

# IT890 - Professional Practice / Seminar

Presented To:  
Dr. Ram Mohana Reddy Guddeti

Presented By:  
Mohd Asif Khan Khaishagi(202IT013)

# Abstract

Air is one the most important aspect of human life, but now a days due to smoke from vehicles, harmful gases from air-conditioners and refrigerator, burning of crops and forests have degraded air quality in our country as well as globally. Air pollution is among the most dangerous issues to human life. To monitor the quality of air in our surroundings is important in getting information about pollution and harmful it is to our health. In this project, I have made an indoor air quality monitor which will show what is the air quality in our surrounding as well as what is what is danger level associated with it.

# Introduction

Air inside the house may seem harmless but there can be colorless and odourless substances in air like carbon monoxide etc. which can affect human health. So for this project, I made Indoor Air Quality Monitoring System which consists of hardware , IOT data aggregation and visualisation platform and an Android App which will show the Air quality status at real time.

# HARDWARE COMPONENTS

- Arduino UNO
- MQ135 Gas Sensor
- MQ7 Carbon Monoxide Sensor
- ESP8266 Wifi Chip
- Breadboard
- Wires etc.

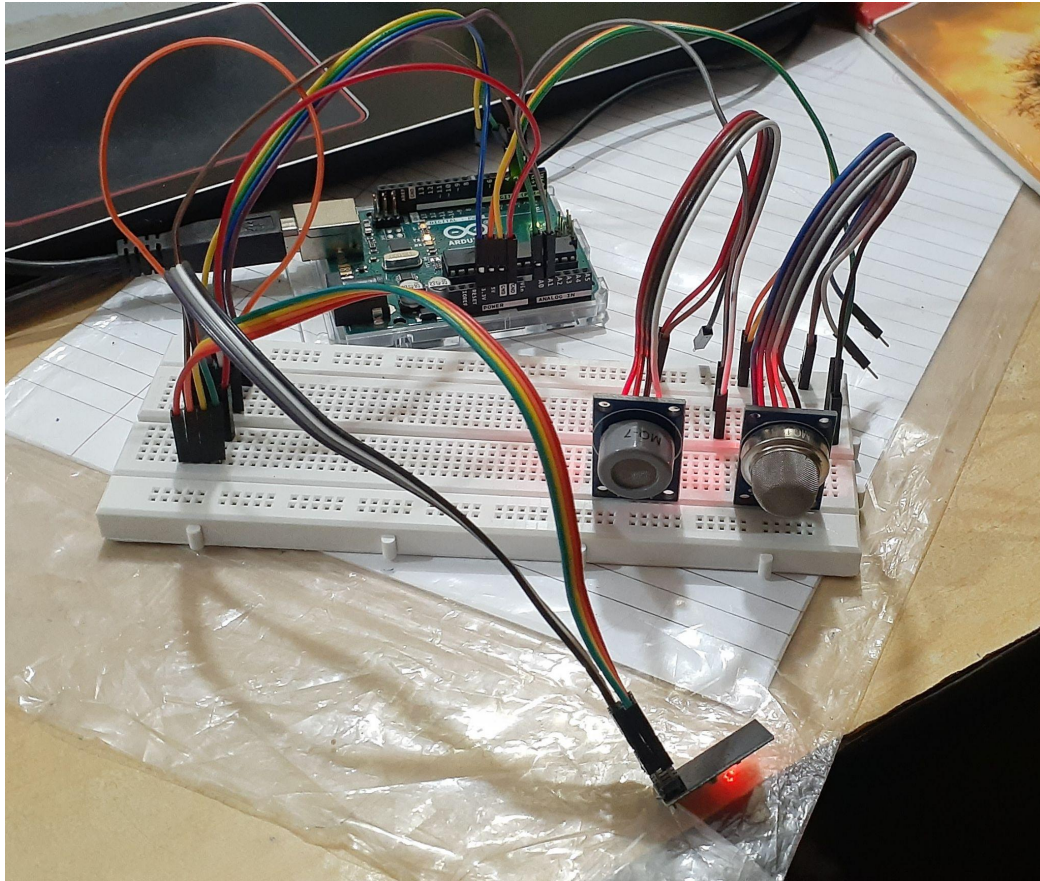


Fig 1 : Air Quality Sensor  
Connected And Running With  
Arduino

# Arduino IDE

The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. This software can be used with any Arduino board.

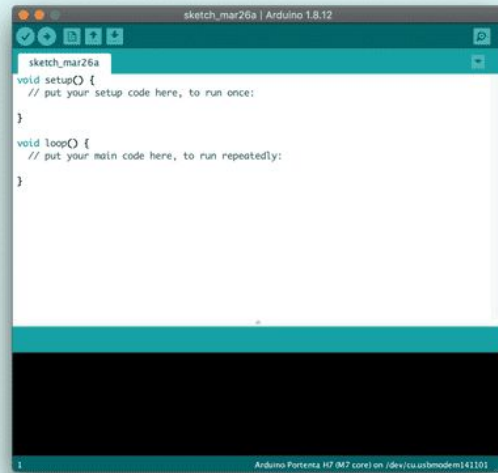


Fig 2: Arduino IDE

# ARDUINO CODING

Step 1 : I have written the code such that on initialization, it connects to the wifi.

Step 2 : Once connected, it will read values from sensor and push them to thingspeak channel.

Repeat Step 2 after every 1.5 second.

File Edit Sketch Tools Help



esp4

```
}

void loop() {
  valSensor = getSensorData();
  valSensor2 = getSensorData2();
  String getData = "GET /update?api_key="+ API +"&" + field1 + "=" + String(valSensor)+"&" + field2 + "=" + String(valSensor2);
  sendCommand("AT+CIPMUX=1",5,"OK");
  sendCommand("AT+CIPSTART=0,\"TCP\", \"\"+ HOST + "\",\" PORT,15,\"OK");
  sendCommand("AT+CIPSEND=0,\" " + String(getData.length()+4),4,>");
  esp8266.println(getData);delay(1500);countTrueCommand++;
  sendCommand("AT+CIPCLOSE=0",5,"OK");
}
```

```
double getSensorData(){
  // Replace with your own sensor code //MQ135
  float sensor_volt; //Define variable for sensor voltage
  float RS_gas; //Define variable for sensor resistance
  float ratio; //Define variable for ratio
  float sensorValue = analogRead(gas_sensor); //Read analog values of sensor
  sensor_volt = sensorValue*(5.0/1023.0); //Convert analog values to voltage
  RS_gas = ((5.0*10.0)/sensor_volt)-10.0; //Get value of RS in a gas
  ratio = RS_gas/R0; // Get ratio RS_gas/RS_air
  double ppm_log = (log10(ratio)-b)/m; //Get ppm value in linear scale according to the the ratio value
  double ppm = pow(10, ppm_log); //Convert ppm value to log scale
  Serial.print("Our desired PPM = ");
  Serial.println(ppm);
  return ppm;
}
```

```
double getSensorData2(){
  // Replace with your own sensor code //MQ7
  float sensor_volt1; //Define variable for sensor voltage
  float RS_gas1; //Define variable for sensor resistance
  float ratio1; //Define variable for ratio
  float sensorValue1 = analogRead(CO_sensor); //Read analog values of sensor
  sensor_volt1 = sensorValue1*(5.0/1023.0); //Convert analog values to voltage
  RS_gas1 = ((5.0*10.0)/sensor_volt1)-10.0; //Get value of RS in a gas
  ratio1 = RS_gas1/R01; // Get ratio RS_gas/RS_air
  double ppm_log1 = (log10(ratio1)-b1)/m1; //Get ppm value in linear scale according to the the ratio value
  double ppm1 = pow(10, ppm_log1); //Convert ppm value to log scale
  Serial.print("CO PPM = ");
  Serial.println(ppm1);
}
```

Error opening serial port '/dev/ttyACM0'. Try consulting the documentation at <http://playground.arduino.cc/Linux/All#Permission>

```
sendCommand("AT+CIPCLOSE=0",5,"OK");
```

Sketch uses 11322 bytes (35%) of program storage space. Maximum is 32256 bytes.  
Global variables use 632 bytes (30%) of dynamic memory, leaving 1416 bytes for local variables. Maximum is 2048 bytes.

1

Fig 3 : Code on Arduino IDE



# ThingSpeak Channel

ThingSpeak is an IoT analytics platform service that allows you to aggregate, visualize, and analyze live data streams in the cloud. You can send data to ThingSpeak from your devices, create instant visualization of live data, and send alerts.

For data aggregation I have made a thingspeak channel where i am collecting gas sensor and carbon monoxide sensor values.

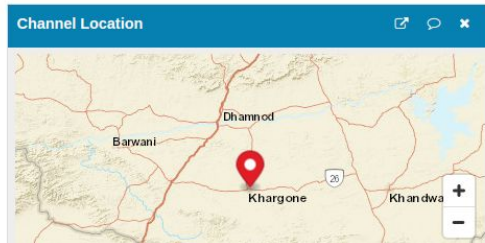
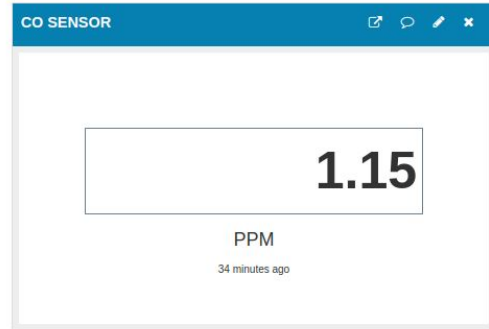
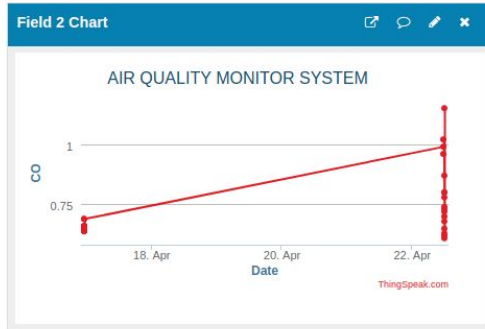
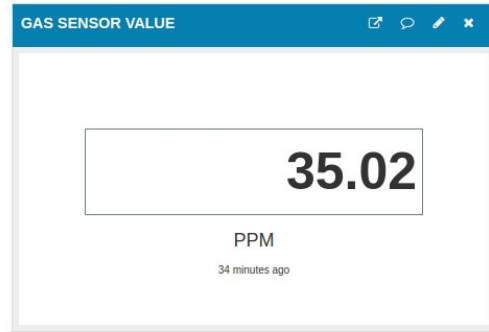
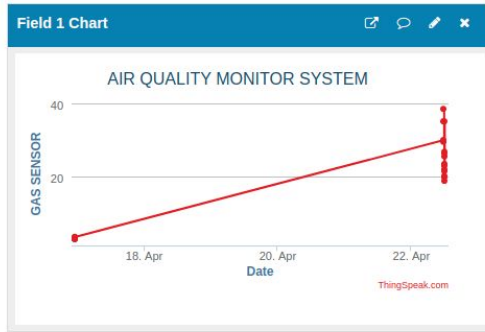


Fig 4 : ThingSpeak Channel Values

# Android

I build the android app on Android Studio IDE using Java, XML. It basically shows the air quality in ppm. Based on air quality it shows status also whether air is good, moderate, unhealthy, very unhealthy and hazardous. You can also view current reading of gas sensor as well as Carbon Monoxide sensor as well as the previous trend graph of the data. I have also added text to speech feature in gas sensor pages. I have attached screenshots of all the screens.

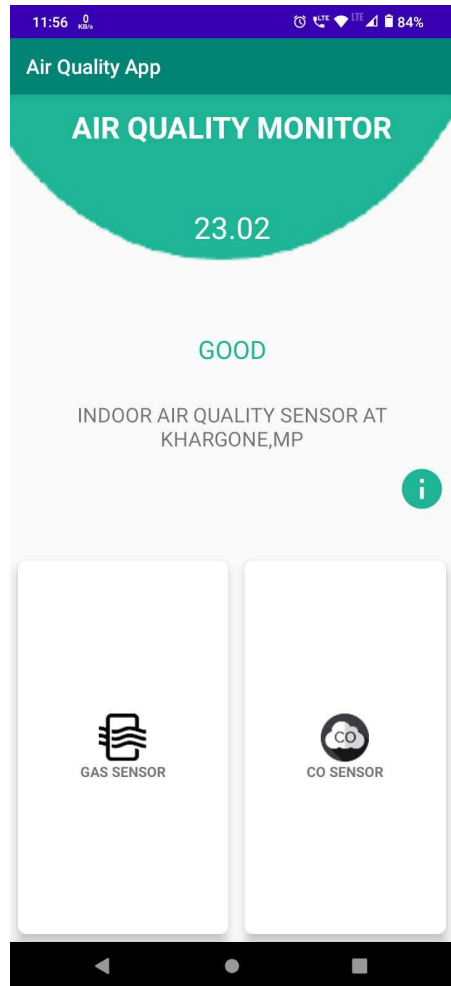


Fig 5 : Home Page



Fig 6: Info Page

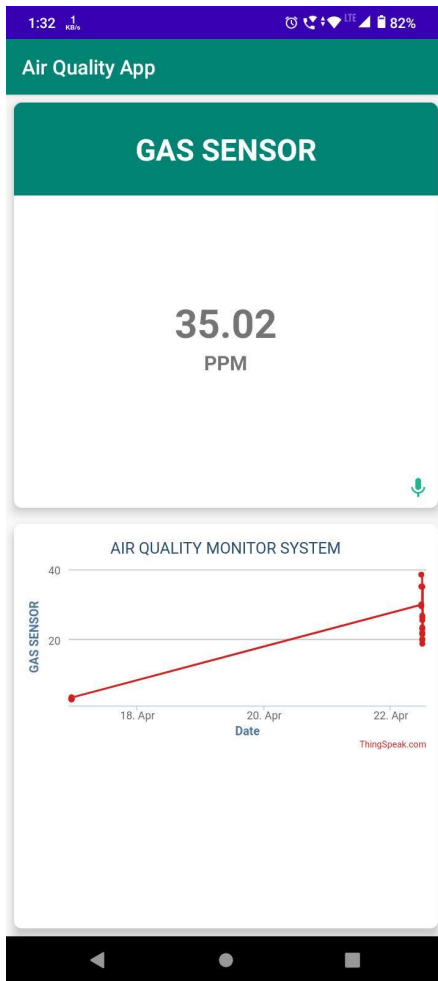


Fig 7 : Gas Sensor Page

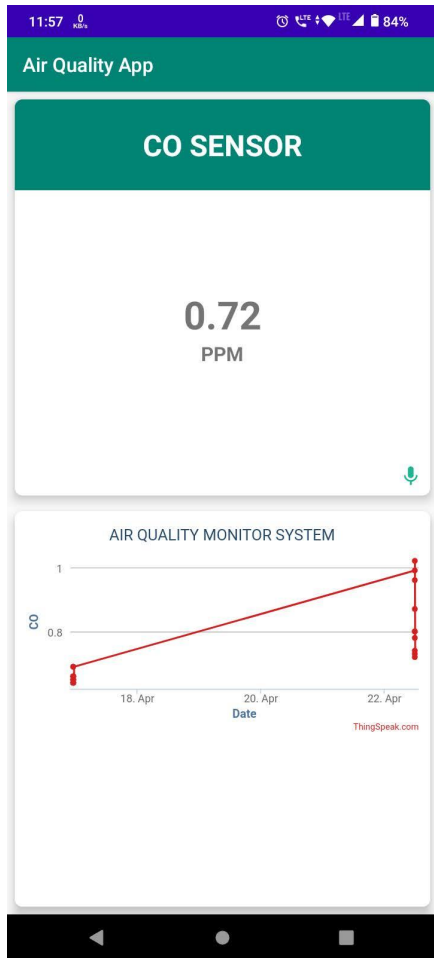


Fig 8 : Carbon Monoxide Sensor Page

# ANALYSIS FROM DATA

	entry_id	GAS_SENSOR	CO_SENSOR
count	500.000000	500.000000	500.000000
mean	287.500000	5.190940	0.274000
std	144.481833	3.939452	0.129026
min	38.000000	1.490000	0.150000
25%	162.750000	2.750000	0.200000
50%	287.500000	4.250000	0.240000
75%	412.250000	6.020000	0.280000
max	537.000000	26.280000	0.930000



# ANALYSIS FROM DATA

GAS SENSOR READINGS IN DIFFERENT ENVIRONMENT

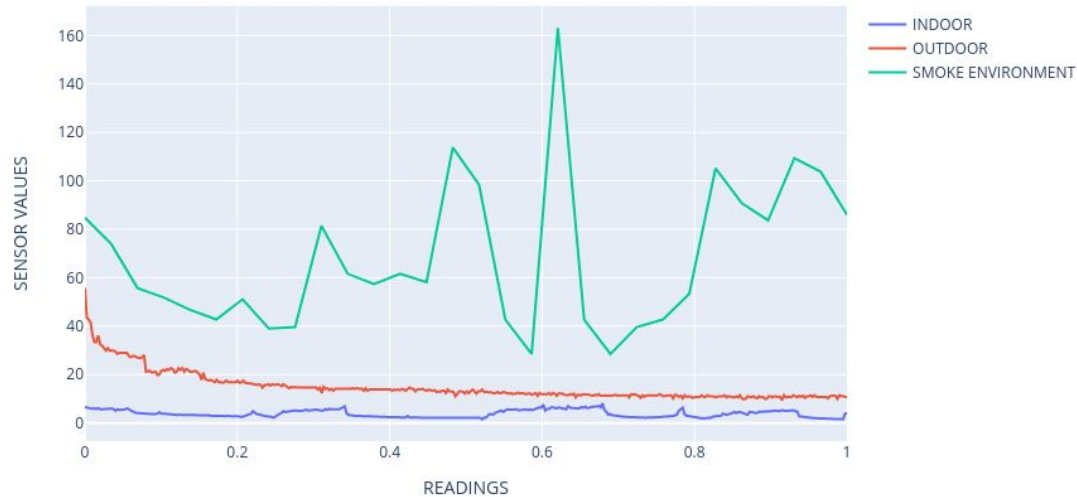


Fig 9 : GAS  
SENSOR  
DATA

# ANALYSIS FROM DATA

CO SENSOR READINGS IN DIFFERENT ENVIRONMENT

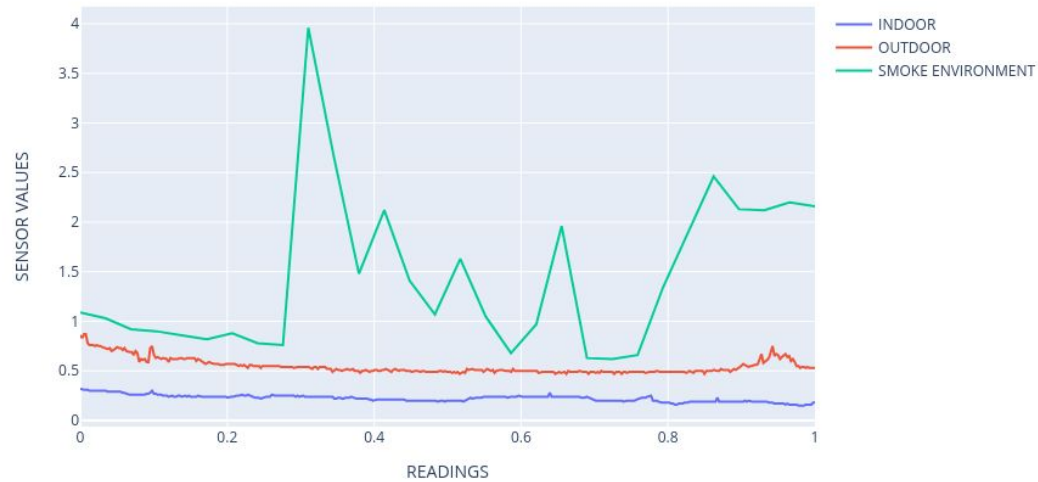


Fig 9 : CO  
SENSOR  
DATA

# Results

Property	Base Paper	This Project
Sensors Cost	48\$ Alphasense brand sensors	5\$
Power Supply	0.5 Watt for AQ device	2.5 Watt for Arduino
Sensor Used	O3,NO2	Gas Sensor, CO
Microcontroller	Raspberry pi	Arduino UNO
Cloud Service	Kairos DB, Graphana	ThingSpeak
Total Cost of Setup	500\$	50\$
Android App	NO	YES

# Market Analysis

Device Name	Price	Mobile App	URL
Kaiterra Laser Egg 2 Air Quality Monitor	9,990	No	<a href="https://tinyurl.com/34wdpsr6">tinyurl.com/34wdpsr6</a>
Prana Air Quality Monitor	6,490	Yes	<a href="https://tinyurl.com/vtvptew7">tinyurl.com/vtvptew7</a>
Xuuxu Air Quality Monitor	3599	No	<a href="https://tinyurl.com/mae64426">tinyurl.com/mae64426</a>
SMILEDRIVE® Portable Air Quality Pollution Meter	7299	No	<a href="https://tinyurl.com/wsp5wsdm">tinyurl.com/wsp5wsdm</a>
AIRATOM Air Quality Monitor	8,999	No	<a href="https://tinyurl.com/kfz6nkvs">tinyurl.com/kfz6nkvs</a>

# Market Analysis

Device Name	Price	Mobile App	URL
HealthInnovative G7015	5,149	No	<a href="https://tinyurl.com/34wdpsr6">tinyurl.com/34wdpsr6</a>
Crusaders AQI	4999	No	<a href="https://tinyurl.com/vtvptew7">tinyurl.com/vtvptew7</a>
IQAir Air Visual Air Quality Monitor	25,300	Yes	<a href="https://tinyurl.com/mae64426">tinyurl.com/mae64426</a>
Airveda Air Quality	9,499	Yes	<a href="https://tinyurl.com/wsp5wsdm">tinyurl.com/wsp5wsdm</a>
Airveda Air Quality With humidity	19,008	Yes	<a href="https://tinyurl.com/kfz6nkvs">tinyurl.com/kfz6nkvs</a>
Our Air Quality Monitoring System	3000	Yes	

# Conclusion

I have made an end to end air quality monitoring system. Now a days, there is a need of this kind of sensors because pollution is increasing day by day. Also the cost of the sensors should be reduced to as minimum as possible. Here the cost of overall system is very less as compared to any other air monitoring system in the market. And none of the commercial air quality monitoring devices gives you monitoring via an android app. I have tried to keep the hardware expenses at minimum but it can be further reduced by using cheaper hardware or different programmable boards. Now a days, There is age of smart systems and with the advancement of IOT we want everything at our fingertips so an Android App is ideal choice for monitoring purpose. Also I used thingspeak as data aggregation platform. This platform is easy to use, but it is little bit slow. Also i used the free version of thingspeak which has a daily limit of fixed messages.

# Applications

- Smart monitoring of house in case of gas leak which can cause fire.
- Smart notifications for people who are sensitive of bad air quality can be notified.
- Smoke detection from crop burning in nearby areas.
- Connect with smart devices to close your windows automatically if smoke is coming from outside.
- Air Quality monitoring at large scale in case of smart cities along with humidity and temperature.

# Limitation And Future Work

Cost of hardware can be reduced further by using cheaper hardware or other NodeMCU based devices which can bring down cost further.

For Monitoring of multiple sensors situated at multiple locations the current thingspeak channel will not scale. A Database for handling data from all the different air quality sensor monitor units can be created.



# References

- Rashmi Ballamajalu, Srijith Nair, Shayal Chhabra, Sumit K. Monga, Anand SVR, Malati Hegde, Yogesh Simmhan, Anamika Sharma, Chandan M. Choudhary, Ronak Sutaria, Rajesh Zele, Sachchida N. Tripathi.(2018) Toward SATVAM: An IoT Network for Air Quality Monitoring. .CoRR, abs/1811.07847.,
- Y. Simmhan (2019) SATVAM: Toward an IoT Cyber-Infrastructure for Low Cost Urban Air Quality Monitoring .doi: 10.1109/eScience.2019.00014
- Kinnera, Bharath Kumar Sai Subbareddy, Somula & Luhach, Ashish (2019). Scalable Computing: Practice and Experience. IOT based Air Quality Monitoring System Using MQ135 and MQ7 with Machine Learning Analysis . 20. 599-606. 10.12694/scpe.v20i4.1561
- Cho, R. (2018, June 26). What you should know about air quality alerts.Retrieved from <https://phys.org/news/2018-06-air-quality.html>