International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 08 | Aug 2021 www.irjet.net p-ISSN: 2395-0072

AIR QUALITY MONITORING SYSTEM

Arsh Meharwal[1], Anurag Sharma[2], Ankit Kumar[3], Anshul Singhal[4]

[1-4]Dept. of ECE, ABES Engineering College, Ghaziabad, India

---

Abstract: In our lives air pollution is a big worry all over the world especially air pollution among other. Our Project will use a combination of CO2, CO, PROPANE, and methane (CH4) gas sensors to estimate air quality and show you what the true situation is, including wind and weather. This device may be used to monitor a range of gases at the same time, which addresses the disadvantages of the conventional air quality sensor. The most difficult aspect will be that this system will offer real-time information on ambient air quality based on existing air quality regulations. The system will offer the user with weather information that is forecasted in advance, as well as information on how polluted the ambient weather is. This system will do a lot of things, including determining how safe it is in smart cities, where people have less and less time to spend and the weather is becoming dirtier. The Goal of our Project is to create a low-cost, real-time pollution index (AQI measuring) system using the sensors, Arduino Microcontroller, and LCD. Also our aim is to make it as sensitive as possible to the people in all the communities that use and, if any, research, organization, would like to do follow-up research, a part of the nominal amount of money to be invested, that would be a great solution for a particular station, that is, a quality measuring system of air.

Introduction

We came to read in news about air pollution every day, people get sick, due to issues of Global warming and air pollution, the end result will be in people's lives. From a top-down perspective, each developing nation is suffering from the Air Pollution. The main cause of climate change and human health is pollution in air. This has resulted in changing of climates and, a global energy shortage, the rain, drought, storm, hard rain, fog, etc, for the Living creatures on land and under water, which is suffering from the many problems that life has changed because of the lack of well-being. The weather is the most useful thing for each and every living being, he would have left right away. Intelligence of air pollution is a very serious problem, the main objective of this scheme is to evaluate the readings of our air, for the people, and all of the other living things on earth from existing ones. It is very important to our lives, in order to know the degree of certainty we have is now, and how much the weather has changed as a result of air pollution. This Project will help you to find answers to your questions in the air. Of the four gas sensing devices, which are mainly accountable for the main air pollutants, are available in the system in order to find out what is the best score of any state in the air. The CO2, CO, and relative humidity are the ones that are most responsible for air pollution, and we had tried to incorporate all of these readings in our system

Literature Survey

1) IOT Based Air Pollution Monitoring System Using Node MCU Arduino

Poonam Pal, Ritik Gupta, Sanjana Tiwari, Ashutosh Sharma

The amount of pollution has risen through time due to a variety of causes such as population growth, increasing vehicle usage, industrialization, and urbanization, all of which have negative impacts on human welfare by directly harming the health of those who are exposed to it. In order to keep track of things, In this project, we will create an IOT-based Air Pollution Monitoring System in which we will monitor the air quality over the internet using a web server and will set off an alarm when the air quality drops below a certain threshold, i.e. when there is a sufficient amount of harmful gases such as CO2, smoke, alcohol, benzene, and NH3 present in the air. On the LCD, it will display the air quality in PPM.

2) IOT Based Air Pollution Monitoring System

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

Every nation's largest challenge, whether established or developing, is air pollution. Health issues have been increasing at a quicker rate, particularly in developing nations' metropolitan centres, where industrialisation and an increase in the number of cars has resulted in the emission of a large amount of gaseous pollutants. Mild allergic reactions such as irritation of the throat, eyes, and nose, as well as more significant issues such as bronchitis, heart disease, pneumonia, lung, and exacerbated asthma, are all harmful impacts of pollution. According to a study, air pollution causes 50,000 to 100,000 premature deaths each year in the United States alone. In the EU, the figure is 300,000, with over 3,000,000 worldwide.

3) IOT Based Air Quality Monitoring System

Ch.V.Saikumar[1] M.Reji[2] P.C.Kishoreraja[3] Department of ECE, Saveetha School of Engineering Saveetha University, Chennai, India

The major goal of this project is to keep track on air pollution in industrial and urban areas. A set of gas sensors (CO and NO2) are positioned on the masses and structure of an IOT (Internet of Things), as well as a dominating server, in the suggested design to assist both short-term real-time event management and long-term strategic planning. The Arduino platform is utilised to exchange data easily and rapidly in this project.The trans receiver is a WSN (Wireless Sensor Network). This gives you a real-time low. Rate monitoring system for low-rate, low-information, and low-control applications for Technology for wireless communication.

The issue with this article is that the sensor has not been calibrated, and the sensor output value has not been translated into PPM. According to UN Data, a SAFE value is 0-50, and a moderate value is 51-100. Delhi is the world's most polluted city, according to records 350PPM. Due to the fact that both sensors have an internal heat element, it uses a lot of power when utilising two sensors.

(4) Arduino Based Weather Monitoring System

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

Temperature, humidity, light intensity, dew point, and heat index are among the weather/environmental variables measured by three sensors in this paper. The Arduino microcontroller processes the values read from the sensors and saves them in a text file can be analysed after being processed. The readings are also shown on an on-screen display.For rapid viewing, there is an LCD on board. All of these data may be examined to determine the weather.Weather patterns are recorded as well as the features of a certain location. These have been documented.Parameters are necessary and differ from one location to the next.

(5) IoT Based Air Pollution Monitoring System

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

The amount of pollution has risen through time due to a variety of causes such as population growth, increasing vehicle usage, industrialisation, and urbanisation, all of which have negative consequences for human well-being by directly harming the health of those who are exposed relating to it In order to keep track of things, In this project, we will create an IoT-based Air Pollution Monitoring System. Monitoring System in which we will use a web server to monitor the air quality. When the air quality falls below a specific threshold, an alert will sound on the internet. When a significant number of hazardous gases, such as CO2, are present in the air, it is said to be polluted. Smoke, alcohol, benzene, and NH3 are all known carcinogens. It will display the air quality in PPM on the LCD and on the internet so that we can easily monitor it. We utilised the MQ135 sensor, which is the ideal choice for air quality monitoring because it can detect the most hazardous pollutants, gases and can precisely quantify their quantity. You may track your progress with this IoT project. Using your computer or mobile device, you may check the pollution level from anywhere.

Methodology

The Pollution of air index, or AQI, is a scale that calculates the intensity of pollution in air. The high the A.Q.I Level, the worse is the air quality is to health of humans.

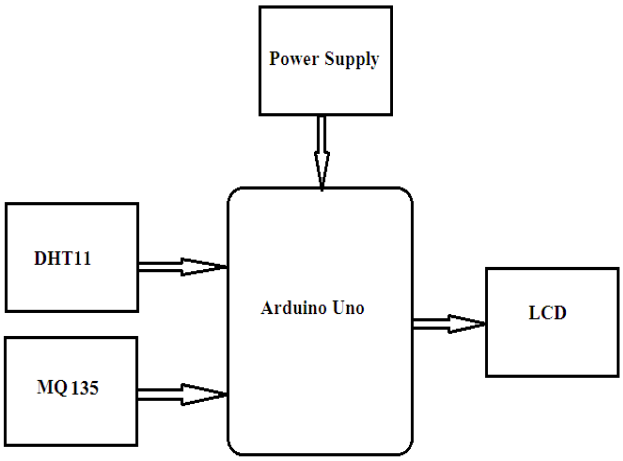


Fig.1 Block Diagram of Proposed System

We Know that MQ-135 Consists of a variable Resistor Rs whose value will change with respect to PPM of Gases

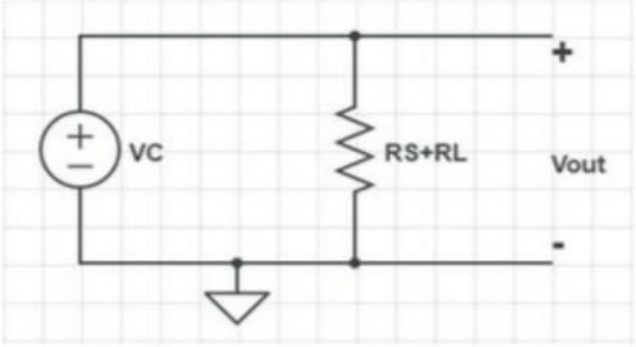


Fig. 3. Internal circuit diagram of MQ135

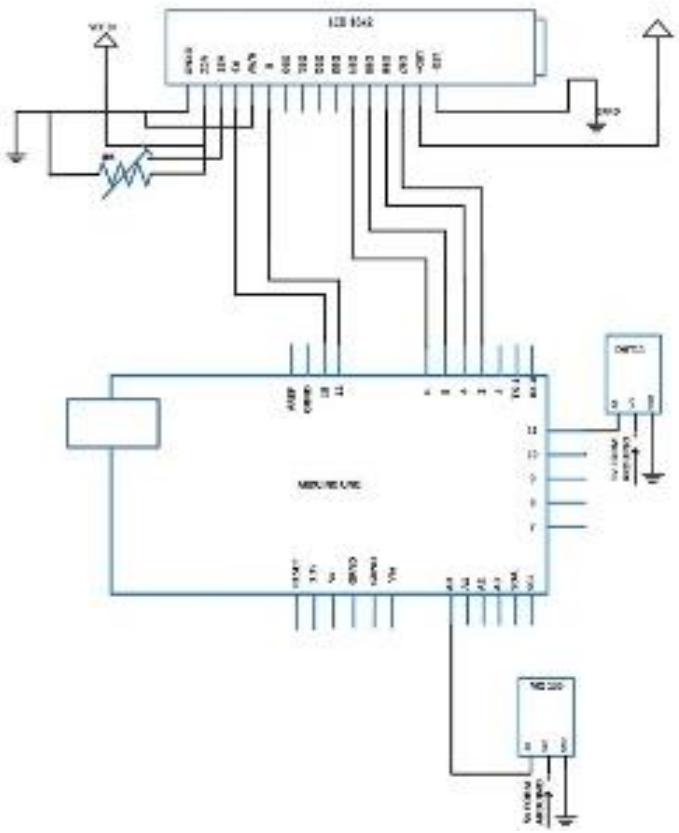


Fig. 2 Circuit Diagram

I = V/ R (1)

From Fig. 3 , equation 1 is equivalent to

I = Vc / Rs + RL (2)

From , we can obtain the output voltage at the load resistor using the value obtained for I and Ohm's Law at constant temperature.

V = I*R

VRL = [Vc/ Rs + RL] ∗ RL (3)

VRL = [Vc ∗ Rl [Rs + Rl] (4)

(VRl ∗ Rs) + (VRl ∗ Rl) = Vc ∗ RL (5)

VRl ∗ Rs = (Vc ∗ Rl) − (VRl ∗ Rl) (6)

Equation 7 help us to find the internal sensor resistance for different PPM of Gases

Rs = (Vc ∗ RL)/ VRL − RL (7)

We Will need to find the value of Rs in fresh air and name it as Ro.

A.Q.I = Rs/Ro

We can Then make a Arduino Code for feed in Arduino so that correct Reading for respective ppm can be obtained

Arduino Code

```
#include "DHT.h"

#define DHTPIN 3

#define DHTTYPE DHT11

DHT dht(DHTPIN, DHTTYPE);

#include <LiquidCrystal.h>

LiquidCrystal lcd(13, 12, 7, 6, 5, 4);

float R0 = 76.63;

float RL = 10.0; // Load resistance on board

void setup() {

 dht.begin();

 lcd.begin(16, 2);

 lcd.setCursor(3, 0);   // 3rd position 0 line 1

 lcd.print("AIR QUALITY");

 lcd.setCursor(3, 1);

 lcd.print("MONITERING");

 delay(5000);

 lcd.clear();

}

void loop() {

 int sensorValue = analogRead(A0);

 float   Rs  =  (5/(sensorValue  *  (5.0/1023.0))-1)*RL;
//Rs = (Vcc/VRL-1)x RL

      int aqi = Rs/R0;

      float h = dht.readHumidity();

      float t = dht.readTemperature();

      lcd.setCursor(0, 0);

      lcd.print("AQI HUMID. TEMP.");

      lcd.setCursor(0, 1);

      lcd.print(aqi);

       lcd.setCursor(4, 1);
```

```
lcd.print(h);

lcd.setCursor(11, 1);

lcd.print(t);
```

This project has been proposed to offer us with real-time AQI readings in a specific region. It is tiny, portable, and reasonably inexpensive because it is built on Arduino. The model is used to track smoke levels in the atmosphere in order to make the environment smarter. The proposed prototype model is depicted in fig2 above, and it is more adaptive and versatile in terms of monitoring environmental conditions. The suggested Arduino Uno based Air Quality Monitoring and Filtering System is made up of several sensors that are utilized to measure various gases as well as the temperature and humidity of the surrounding environment. Different sensors are employed in the proposed system for MQ135, DHT11, which are utilized for detecting various gases present in the atmosphere.

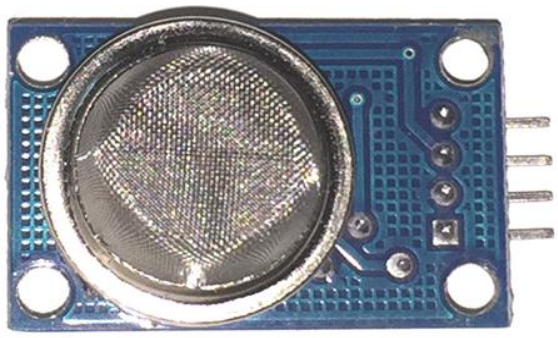
Components

A. Arduino UNO

The Arduino Uno is a microcontroller board that uses the ATmega328P microprocessor. It contains 14 digital input/output pins, 6 analogue inputs, a 16 MHz ceramic resonator, a USB connection, a power connector, an ICSP header, and a reset button. It comes with everything you'll need to get started with the microcontroller; simply plug it into a computer with a USB connection or power it with an AC-to-DC converter or battery.

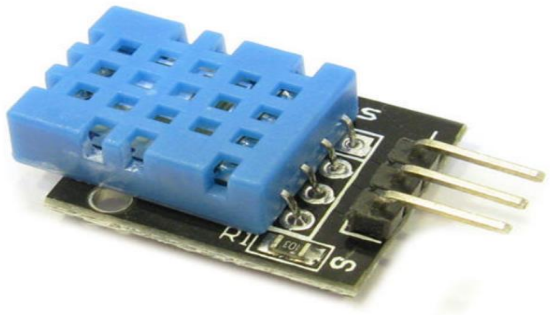
B. POLLUTION SENSOR (MQ135)

A wide variety of gases, including NH3, NOx, alcohol, benzene, smoke, and CO2, are detected by this air quality sensor. Ideal for usage in a factory or office. The MQ135 gas sensor is extremely sensitive to ammonia, sulphide, and benzene steam, as well as smoke and other hazardous gases. It has a cheap cost and is especially well suited for air quality monitoring applications.



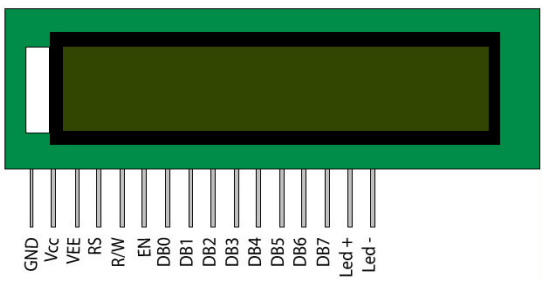
C. DHT 11

The DHT11 is a low-cost digital temperature and humidity sensor. This sensor may simply be connected to any microcontroller (Arduino, Raspberry Pi, etc.) to detect humidity and temperature in real time. A capacitive humidity detecting element and a thermistor for temperature detection make up the DHT11 sensor. The IC measures, processes, and converts the resistance values into digital form.



D. LCD Display

A **16x2** LCD can display 16 characters per line on each of its two lines. Each character is presented in a 5x7 pixel matrix on this LCD. Command and Data are the two registers on this LCD. The LCD command instructions are stored in the command register. A command tells the LCD to perform a certain activity, such as initialising it, cleaning its screen, setting the cursor location, managing the display, and so on.



Results and Discussion

From the below AQI Chart we can deduce that a sufficiently good AQI depends on many factors. All of these factors can be deduced by our system and a precise API Can be calculated along with Temperature and Humidity Readings.

For Temperature:

Data is collected at interval of 20 mins on a particular day

Mean of System data:

$$T_s = \frac{Sum\ of\ System\ Readings}{No.Of\ Observation} = 35^0C$$

$$[T_s = System\ Temperature]$$

Standard Data

$$T_{sd} = \frac{Sum\ of\ Official\ Temperatures}{No.of\ observations} = 35.6^0C$$

$$[T_{sd} = Standard\ Temperature]$$

Percentage Error

$$e = \frac{35.6 - 35}{35.6} \times 100 = 1.68\%$$

For Humidity:

Mean of System data:

$$H_s = \frac{Sum\ of\ System\ Readings}{No.Of\ Observation} = 75.2\ g/m\text{^}3$$

$$[H_s = System\ Humidity]$$

Standard Data

$$H_{sd} = \frac{Sum\ of\ Official\ Temperatures}{No.of\ observations} = 76.4\ \ g/m\text{^}3$$

$$[H_{sd} = Standard\ Humidity]$$

Percentage Error

$$e = \frac{76.4 - 75.2}{76.4} \times 100 = 1.57\%$$

For AQI

Data is taken at interval of 10 days

DATE	AQI data observed by our machine	AQI data observed from Official data
10/06/2021	143	150
11/06/2021	120	117
12/06/2021	95	96
13/06/2021	101	105
14/06/2021	101	104
15/06/2021	95	94
16/06/2021	96	98
17/06/2021	107	112
18/06/2021	70	73
19/06/2021	65	71

Mean of System data:

$$AQI_s = \frac{Sum\ of\ System\ Readings}{No.Of\ Observation} = 99.3$$

$$[AQI_s = System\ AQI]$$

Standard Data

$$T_{sd} = \frac{Sum\ of\ Official\ Temperatures}{No.of\ observations} = 100.7$$

$$[T_{sd} = Standard\ Temperature]$$

Percentage Error

$$e = \frac{100.7 - 99.3}{100.7} \times 100 = 1.4\%$$

AQI Category	AQI	Concentration range*							
		PM_{10}	$PM_{2.5}$	NO_2	O_3	CO	SO_2	NH_3	Pb
Good	0 - 50	0 - 50	0 - 30	0 - 40	0 - 50	0 - 1.0	0 - 40	0 - 200	0 - 0.5
Satisfactory	51 - 100	51 - 100	31 - 60	41 - 80	51 - 100	1.1 - 2.0	41 - 80	201 - 400	0.5 - 1.0
Moderately polluted	101 - 200	101 - 250	61 - 90	81 - 180	101 - 168	2.1 - 10	81 - 380	401 - 800	1.1 - 2.0
Poor	201 - 300	251 - 350	91 - 120	181 - 280	169 - 208	10 - 17	381 - 800	801 - 1200	2.1 - 3.0
Very poor	301 - 400	351 - 430	121 - 250	281 - 400	209 - 748*	17 - 34	801 - 1600	1200 -1800	3.1 - 3.5
Severe	401 - 500	430+	250+	400+	748+*	34+	1600+	1800+	3.5+

* CO in mg/m^3 and other pollutants in $\mu g/m^3$; 2h-hourly average values for PM_{10}, $PM_{2.5}$, NO_2, SO_2, NH_3, and Pb, and 8-hourly values for CO and O_3.

Here is the chart of the sensors that is used to take the readings of a certain place in Ghaziabad. In this chart we have seen that CO result is in between 1100-2000 ppm, which states that concentrations typical of occupied

indoor spaces with good air exchange. It mean that CO level, is not that ideal for humans.

Our device will show accurate results even in the highly polluted times and can help to avoid people in coming outside to be exposed to such a dreadful condition and help save people lives.

Conclusion

This research presents a unique technique to monitor the environment, air, and sound pollution using a low-cost, efficient, and embedded technology. The functions of various sensors and how they work were explained in the suggested architecture. They are also discussed in terms of the way they are working, their uses, their features, and their way they collect data and comparisons to regular known data. The noise and air pollution monitoring system was put to the test in order to keep track of gas levels in various sections of the country. The sensor parameters were also provided to the data server. Our project equipment proved to be effective, inexpensive, and equipped with various highly functional sensors it may, indeed, be reliable, and to all of you, and then the data is going to be the key to take any action that is necessary in order to improve the community, as it will help you to identify the affected area so that we can take early action to reduce the damage, reduce the generations to come.

References

[1] Poonam Paul, Ritik Gupta, Sanjana Tiwari, Ashutosh Sharma, "IoT based Air Pollution Monitoring System with Arduino", IJART, May 2005.

[2] Zishan Khan, Abbas Ali, Moin Moghal, "IoT based Air Pollution using NodeMCU and Thingspeak", IRANS, pp. 11-16, March 2014.

[3] SaiKumar, M. Reji, P.C. KishoreRaja "AirQuality Index in India", IEEE conference Chennai, August 2014.

[4] Mohan Joshi, "Research Paper on IoT based Air and Sound Pollution monitoring system", IETS Journal, pp. 11-17, September 2015.

[5] Malaya Ranjan, Rai kumar, "Understanding Parts per million in real time air Air Quality Monitoring System 9 quality index", Journal of Mathematics and advanced sciences, pp. 23-29, September 2009

[6] D. Bandyopadhyay and J. Sen, "Internet of Things: Applications and Challenges in Technology and Standardization," Wirel. Pers. Commun., vol. 58, no. 1, pp. 49–69, May 2011.

[7] L. Atzori, A. Iera, and G. Morabito, "The Internet of Things: A Survey," Comput. Netw., vol. 54, no. 15, pp. 2787–2805, October 2010.

[8] H. Kopetz, Real-Time Systems: Design Principles for Distributed Embedded Applications. Boston, MA: Springer US, 2011, ch. Internet of Things, pp. 307– 323.

[9] A. Gluhak, S. Krco, M. Nati, D. Pfisterer, N. Mitton, and T. Razafindralambo, "A Survey on Facilities for Experimental Internet of Things Research," IEEE Communications Magazine, vol. 49, no. 11, pp. 58–67, November 2011.

[10] J. Kim, J. Lee, J. Kim, and J. Yun, "M2M Service Platforms: Survey, Issues, and Enabling Technologies," IEEE Communications Surveys Tutorials, vol. 16, no. 1, pp. 61–76, January 2014.

[11] Jen-Hao Liu, Yu-Fan Chen, Tzu-Shiang Lin, And Da-Wei Lai ,Tzai-Hung Wen, Chih-Hong Sun, And Jehn-Yih Juang,Joe-Air Jiangdeveloped Urban Air Quality Monitoring System Based On Wireless Sensor Networks 2011 IEEE.

[12] Srinivas Devarakonda, Parveen Sevusu, Hongz Hang Liu, Ruilin Liu, Liviu Iftode, Badri Nath Urbcomp‟ Real-Time Air Quality Monitoring Through Mobile Sensing In Metropolitan Areas‟13, August 2013 Acm.

[13] Fouzi Harrou, Mohamed Nounou,Hazem Nounou "Detecting Abnormal Ozone Levels Using Pca Based Glr Hypothesis Testing"2013 Ieee Symposium On Computational Intelligence And Data Mining.

[14] Elias Yaacoub, Abdullah Kadri, Mohammad Mushtaha And Adman AbuDayya,"Air Quality Monitoring And Analysis In Qatar Using A Wireless Sensor Network Deployment"596-601,2013 IEEE.

[15] Parr, T. W., Ferretti, M., Simpson, I. C., Forsius, M., & Kovács-Láng, E. (2002). Towards a long-term integrated monitoring programme in Europe: network design in theory and practice. Environmental monitoring and assessment, 78(3), 253-290.

[16] Jerrett, M., Arain, A., Kanaroglou, P., Beckerman, B., Potoglou, D., Sahsuvaroglu, T., ... & Giovis, C. (2005). A review and evaluation of intraurban air pollution exposure models. Journal of Exposure Science and Environmental Epidemiology, 15(2), 185

[17] Oh, S. J., & Chung, W. Y. Room environment monitoring system from PDA terminal. In Intelligent Signal Processing and Communication Systems, 2004.ISPACS 2004.Proceedings of 2004 International Symposium.IEEE: 2004. pp. 497-501.

[18] Kim, S., & Paulos, E. (2010, April). In Air: sharing indoor air quality measurements and visualizations. In Proceedings of the 28th international conference on Human factors in computing systems.ACM:2010. pp.1861-1870.

[19] K.-H. Kim, E. Kabir, and S. Kabir, "A review on the human health impact of airborne particulate matter," Environment international, vol. 74, 2015.

[20] M. Franchini and P. M. Mannucci, "Thrombogenicity and cardiovascular effects of ambient air pollution," Blood, vol. 118, no. 9, 2011

[21] H. N. Saha et al., "Pollution control using internet of things (iot)," in 8th Annual Industrial Automation and Electromechanical Engineering Conference (IEMECON), IEEE, 2017.

[22] O. Hahm, E. Baccelli, H. Petersen, and N. Tsiftes, "Operating systems for low-end devices in the internet of things: a survey," IEEE Internet of Things Journal, vol. 3, no. 5, 2016.