



## IoT- Based Air Pollution Monitoring System

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Mrinal Krishn Singh and Nandini Singh Chaudhary

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# IoT- Based Air Pollution Monitoring System

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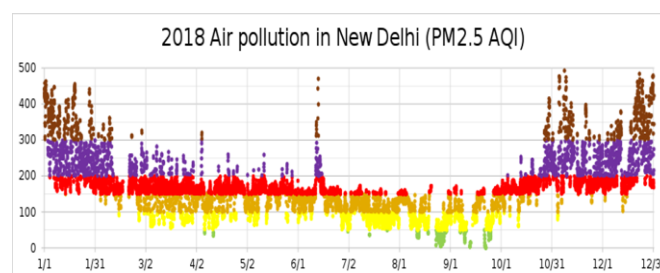
## Abstract—

Air pollution has created a big impact on humans. This abrupt rising of pollutants in the air contaminates it and make it hazardous for living. Earlier the air we breathe in use to be pure and fresh but now a days, due to the abrupt rise in urbanization, industrialization, and associated anthropogenic activities are the main reasons that lead to air pollutant emissions and degradation of air quality. It is expected that by 2030, around 50% of the global population will be residing in urban areas. More than 80% of population in urban areas is exposed to emissions that exceed the standards set by World Health Organization (WHO 2016). Also as per WHO (2016) estimates, 10 out of 20 most polluted cities in the world are in India. Hence it is necessary to take several steps by which we can check the quality of air at different locations. We tried to set up a small Intelligent air pollution monitoring system where we are using MQ315 sensor which senses the pollutants present in the air and will give the output in form of voltage pulses. Further those pulses will get converted into ppm scale and hence we can check the quality of air present in a particular region. This proposed work requires less instrumentation with less area of installation and hence it could be deployed at any location and will display the level of pollution of that particular region. So by this proposed work, one can get the real time values of the pollutants present in the air of a particular geographical area in form of a graph via ThingSpeak server and one could also get the SMS alerts on their devices if the pollution rises above a certain level. As we have used Arduino uno microcontroller in our proposed work, that's why we are naming it as an IoT based air pollution monitoring system.

## I. INTRODUCTION

Air pollution may be defined as the contamination of air through various pollutants mainly CO, N, CO<sub>2</sub> and lots of other pollutants. Nowadays, the quality of air has become very polluted. Due to the increase in demand of cars and factories, the smoke and the hazardous gases that they emit creates smoke and dust everywhere in our surroundings. Government's all around the world have taken some major steps to control air pollution but still millions of people die each year because of the effect of air pollution on their health.

The rise in population growth has had some consequent effects on the air quality in the Indian scenario. The metropolitan cities like Delhi, Kolkata, and Mumbai have experienced huge growth in the levels of pollution.



2018 Air Pollution Level in New Delhi

Now a days pollution is responsible for more than 6 million pre mature deaths all around the world, They are far above the deaths that are caused by diseases like AIDS, cancer, malaria and tuberculosis.

As per a survey generally the elderly and children are more affected by air pollution then other age groups. Day to day workers like street vendors, auto rickshaws drivers,

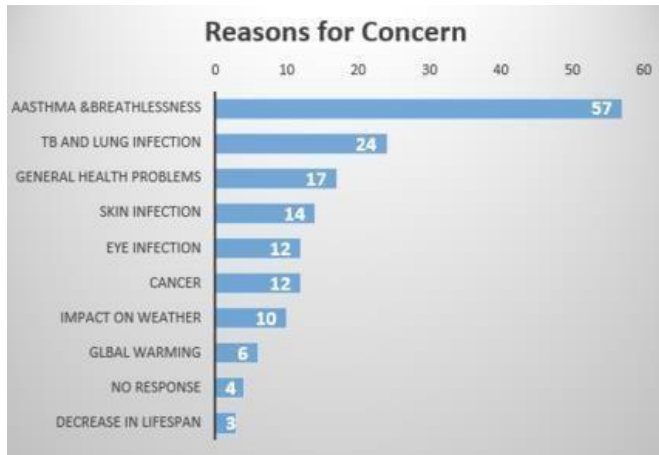
labourers and open field workers are directly exposed to these hazardous emissions which takes a toll on their health.

Major concerns related to increasing air pollution:

- Asthma and breathlessness
- Tuberculosis and Lung infection
- General health problem- cough etc
- Skin infection
- Eye infection
- Cancer
- Impact on Weather- Smog
- Global Warming
- Decrease in Lifespan

## II. MOTIVATION

Pure and clean air is critical to life on earth. Human life can't survive without getting clean air from the environment. But as the planet gets more and more industrialized and with a massive rise in the population the air around us gets more and more polluted, which creates a threat for the survival of life on this planet. This creates a need for monitoring the quality of air so that we can take necessary actions for improving its quality if it gets affected. Some of the main causes for air pollution are burning of fossil fuels, construction activities, pollutants discharged from industries, automobile exhausts etc. Some gases like carbon monoxide, Sulphur dioxide, nitrogen dioxide is particularly harmful for humans and are the main reason behind the significant increase in lungs related diseases that we are seeing from last few years. The massive amount of carbon dioxide present in the environment is also one of the main reasons behind the increase in global warming. Many steps have been taken to improve the quality of air in the environment and to limit further emission but countries around the globe needs to do even more for solving this problem and air quality monitoring plays a key role in successfully achieving the target to provide clean air to every living being.

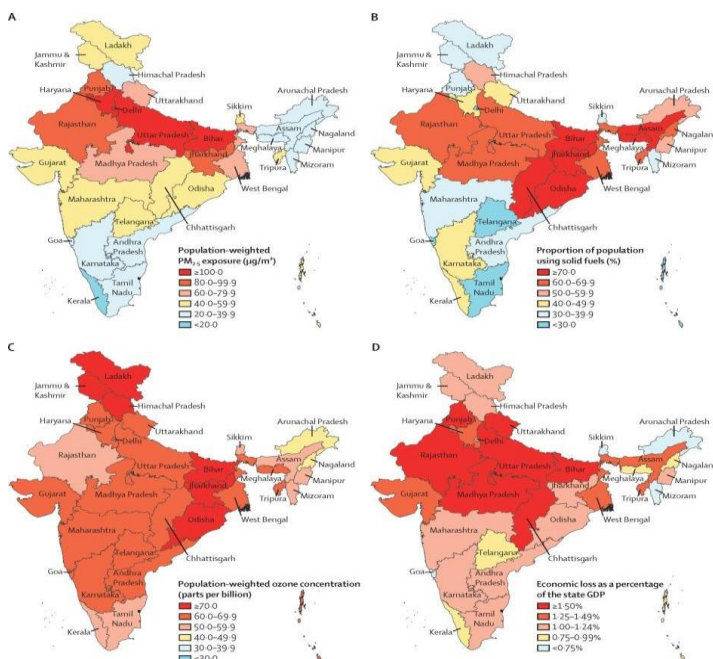


Reasons for concern regarding increase in Air Pollution

So, we have decided to make a proposed work on Monitoring Air quality using some concepts of IoT as the components used in this proposed work are very cost effective and this proposed work can further be used on a small scale such as hotels, schools, universities to check the real time air quality. As this proposed work will give updates to its users when the air quality reaches towards a certain extent.

## NEED FOR MONITORING

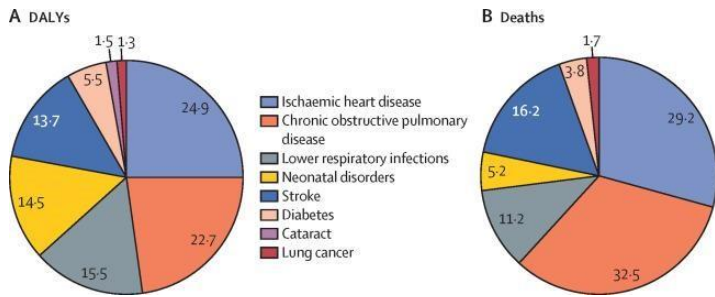
Air pollution is the contamination of air that is caused due to presence of many type of substances like carbon dioxide, sulphur dioxide, ammonia etc mixed in the air and thus risks our potential for survival and also that of other animals and plants. Air pollution can cause severe health problems but in addition to it, it is also a major cause for the harm caused to the environment, which leads to rising global temperatures and climate change. It causes the economic loss of billions of dollars of the world each year. Air pollution rising at an unprecedented rate is now slowly turning into an epidemic.



Exposure to air pollution and economic loss due to premature deaths and morbidity attributable to air pollution in the states of India, 2019

We know that when air quality is poor it is unhealthy, especially for people who are sensitive to it such as children, older adults, or people with heart disease, asthma, and other respiratory ailments. But air quality isn't the same everywhere. Pollution can build up in isolated pockets, and local sources for example near industry or a busy road can add to the overall poor air quality. Also the weather conditions in an area play a part in the quality of the air. Because different areas have different levels of air quality at different times it is important for us to monitor what is happening. That way we can identify trouble spots and ensure that we are taking the right steps to ensure we all enjoy the cleanest air possible.

The heat turned emissions from cars and power plants into a soupy haze of ground-level ozone and fine particles left over from burning fossil fuels. Trapped in place by the high pressure system that had settled over the eastern and central United States, the haze had built up over several days.



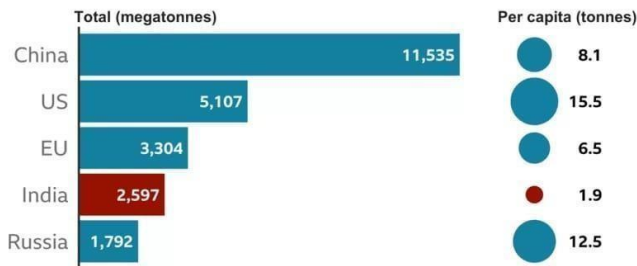
Causes of DALYs (A) and deaths (B) attributable to air pollution in India

In many places, the Environmental Protection Agency warned that the air was unhealthy to breathe for those sensitive to poor air quality such as children, older adults, or people with heart disease, asthma, and other respiratory ailments. But air quality was not the same everywhere. Pollution can build up in isolated pockets, and local sources (an industrial plant or a busy road) can add to the overall poor air quality. A network of citizen scientists monitoring air quality throughout a region could help reveal how pollution travels through the region and could help identify pollution “hot spots.”

India is the world's fourth biggest emitter of carbon dioxide after China, the US and the EU. But its huge population means its emissions per capita are much lower than other major world economies. India emitted 1.9 tonnes of CO<sub>2</sub> per head of population in 2019, compared with 15.5 tonnes for the US and 12.5 tonnes for Russia that year.

### India is the world's fourth biggest emitter of carbon dioxide

Total and per capita emissions of CO<sub>2</sub> per year



2019 data, EU includes UK  
One megatonne = 1,000,000 tonnes

India comparison with major countries for the per capita emissions of CO<sub>2</sub> per year

### III. LITERATURE SURVEY

The most basic use of an Air Pollution Monitoring system is to detect and monitor the air quality index of a particular place at a particular time. The proposed IOT based Air pollution monitoring system using Arduino, WIFI module and GSM module for sensing the amount of pollutants present in the air that are causing the contamination of air. It gives real-time data to the ThingSpeak server and gives the data in form of graphs, and will also send the SMS as well as email alert to its users with the help of ESP8266 module and GSM module.

The increase in the levels of air pollutants thus increasing health related issues is the major worry which leads to the use of Air Pollution Monitoring systems. The rapid industrialization and urbanization have led to the increase in the levels of particulate matters in the air. This has created the need for measurement and analysis of air in real time so as to take timely and appropriate decisions concerning our health and environment. GSM is used to deliver message to the user's mobile and WIFI module is used to send the real time data to the ThingSpeak server. IOT helps in updating the real time data on webpage. The MQ135 sensor is used to sense venomous gases like CO<sub>2</sub>, benzene, nitrogen oxides. It gives the output in form on voltage levels. The potentiometer takes the input as per the concentration of the gases.

At the COP26 summit held in Glasgow to reaffirm the Paris agreement goal of holding the increase in the global temperature to well below 2 °C above pre-industrial levels and making efforts to limit the global rising temperatures to 1.5 °C above pre-industrial levels", India has pledged to be carbon neutral by 2070, PM Modi made the pledge as one of five commitments from his country.

They include a promise for India to get 50% of its energy from renewable resources by 2030, and by the same year to reduce total projected carbon emissions by one billion tonnes. Our work helps in monitoring the amount of pollutants present in the air so that necessary actions could be taken to reach our net zero target

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The objective of this project is to monitor the quality of air around industrial as well as urban areas. The proposed work includes a number of gas sensors (CO, and NO<sub>2</sub>) that are working on masses and structure of a IOT and a strong server to support short-range and real time incident management. Here Arduino platform is used to communicate the data in a very simple manner. Here WSN acts as the trans receiver which is providing a real-time and low-rate monitoring system over the use of low rate, low information rate, and little control wireless communication technology. This projected monitoring system can be transferred or can be shared by different applications. With the help of IOT we can able to visualize the values from the different parts of the globe.

The problem associated with this paper is that they haven't calibrated the sensor and they have not even converted output values of sensor into PPM. According to the guidelines by UN Data, 0-50 is considered as SAFE value and 51-100 comes under moderate. While using these two sensors, as both sensors possess internal heat elements, which draws more power (P= VxI), so though the both sensors are ON, still its output voltage level varies and shows distorted values due to insufficient drive. But as we have used MQ135 sensor which is used for detecting a number of

of gases, including ammonia, benzene, smoke, NO<sub>x</sub>, alcohol and CO<sub>2</sub>. Ideal for use in office or factory. MQ135 gas sensor can detect substances like ammonia, sulphide and benzene and it is also sensitive to smoke and some other harmful gases, so by using this sensor, the values at the output that we will get would be accurate and will not show any distortion.[1]

## 2. Monika Singh Et al. in August 2019 proposed an Air Pollution

Monitoring System. This system uses an Arduino microcontroller connected with MQ135 and MQ6 gas sensor which senses the different types of gases present in the environment. It was then connected to the Wi-Fi module which connects it to the internet. The LCD is being used to display the output to the user and buzzer alerts when the ppm crosses certain limit. Their applications were industrial perimeter monitoring, indoor air quality monitoring, site selection for reference monitoring stations, making data available to users.[2]

## 3. Yamunathangam Et al. in November 2018

Used IoT by measuring the concentration of gases and other substances using various sensors which were observed through the serial monitor of arduino. This data is collected in Thing speak channels by means of Ethernet shield which is available in live for further processing. These analyzed results were viewed through thing speak in a graphical format. Then the average pollution level was calculated using MATLAB analysis and the results were viewed through a mobile app. Further based on the location, the air quality index value was obtained through the android app. Along with this, the health effects were also displayed in this app, so that the users can stay aware of the pollution levels. [3]

## 4. Riteeka Nayak , Malaya Ranjan Panigrahy ,Vivek Kumar Rai, T Appa Rao

The pollution level has increased a lot with factors like the increase in population, increased use of automobiles, rapid growth in industrialization and urbanization which results in evolution of harmful gases which affects human well being by directly affecting health of population exposed to it. In order to monitor the pollution levels ,in this project we are going to make an IoT Based Air Pollution Monitoring System in which we will monitor the Air Quality over a web server using internet and will trigger an alarm when the air quality goes down beyond a certain level, means when there are sufficient amount of harmful gases are present in the air like CO<sub>2</sub>, smoke, alcohol, benzene and NH<sub>3</sub>. It will show the air quality in PPM on the LCD and as well as on webpage so that we can monitor it very easily. We have used MQ135 sensor which is the best choice for monitoring Air Quality as it detects most harmful gases and can measure their amount accurately. In this IoT project, you can monitor the pollution level from anywhere using your computer or mobile.

This paper has wrong assumption as this shows the output 997PPM as the fresh air, where Delhi which is one of the most polluted cities records 350PPM. It can be concluded that the

calibration of the sensor is not done and there is no conversion of the raw sensor data into PPM using derivations. They have used Localhost which is limited where they are able to see the output only on the laptop within the experimental setup connected. But we have used premium IoT platforms which are highly secured and open source IoT platform. [4]

## 5. Meghana P Gowda, Harshitha G Y, Jyothi K N, Srushti, Padma R

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Assistant Professor, Department of ECE, GSSSIETW- Affiliated to VTU, Mysuru, Karnataka, India

They have proposed a hardware system in which they are using node MCU, an intelligent gas sensor MQ135 which can sense various types of gases such as Ammonia (NH<sub>3</sub>), sulphur (S), Benzene (C<sub>6</sub>H<sub>6</sub>), CO<sub>2</sub>, and other harmful gases and smoke and Arduino is the brain of this project which is controlling the whole system. Wi-Fi module is connecting the whole process to the internet and the LCD is used for displaying the Output.

The problem with this project is that, they are only using Wi-Fi module i.e. Node MCU chip and giving alerts via twitter. But our project is using both Wi-Fi chip as well as the GSM module. The Wi-Fi module will connect through the web server (ThingSpeak) and will provide the output there in terms of graphical values and the GSM module will connect through the mobiles and other user-friendly devices and will give the SMS alert to them in case of the high level of pollutants present in the air.[5]

## 6. Mohd Hakimi Bin Zohari, Mohamad Farid Bin Johari

In this proposed weather monitoring system, they have used an application named as Blynk application which is being used for collecting all the data. In this project they are trying to monitor the weather of the city or a particular region and they are also trying to make it beneficial for farmers. This project attains the objectives where weather monitoring system is to be build and from where it can check the weather conditions. By using application, Blynk, it checks the weather conditions. Moreover, This project is also able to forecast the current weather conditions on the system of weather monitoring system. The is how they are implementing their system to monitor the weather using Internet of Things (IoT) is consummate. [6]

### Describing The Blynk app.

The Blynk app was designed for the Internet of Things which can control hardware remotely, display sensor data, store data, visualize it and do many other things. The three components in the platform:

- Blynk App - It allows user to create amazing interfaces for their projects using various widgets that they provide in their menu.
- Blynk Server – It is responsible for all the communications between the smartphone and hardware where we have to use Blynk Cloud or run our private

Blynk server locally. It is an opensource server, and it can easily handle thousands of devices and can be launched on Raspberry Pi.

- Blynk Libraries – It is used for all the popular hardware platforms – It also enables communication with the server and process all the incoming and out coming commands.

#### 7. Poonam Pal Et al. in October 2017

The proposed system is used to monitor the air quality using Arduino microcontroller. They used MQ135 gas sensor to sense the different type of gases and Arduino to control the entire process. MQ135 gas sensor gives the output in form of voltage levels and needs to be converted into PPM. Wi-Fi module connects the whole process to the internet and LCD was used for displaying the output. When the value is less than 1000 PPM, the LCD and webpage will display “Fresh Air” and when the PPM exceeds the limit then the buzzer starts beeping and the LCD and webpage will display “Poor Air, Open Windows”. If it will increase 2000 then the buzzer will keep beeping and the LCD and webpage will display “Danger! Move to fresh Air”. [7]

The problem with the above proposed system is that it lacks the connection with the user at a larger spectrum of area. The message displayed on LCD and the buzzer is specific to the region of installation. It fails to alert the user if the user is out of the range of the certain area of installation.

To overcome the above set back we have introduced a Wi-Fi module to send an alert to the user via mobile phone.

#### 8. Alhmiedat T, Samara G.

Alhmiedat and Samara have proposed a cost efficient ZigBee sensor network architecture that will be able to monitor indoor air quality in realtime. To monitor air pollution in the indoor environment they have installed four sensor nodes at different places either in a house or inside an office or work place, the system is able to collect this data from all these places where it is placed and it is also able to store this data for a time period of more than four weeks. All this environmental data collected by the system is then stored which is then transferred for analysis through a ZigBee communication protocol. Authors of this paper have analysed gases like benzene, CO<sub>2</sub>, ammonia and NO<sub>x</sub> for indoor air quality assessment. This system is used to monitor the quality of air in the kitchen at the time of cooking, the air quality inside a school or hospital. The sensors can be used to monitor air quality from areas like living room, bed room and office area. It provides real-time monitoring of all factors which contributes in polluting indoor air.

However, there are few limitations of this system as it consumes more power than the general air quality monitoring systems in use, also there is a need for improving the accuracy of the parameters that are monitored by the system.[8]

#### 9. IOT Based Air Pollution Monitoring System

Harsh N. Shah 1, Zishan Khan 2, Abbas Ali Merchant 3, Moin Moghal 4, Aamir Shaikh 5, Priti Rane 6 1, 2, 3, 4,5Student, Diploma in Computer Engineering, BGIT, Mumbai Central, India 6Assistant Professor, BGIT, Mumbai Central, India

Air pollution has become the biggest problem of every nation, whether it is a developed nation or developing nations. Now a days, various health problems have been growing at faster rate especially in the urban areas of developing countries where due to industrialization and the growing level of transportation and vehicles lead to release of lot of hazardous gaseous pollutants. Harmful effects of pollution can vary from mild allergic reactions such as irritation of the throat, eyes and nose to some very serious problems such as bronchitis, heart diseases, pneumonia, lung and aggravated asthma. According to a survey, due to air pollution, there occurs 50,000 to 100,000 premature deaths per year alone in U.S. Whereas in EU, this number reaches to 300,000 and over 3,000,000 worldwide.

This IOT Based Air Pollution Monitoring System tries to monitor the Air quality over a web server using Internet and will also trigger an alarm when the quality of air gets worse, or goes down beyond a certain limit, it means that when there are sufficient amount of harmful gases present in the air like CO<sub>2</sub>, smoke, alcohol, benzene, NH<sub>3</sub>, LPG and NO<sub>x</sub>, the system will show the quality of air of that particular moment in PPM on the LCD and as well as on webpage so that it can be monitored very easily.[9]

#### 10. Arduino Based Weather Monitoring System

Karthik Krishnamurthi, Suraj Thapa, Lokesh Kothari, Arun Prakash Department of Computer Science, Christ University, Bangalore, India

This Paper makes use of 3 sensors to measure the weather/environment factors such as humidity, light intensity, temperature, dew point and heat index. The values stored by the sensors are then analysed by the Arduino microcontroller and is stored in a text file which can be processed upon to derive analysis. The readings are also displayed on an on board LCD for quick viewing. All these readings can be analyzed to get the weather characteristics of a particular area and record the weather pattern. These recorded parameters are essential and vary from places to places.[10]

The problem with this paper is that if a user wants to monitor the levels from a far away place. It is not possible as there is no availability of a module for uploading the data on cloud.

The table below gives a clearer picture of the pros and cons of the above-mentioned proposed works and why there is the need for improvisation in the above proposed works.

Table-1: The critical review of proposed works mentioned in the literature review

Advantages	Disadvantages
[1] A very simple and straightforward system that is designed for testing the quality of air in industrial areas and is cost ineffective also. This system is only limited for the detection of gases such as NO <sub>2</sub> and CO and additionally, no calibration of sensor is performed in this project	This system is only limited for the detection of gases such as NO <sub>2</sub> and CO and additionally, no calibration of sensor is performed in this project.
[2] This system uses an Arduino microcontroller connected with MQ135 and MQ6 gas sensor which senses the different types of gases present in the environment	They are using MQ6 and MQ135 sensors together which is not necessary. They may use only MQ135 sensor as MQ135 can detect a variety of gases as compared to MQ6 which is used in gas leakage detecting equipment in consumer and industry.
[4] This system is having a simple approach to detect the level of pollutants in the air and is easy to install and it is very cost ineffective also.	They have made wrong assumptions in their project which clearly shows that they have not calibrated the sensor, as well as they have not even converted the voltage values in PPM.
[6] This project provides a simple weather monitoring system that uses an app named Blynk app which displays the sensor data.	This project provides a simple weather monitoring system that uses an app named Blynk app which displays the sensor data. This project is only limited to measure the weather conditions not the quality of air. They could have used some gas detection sensors (for ex MQ135) by which they could detect the pollutants level.
[7] It is a small and compactly designed project that can be used at any location and could detect the values of the pollutants of that particular region.	This project is only limited to a particular geographical area means if a user is in a particular range, then only he can get the alerts.
[8] This system can be used to monitor the indoor air quality of a house, office, school, hospital etc. The system has four sensor nodes that are used to monitor the quality of air from four different places. This data can be stored for further analysis for a time period of more than four weeks	There should be some changes that are needed in this system like reducing the power consumption and improving the accuracy of the parameters that are monitored by the system.

#### IV. RELATED WORK

##### Technology Used:

Arduino 1.6.13: **The Arduino Integrated Development Environment (IDE)** is a software application that works for Windows, macOS, Linux and it is written in functions from C and C++. [11] It is used to code and transfer the programs to boards that are Arduino compatible, these codes can also be transferred to other vendor development boards.

The Arduino IDE is based on the languages like C and C++ using the rules of code structure building.[14] The Arduino IDE is used to supply a software library from the Wiring project, which are used for many general input/output procedures. The user-written code are based on two different functions, for sketch starting and main program loop, these functions are

Further linked and then compiled with a program stub main() into a cyclic program which can be executed with the help of GNU toolchain that is included with the IDE distribution.[15] The Arduino IDE converts the executable code into a text file which is in hexadecimal encoding and it is then loaded into the Arduino board through a loader program provided in the board's firmware. By default, avrdude is used as the uploading tool to transfer the user code into the Arduino board.

Arduino IDE is a derivative of the Processing IDE, however as of version 2.0, the Processing IDE will be replaced with the Visual Studio Code-based Eclipse Theia IDE framework.

In October 2019 the Arduino organization began providing early access to a new Arduino Pro IDE with debugging and other advanced features.

##### WHY ARDUINO 1.6.13?

Improved robustness of Serial Plotter while dealing with malformed or partial data. Thanks @xloem.

\* Fixed regression on command line upload.

\* Bugfix installing libraries from command line: the IDE tries to update the libraries index but it didn't use it straight away (this caused issues mainly on CI environments)

\* Libraries and Boards Managers: if a download error happens (CRC error) the IDE tries to download the file again without the need to remove the corrupted file manually.

\* Improved serial plotter with horizontal axis and grid. Thanks @duff2013

\* Windows: Improved DPI detection

\* Fixed a bunch of small bugs in the editor.

## EMBEDDED C LANGUAGE

Embedded C is most popular programming language in software field for developing electronic gadgets. Each processor used in electronic system is associated with embedded software.

Embedded C programming plays a key role in performing specific function by the processor. In day-to-day life we used many electronic devices such as mobile phone, washing machine, digital camera, etc. These all device working is based on microcontroller that are programmed by embedded C.

In embedded system programming C code is preferred over other language. Due to the following reasons:

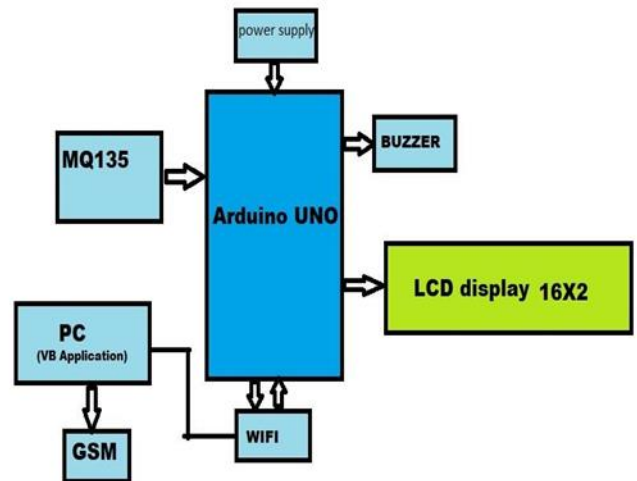
- o Easy to understand
- o High Reliability
- o Portability
- o Scalability

Function is a collection of statements that is used for performing a specific task and a collection of one or more functions is called a programming language. Every language is consisting of basic elements and grammatical rules. The C language programming is designed for function with variables, character set, data types, keywords, expression and so on are used for writing a C program.

The extension in C language is known as embedded C programming language. As compared to above the embedded programming in C is also have some additional features like data types, keywords and header file etc is represented by: `#include<microcontroller name.h>`

## V. SYSTEM DESIGN

In our project we are using MQ315 sensor, WIFI module ESP8266, Arduino UNO microcontroller, buzzer, LCD display, wires, power supply, and some gases like CO<sub>2</sub>, NH<sub>3</sub> etc. for detection. The MQ315 sensor is used to sense NH<sub>3</sub>, alcohol, NO<sub>x</sub>, benzene, CO<sub>2</sub> and other gases and it gives the output in the form of voltage levels. The WIFI module ESP8266 is a cost efficient WIFI chip that has full TCP/IP stack and MCU capability, it works on 3.3V and it helps in connecting our system to WIFI or internet as Arduino doesn't have any inbuilt WIFI or internet capacity so we have to use this module to connect it to WIFI or internet. The liquid crystal display or a 16X2 LCD display is a display that we are using to display our results. The display generally has 2 rows and 16 columns and it displays the air and humidity in PPM. The buzzer that we are using acts like a signaling device that is used to indicate that the air quality is poor whenever the air pollution crosses a certain threshold level.

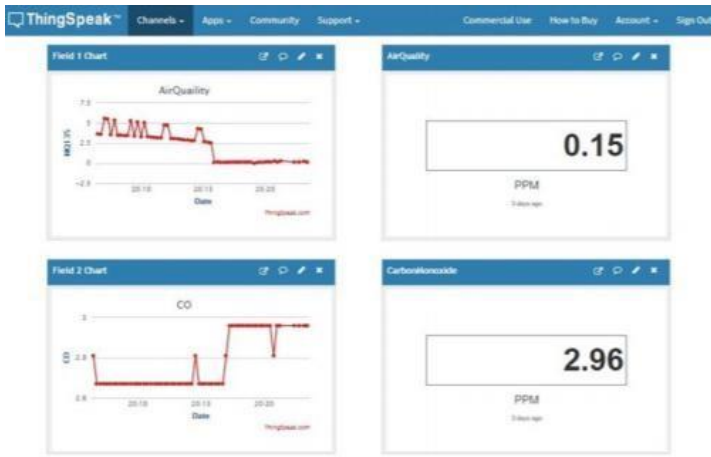


BLOCK DIAGRAM

## VI. DISCUSSION AND RESULT

In the circuit, first of all the ESP8266 is connected to the Arduino by connecting the VCC and CH\_PD to 3.3 pin of Arduino by connecting three resistors in series. Then we have to connect the MQ135 to the Arduino UNO, the VCC to the 5V power supply and the ground pin to the ground, the analog pin to A0 of the Arduino UNO and the pin 8 of the board is connected to the buzzer. Then Whenever the MQ135 senses any of the gas like CO<sub>2</sub>, NO<sub>2</sub>, NH<sub>3</sub>, Benzene etc. The MQ135 gives the output in the form of voltage levels but we expect the output in the form of PPM so we have to convert it into the form of PPM. When there is no gas and nothing is detected then the sensor will give us the output of 90. The output of 350 PPM is considered to be safe and the output should never exceed 1000 ppm. If the output is more than 1000 ppm any person in that environment can experience sleeplessness, headache, stuffy nose and it smells stagnant. If it further exceeds to 2000ppm then one may experience severe symptoms like abnormal heart beat, and other breathing related problems. So whenever the pollution level exceeds 1000ppm the buzzer gives an alarm with the LCD displaying "Bad air quality" indicating that the air quality in the region is not good for health and one should move to some other area or wear a mask for his protection. The ESP8266 WIFI module connects the microcontroller to the internet it helps in the storage and further analysis of the data of the sensor, which makes it easier to monitor the pollutants in the air through internet using the application. The system triggers an alert message on mobiles and watches when the quality of air crosses a threshold level ie. When the quality of air becomes hazardous for the health of an individual. Our work helps in the proper detection and monitoring of the quality of the air and plays a key role in controlling and combating air pollution by monitoring the quality of air so that necessary actions could be taken effectively to control air pollution.





Output At ThingSpeak

## VII. CONCLUSION

In recent years, with the rapid advancement in industrialization and urbanization, there has been increase in the air pollution which has led to many acute health diseases like asthma, increased cardiac arrest, bronchitis, major dermatological diseases and many more. It's the need of the current scenario to come up with some new technologies to get the grip of the ever-depleting air pollution condition, for which first we need to monitor and detect the air quality of a certain region first. The proposed project works on detection and monitoring of air pollution for a small area using the Arduino uno microcontroller.

The concepts of IOT intensify the process of monitoring various aspects of environment such as air quality monitoring issue that is being discussed in this paper.

The sensor that we are using in this project is MQ135. MQ315 is used here because of its ability to sense various types of harmful and dangerous gases in our surroundings. The MQ-135 Gas sensor can detect gases like Ammonia (NH<sub>3</sub>), Sulphur (S), Benzene (C<sub>6</sub>H<sub>6</sub>), CO<sub>2</sub>, and other harmful gases and smoke.

Along with the sensors, LCD is also used, a Wi-Fi and a GSM module is also used in this project which is used in sending the real time data to its user via webserver on their mobiles and computers along with the SMS alerts also.

## VIII. LIMITATIONS

Though we have made advancements in the proposed work with respect to the earlier works in this area, still there arises some limitations of our proposed work.

- Loss of signal, loss of network etc. which sometimes creates hindrance in the execution of the project.
- We have also noticed that it takes some time to update the values on the server, which sometimes can come across like a time consuming process.
- The MQ 135 gas sensor can detect gases namely ammonia, sulphur, benzene, carbon dioxide, and smoke.

Hazardous gases other than the above mentioned ones cannot be detected.

- The comparative analysis of the pollution rate over a long period of time cannot be done as our proposed idea doesn't store any database.

With more and more researches on this topic, the limitations of the project may reduce.

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