Wireless Weather and Soil Monitoring Station

Archana Chaudhary[1], Akshay Bhogan[2], Atulya Kumar[3], Swarali Desai[4] and Asmita Dabholkar[5]

[1]Assistant professor, Department of Electronics and Telecommunications, DJSCE, Vile Parle(W), Mumbai-400056
[2,3,4,5]U.G. student, Department of Electronics and Telecommunications, DJSCE, Vile Parle(W), Mumbai-400056
Email id: [1]archana.chaudhary@djsce.ac.in,[2] akshaybhogan98@gmail.com, [3]atulyakumar97@gmail.com,[4] swaralidesai75@gmail.com, [5]dabholkar.asmita@gmail.com

Abstract: Weather is a state of the atmosphere. It describes how hot, cold, humid, clear or cloudy the atmosphere is. Weather stations are used to keep tab of weather in local places. Such stations collect data about the current state of information and predict how the weather will evolve in near future. Modern day weather stations in cities and large industrial areas also detect the pollution levels in the air and alert citizens if the air becomes unfit for breathing. Soil moisture is an important factor that must be monitored for efficient irrigation and predicting crop health. Knowing information about weather and soil conditions would help the agricultural sector to optimise their water usage, produce high quality crops and make the entire process cost efficient. A low voltage wireless system would be thus required to collect data of weather and soil conditions on the field which uploads and stores this sensed data online over regular intervals.

Keywords: Arduino UNO, Weather monitoring, Pollution, Soil Moisture Detection, IoT

I. INTRODUCTION

Our main project objective is to integrate Temperature & Humidity Sensor (DHT11), Carbon Monoxide Sensor (MQ-7) and Soil Moisture Sensor with the Arduino Microcontroller.

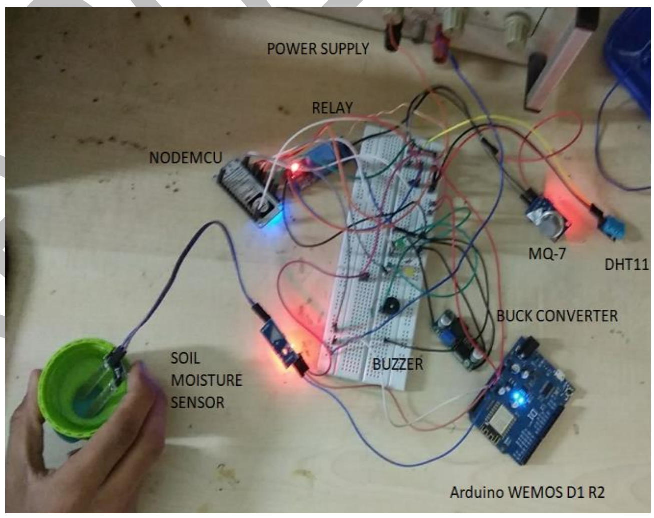
The final device is a low voltage system i.e. all sensors and components can work with a 6V battery or external power supply and is completely wireless with minimum internal connections making it ideal to be placed outside in the field.

The system is completely wireless that senses and uploads data to a third-party website thingspeak.com, using the nodeMCU. All information sensed by the sensors will be uploaded at fixed intervals and stored online in a graphical manner with proper date and time-stamps to allow ease of access.

Once the data acquisition system is successfully working and has collected data over certain time period, we begin analysing the data obtained.

We developed a python app to scrape data from our IoT server https://thingspeak.com/channels/408082 The app displays real-time value as well averages of sensor values over a time period.

Furthermore, by using Twilio API and Python we were able to send SMS to a mobile number in case of a high ppm value reported by the MQ-7 sensor along with a physical buzzer that is powered up if MQ-7 senses values above 250 ppm.



Final Circuit

II. DESCRIPTION

1. Arduino UNO: Arduino is an open-source computer hardware and software. It is based on Atemega328. The arduino is installed with code and thus it proves to be a very helpful device for robotics as well as for advanced sensor-based projects. The Arduino Uno is powered via the USB connection or with an external power supply. The power source is selected automatically. Due to its ease of use arduino is thus deployed in 'Internet of Things' projects as well. The typical arduino board is as shown in the figure below which includes of various mounted components such as IC and ports for external connections. All these components are mounted on the arduino.

ISBN: 978-93-5300-801-7

2. Temperature and Humidity: DHT11 sensor is used to sense temperature and humidity. It facilitates us with analog and digital output. We are using digital output pin to connect it directly with the digital pin of the NodeMcu.Sensor has a full range temperature compensation, low power consumption,and calibrated digital signal. The sensor has a resistive element and a sense of wet NTC temperature measuring devices. A basic chip is been provided that makes analog to digital conversion and spits out a digital signal with temperature and humidity.The sensor is integrated with an high-performance 8-bit microcontroller. Sensor calibration-coefficient is saved in OTP memory to provide accurate temperature readings. To control the power consumption of the sensor a step-up register is used. Main advantage is its small size, low power, signal transmission distance up to 20 meters,reliable and inexpensive.

3. Carbon Monoxide (CO): MQ-7 carbon monoxide sensor is suitable for sensing CO concentrations in the air. MQ-7 can detect CO-gas concentrations in the range of 20 to 2000 ppm. According to MQ-7 datasheet, in order to get proper measurements, the sensor has to run through high and low-heating cycles. For detection purpose it uses the method of cycle high and low temperature. During low temperature, carbon monoxide is absorbed producing a meaningful data. During high temperature absorbed carbon monoxide evaporate cleaning the sensor plate for reading the next measurement. Due to sensor's high sensitivity and fast response time, it finds its application in domestic CO gas leakage alarm, industrial CO gas alarm and portable CO gas detector.

So, in general operation is:

Step 1: Apply 5V for 60 seconds

Step 2: Apply 1.4V for 90 seconds for reading the CO levels.

Step 3: Go to Step 1

4. Relay Module: The SRD relay module is used to control high-voltage electrical devices with a maximum voltage of 250V. It is used in interactive projects and is also used to control the lighting, electrical and other equipments. It is controlled directly by a range of microcontrollers through the microcontrollers digital IO port. In our Weather station we have directly connected the relay on the powering line of the MQ-7 CO gas sensor and has the role of cycling between 1.4V for 90 seconds and 5V for 60 seconds.

5. Step Down Buck Converter: This component is needed to step down the voltage from 5V to 1.4V. The 1.4V is then used to power up the MQ-7 gas sensor for a period of 90 seconds, called as the "reading period".

6. Node MCU and WeMoS D1: NodeMCU is an open source IoT platform. It has a firmware which runs on the ESP8266 Wi-Fi SoC and hardware which is based on the ESP-12 module.NodeMCU is a smart Wi-Fi enabled and inexpensive platform which runs on the Lua scripting language.It facilitates us the feature of programming it with the Arduino IDE. WeMos D1 is an ESP8266 based development board which uses Arduino layout with an operating voltage of 3.3V. Both of these modules are used to connect the weather station to the local network.

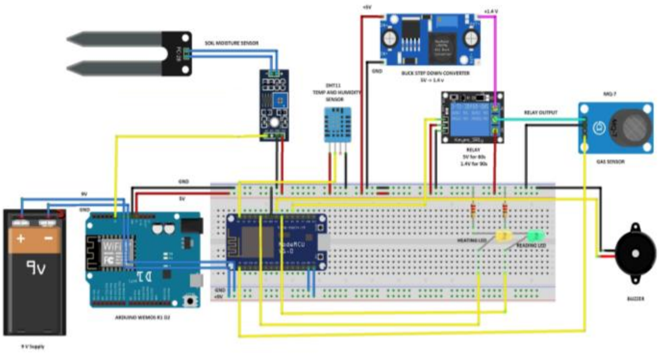
7. Soil Moisture Sensor: Soil moisture sensor is used to measure the volumetric water content in soil. Soil moisture sensor makes use of the properties like resistance, dielectric constant or interaction with neutrons, as a proxy for the moisture content which are indirectly related to the volumetric water content. The concepts that indirectly measure volumetric water content are:

1. Soil resistivity: It is used to determine the soil moisture content by measuring the resistance of soil to the flow of electricity between two electrodes.
2. Galvanic cell: Based on the voltage the soil produces it determines the amount of water present because water acts as an electrolyte and produces electricity. Same is the technology of galvanic cells.

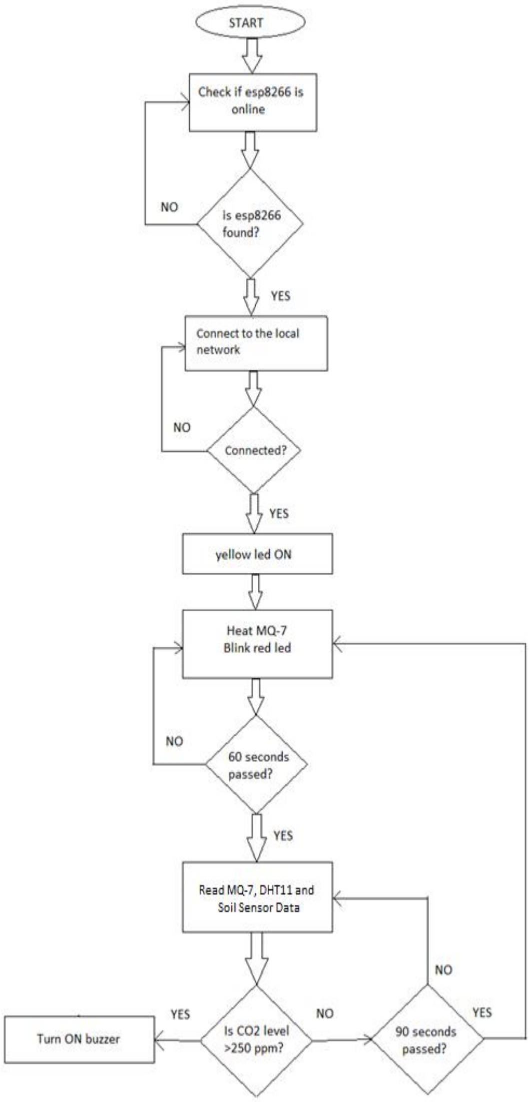
The measured properties like dielectric constant or electrical resistance and soil moisture need to be calibrated as the measured property may vary depending on environmental factors like type of soil, conductivity, temperature, etc.

ISBN: 978-93-5300-801-7

ISBN: 978-93-5300-801-7

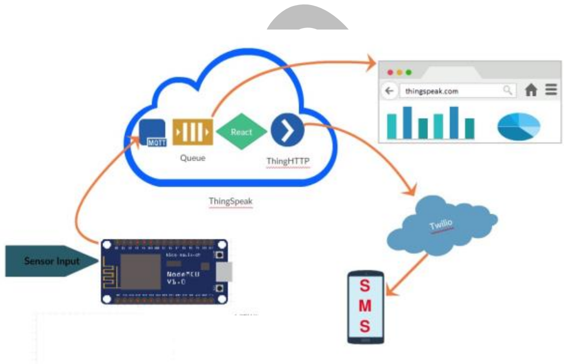


III. BLOCK DIAGRAM



IV. WORKING PRINCIPLE

The weather station is connected to the internet via NodeMCU and ESP8266. The yellow led turns ON as soon as the modules are connected to the internet. The relay module cycles between 5V for 60 seconds and 1.4V for the next 90 seconds. The MQ7 carbon monoxide sensor starts taking readings of CO levels after the first sixty seconds for a period of 90 seconds. The DHT11 temperature and humidity sensor and the soil moisture sensor take readings simultaneously in specified intervals of time. The sensed data is then uploaded on a channel on thingspeak.com where the user can view all the collected data in graphical form. The real time data and their average values based on previous readings are also displayed on the python-based GUI. The system generates an alert in the form of a buzzer if the CO content in the air increases above 250 ppm as well as sends an SMS to the registered mobile number indicating the rise in CO level.



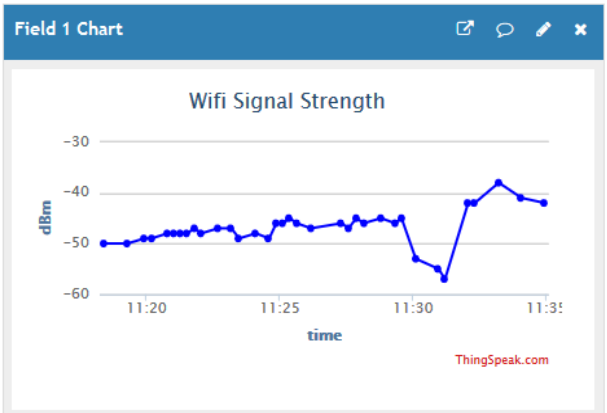
SMS sending process

Schematic Diagram

V. OUTPUT AND DISCUSSION

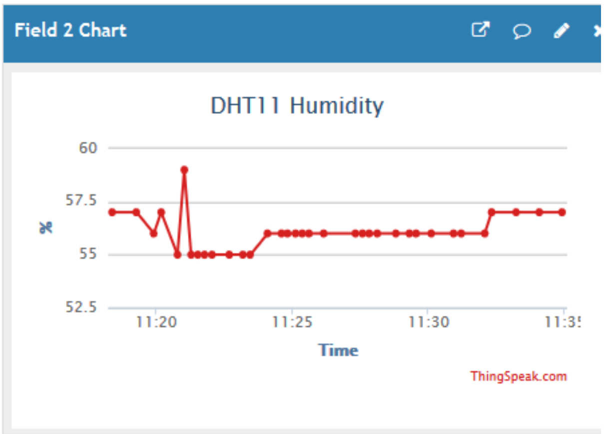
Sensor data is successfully being uploaded on the IoT server at regular intervals. The buzzer is activating at 250 ppm CO value as well as SMS is being sent.

Uploading sensor data on Thingspeak
https://thingspeak.com/channels/408082/

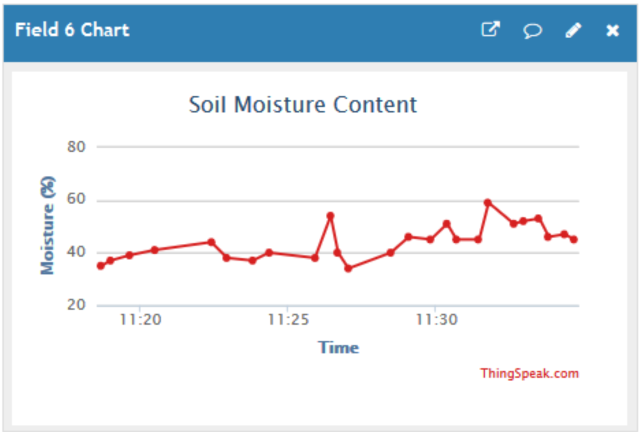


Wifi Signal Strength (dB) uploaded by nodeMCU WiFi module

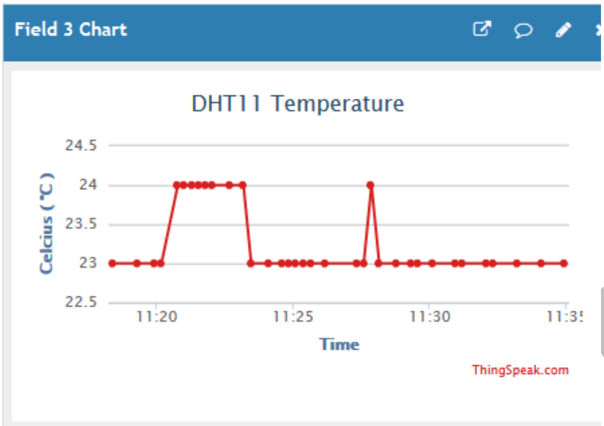
ISBN: 978-93-5300-801-7



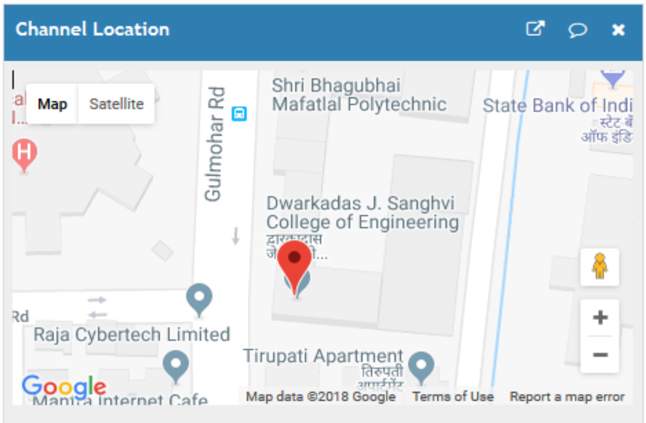
Humidity (%) data sensed by DHT11 Sensor



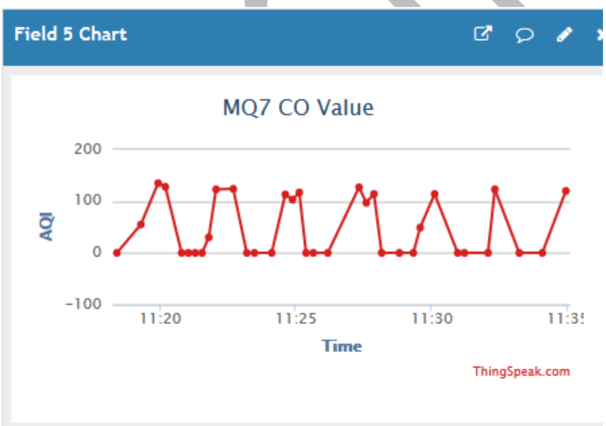
Soil Moisture (%) sensed by Soil Moisture Sensor



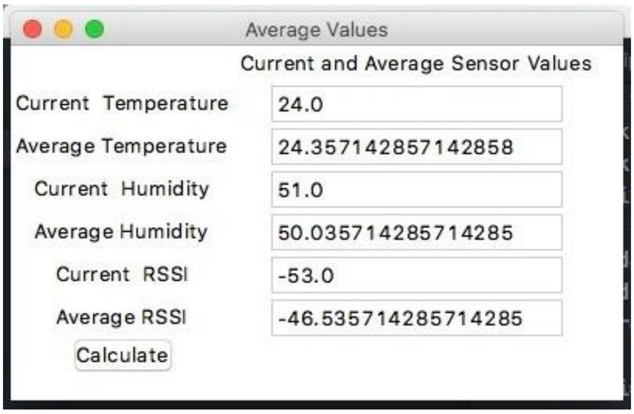
Temperature (° C) data sensed by DHT11 Sensor



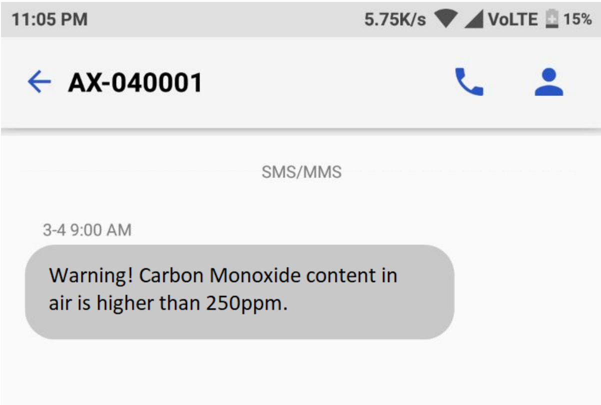
Uploading Location



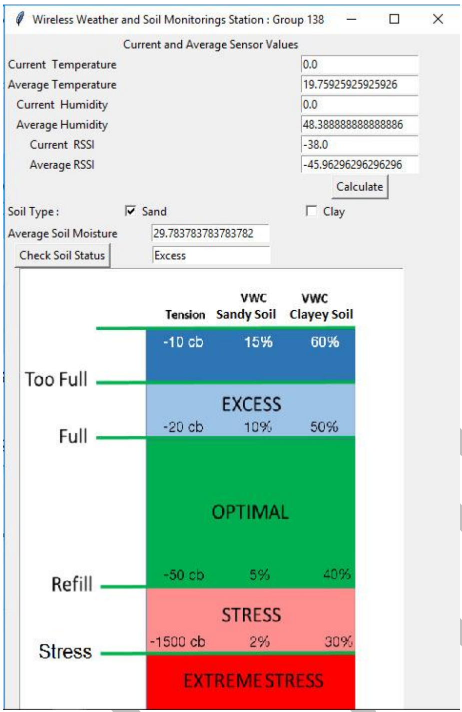
Carbon Monoxide (ppm) data sensed by MQ7 Sensor



Python GUI performing data analytics



SMS from Twilio API being received successfully



VI. CONCLUSION

Hence we have integrated Temperature & Humidity Sensor (DHT11), Carbon Monoxide Sensor (MQ-7) and Soil Moisture Content Sensor with the Arduino UNO Microcontroller and implemented a completely wireless system that senses and uploads data to a third-party website thingspeak.com, using the Node MCU and WeMoS D1 modules. All information sensed by the sensors has been uploaded and stored online in a graphical manner with proper date and time-stamps to allow ease of access.

VII. SCOPE

By building our own “Wireless Weather and Soil Monitoring Station” we can determine weather conditions of a local area and alert citizens if the Carbon Monoxide (CO) content is higher than normal as done by System of Air Quality and Weather Forecasting and Research (SAFAR). The alert will be in the form of a buzzer that shall act as a warning signal to indicate if air in the vicinity is unfit for breathing. We can also determine the water content in the soil which in turn can help in deciding various land-based activities like farming, construction, etc. Weather Monitoring System is very important in a country like India because of the heterogeneous geographical setup (mountain, deserts, island, forests) which often changes parameter of this land. Using such system can make this achievement.

VIII. ACKNOWLEDGEMENTS

We would like to acknowledge our sincere thanks to the faculty and staff of D. J. Sanghvi College of Engineering for their valuable guidance and constant support throughout the course of the project.

Special thanks to Archana ma’am for guiding us throughout the project and reviewing and providing feedback of the project at critical stages.

IX. REFERENCES

1. http://www.esp8266.com/viewtopic.php?f=11&t=3569
2. http://www.instructables.com/id/Getting-Started-with-the-ESP8266-ESP-12/?ALLSTEPS
3. http://www.instructables.com/id/Wireless-Temperature-and-Humidity-Monitor-With-ESP/
4. http://www.instructables.com/id/Programming-ESP8266-ESP-12E-NodeMCU-Using-Arduino-/
5. http://www.srccodes.com/p/article/63/iot-smoke-alarm-esp8266-mq2-gas-sensor-twilio-cloud-sms-thingspeak-analytics-mqtt