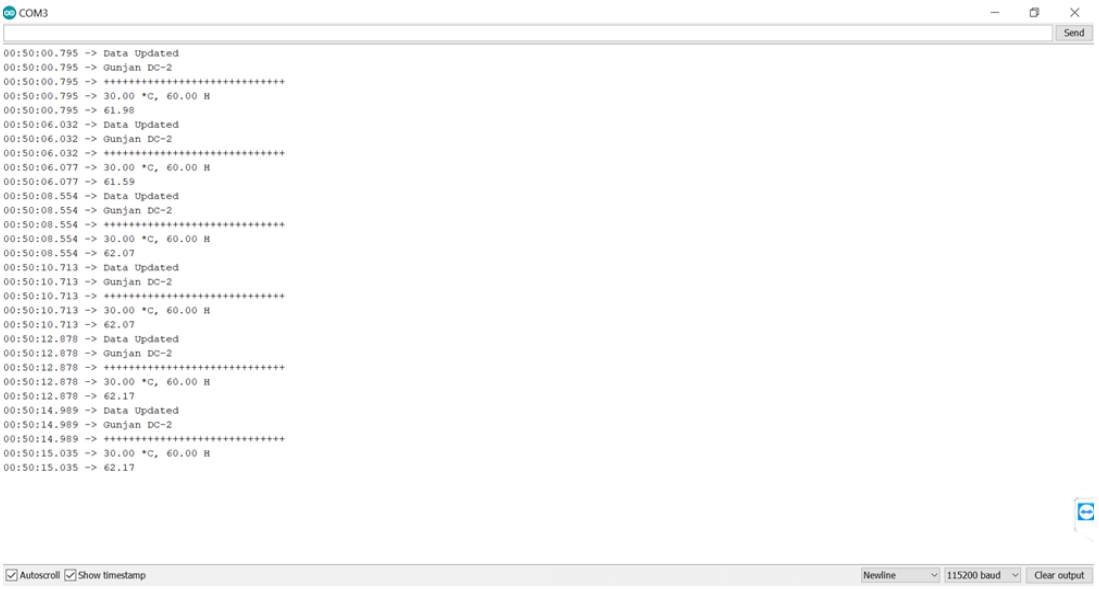


Figure 6.2.1

6.2.2 Model Picture

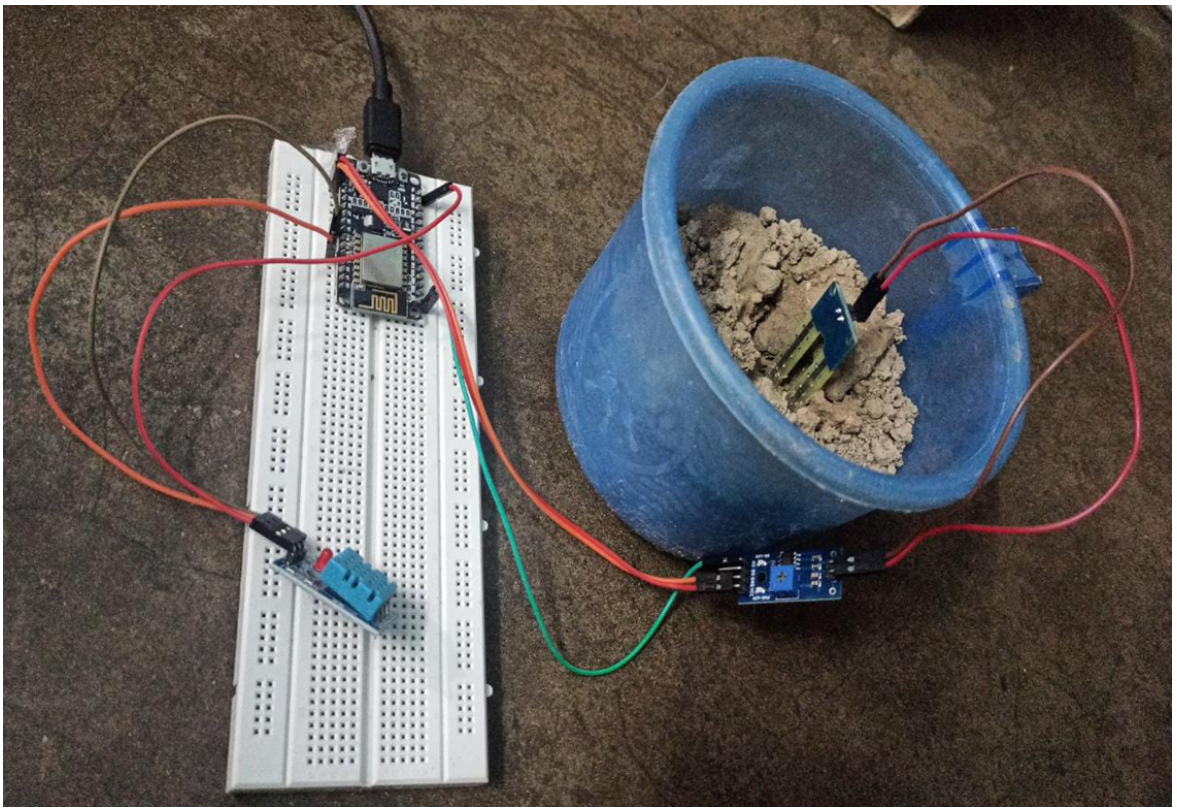


Figure 6.2.2

6.3 PROJECT IMPLEMENTATION SCHEDULE

Topics	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Study on Sensors **1.Temperature** **2. Pressure** **3. Soil Moisture** **4. Humidity** **5. Soil pH** **6. Wind speed and Direction**	✓ ✓ ✓	 ✓ ✓	 ✓ ✓						
Study on IOT		✓	✓						
Study of microcontroller		✓	✓						
Design of Circuits		✓	✓						
Interface the sensors with nodeMCU			✓						
Synopsis Report			✓						
Interfacing with nodeMCU **1. DHT11** **2. BMP180**				 ✓ ✓	 ✓ ✓				
Implementation of Wi-Fi connection					 ✓				

Interfacing with nodeMCU **1. HL 69** **2. Gravity pH Sensor** **3. Cup Anemometer**						✓ ✓	✓ ✓ ✓	 ✓	
Data Collection							✓	✓	
Final Project Report								✓	✓

Chapter-7

MARKET POTENTIAL

India has agriculture based economy. So it needs to make agriculture potentially strong in every measure. In the current world, Technology is the best weapon to do the same. Every sector is becoming improved with smart gadgets. So, here comes the question, why not agriculture?

Every year farming faces a lot of problem due to rain, storm, and bad soil quality after farming twice in a year and so many other unexpected facts.

Other Similar product available in the market:

Automatic Weather Station:

Manufactured by : Aeron Systems Pvt. Ltd

Aeron‘s Automatic Weather Station, also known as Wireless Weather Station measures weather parameters such as Wind Speed, Wind Direction, Air Temperature, Relative Humidity, Barometric Pressure, Solar Radiation, Leaf Wetness, Soil Moisture, Soil Temperature and others using precision sensors and Wireless Data Logger.During no-network or poor-network situations when data logger is not able to make Connection with cloud, data is stored in temporary flash memory (2MB size), the same is uploaded to server as soon as connection is established.

Technical Specifications of Sensors:

➢ Solar Radiation (Davis)

- Spectral Range: 400 - 1100nm
- Range: 0 to 1800 W/m2
- Accuracy: • 5%

➢ Barometric Pressure (Aeron)

- Type: Piezoresistive
- Range: 15 to 115 kPa
- Resolution: 0.1 mm

➢ Leaf Wetness (Aeron)
- Type: Electrical resistance
- Range: 0 - 15
- Accuracy: 0.5

➢ Soil Moisture (Vegetronix)
- Type: Electrical resistance
- Range: 0 to 200 cb
- Accuracy: 1 cb
- Cable length: 5m

➢ Air Temperature (Davis)
- Type: Thermistor
- Range: -40℃ to 65℃
- Accuracy: 5%

➢ Relative humidity (Davis)
- Type: Film capacitor
- Range: 1 to 100% RH
- Accuracy: 3%
- Resolution: 1%

➢ Wind Speed (Davis)
- Type: 3 cup anemometer
- Range: 0 - 79 m/s
- Accuracy: 1.5 m/s or 5%
- Starting threshold: 1.5 m/s
- Resolution: 0.1 m/s

➢ Wind Direction (Davis)
- Type: Wind vane
- Range: 0° - 360°
- Accuracy: 7°
- Resolution: 1°

➢ Rain Gauge (Davis)

- Type: Tipping bucket
- Range: Unknown
- Accuracy: 0.25 mm
- Resolution: 0.1 mm

Technical Specifications of Data Logger:

Data Logger plays an important role in accurate and reliable measurement of data from various weather sensors and Aeron‘s Data Logger does nothing less than best job! Aeron‘s Data Logger consumes lowest energy among its category of devices so that it can work for days without charging. Some of its features such as Firmware-Over-The-Air upgrade, configurations through SMS, user defined target server for data collection, etc. make it highly versatile device. Aeron offers cloud service ―Aeron Live‖ for 24x7 data access from Automatic Weather Stations, Automatic Rain Gauges and Wind Meters.

- Analog inputs: up to 8 single-ended

- Analog inputs range: 0-20mA, 4-20mA, 0-1V, 0-5V
- A/D Bits: 12
- Pulse counters: 2
- Serial inputs: RS232 ASCII and SDI-12
- Serial output: RS232 (for integration with PC)
- Wireless communication: Built-in GSM/GPRS Modem
- GSM Network Type: Quad band (850/900/1800/1900 MHz)
- Memory: 2MB (internal flash), 2GB (external micro SD card)
- Display: Graphic LCD, 128 x 64 resolutions
- Timer: RTC with backup battery, synchronisation with server time
- Operating voltage: 9-30 VDC
- Internal power: Li-ion batteries (rechargeable)
- External power: Solar panel or 9-30 VDC

WEB INTERFACE:

Aeron provides web interface for automatic weather stations fitted with Wireless Data Logger ARN- DLG88. The user is provided with login and password to view and download the data. The data is displayed in tabular format with date selection for easy viewing. The data is downloaded in .xls file format. The Wind Speed and Air Temperature data is stored and shown with minimum and maximum values during logging interval in addition to the averaged value.

The rain collection is total value of rainfall within the logging interval.Market Value of Automatic Weather Station by Aeron Systems Pvt. Ltd is INR 33,000.

Our Model

Our proposed project has almost similar features with respect to the above mentioned product. Although it‘s sensors has higher range of measurement, We can say that our product will be good and sufficient for monitoring all these parameters.

Our Products Price Calculation:

Total Product Cost:

Total Component Cost	2290
Labour Cost	500
Research & Development Cost	2000
Infrastructure Cost	1000
Marketing & Promotion Cost	150
Total Cost	**5940**

As we can make the product at Rs. 5940, we can set MRP at Rs. 18000. So our product is almost half the cost with compared to other product, which are available in the market. So it is affordable to the farmers in the poor countries like India.

Chapter-8

8.1 ADVANTAGES

- IOTweather mentoring system project using nodeMCU.
- Uno is fully automated.
- It does not require any human attention.
- We can get prior alert of weather conditions
- The low cost and efforts are less in this system
- Accuracy is high.
- Self Protection
- Smart way to monitor Environment
- Efficient

8.2 DISADVANTAGES

- Disadvantage of an automatic weather station is that it removes the observer from the real elements being measured.
- Observers need to deal with different applications.
- Problems concerning about spare parts and calibration.
- It may not work perfectly in all weather conditions.
- Non uniformity in units of measurements.

Chapter-9

APPLICATIONS

- IoT offers more precise farming

Using sensors in your fields allows more precision with their weather data collection. This makes water use, planting, and maintenance more accurate, thus using less resources. This can help you save time, labour and money.

- Technology offers better data

By remote accessing exact data for the weather in your fields, you are able to better see and forecast upcoming rainfall, humidity, temperatures, and freezes. This can help you better prepare your crops for weather conditions like frost, drought, or heavy rainfall.By monitoring the data and metrics mentioned above, farmers find a wealth of benefits, including higher production quality and quantity. Other benefits include:

- **Save costs**: smart farming leaders to lower costs on labour, water, and nutrients for crops.
- **Save water resources**: knowing the exact rainfall for each crop can help optimise watering, thus preventing overwatering, which can impact not only crop health, but the environment.
- **Save time and be more organised**: being able to view water levels and weather conditions remotely saves the time it takes to physically go out to the fields. In addition, by knowing weather patterns, you are able to better plan out what needs done during the day while avoiding rain or other weather
- **Easier to make decisions**: Everything from pesticides, seeding, irrigation, and labour can be done more accurately with precise data. You can better predict spraying times by tracking historical weather patterns for the exact area and better anticipate disease risks through weather patterns and conditions.
- **More efficient crop monitoring with less human error**: automatic monitoring will lead to more accurate data in less time and with less labour.

Automatic Weather Station will help the farmers of India to grow crops according to the climatic conditions. As we know there are six seasons in India as winter, spring, summer, monsoon, autumn, late autumn. According to these climatic conditions there are different types of crops that need to be harvested. So, with the help of Automatic Weather Station we can track at which season it is best to harvest which kind of crop. Another important feature of Automatic Weather Station is that it has the ability to detect pH level of soil, whether it is alkaline or acidic. So we could treat the soil to make it right pH making it suitable for crops to grow.

An Automatic Weather Station can store the data of the climate and give us the changes in climatic conditions.

Chapter-10

CONCLUSION

By keeping the weather station in the environment for monitoring enables self-protection (i.e., smart environment)to the environment. To implement this need to use the sensor devices in the environment for collecting the data and analysis. By using sensor devices in the environment, we can bring the environment into real life. Then the collected data and analysis results will be available to the user through the Wi-Fi. The smart way to monitor environment an efficient low cost embedded system is presented in this paper. It also sent the sensor parameters to the cloud. This data will be helpful for future analysis and it can be easily shared to other users also. This model can be expanded to monitor the developing cities and industrial zones for pollution monitoring. To protect the public health from pollution, this model provides an efficient and low cost solution for continuous monitoring of environment.

APPENDIX

PART-A

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6.1.2	22
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6.1.4	23
6.2.1	23
6.2.2	24

PART-B

Code:

```
#include <SimpleDHT.h>
#include <Adafruit_Sensor.h>
#include <ThingSpeak.h>
#include <ESP8266WiFi.h>
#include <WiFiClient.h>
#include <ESP8266WiFi.h>

int pinDHT11 = 2;
SimpleDHT11 dht11(pinDHT11);
int soilMoisturePin = A0;
const char* ssid          = "Gunjan DC-2";
const char* password = "gunjan_2022";
float soilMoisture = 0;

WiFiClient client;
unsigned long myChannelNumber = 1749280;
const char * myWriteAPIKey = "B7YA0B87ZY305HHL";

void setup() {

        Serial.begin(115200);

        Serial.print("Connecting to ");
        Serial.println(ssid);
        WiFi.begin(ssid, password);
        while (WiFi.status() != WL_CONNECTED) {

                delay(500);
                Serial.print(".");
        }
        Serial.println("");
        Serial.println("WiFi connected.");
        Serial.println("IP address: ");
        Serial.println(WiFi.localIP());

        ThingSpeak.begin(client);
}
void loop(){

        Serial.println(WiFi.SSID());
        Serial.println("++++++++++++++++++++++++++++++");

        byte temp = 0;
        byte hum = 0;`
```

```
        dht11.read(&temp, &hum, NULL);
        Serial.print((float)temp);
        Serial.print(" *C, ");
        Serial.print((float)hum);
        Serial.println(" H");
        soilMoisture = ( 100.10 - ( (analogRead(soilMoisturePin)/1023.00) * 100.00 ) );
        Serial.println(soilMoisture);

        ThingSpeak.setField(1,temp);
        ThingSpeak.setField(2,hum);
        ThingSpeak.setField(3,soilMoisture);

        ThingSpeak.writeFields(myChannelNumber,myWriteAPIKey);
        delay(1000);
        delay(500);
        Serial.println("Data Updated");
}
```

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