

IOT Enabled Air Pollution Monitoring and Awareness Creation System

Yamunathangam, K. Pritheka, P. Varuna

Abstract: The air pollution rates now a days are drastically increasing in all the developed and the developing countries which requires a more portable and cost effective solution. The proposed system includes the design for monitoring air pollution and creating awareness among the public. This paper aims at using IOT along with cloud to make the services real time and faster. The proposed system is installed in a particular locality where there is acute air pollution. The level of each hazardous pollutant is monitored at periodic intervals. The Air Quality Index (AQI) for the observed pollutants is determined and awareness is created among the public through an android app which displays the level of each observed pollutant and also the air quality index in that particular location. Thus the quality of air in that area can be understood by the public by viewing the concentration of the gases in both numerical and graphical format. Further this system is to be extended in future by allowing the public to register themselves in an app which pushes weekly or monthly air quality report through message which reaches the user as a notification that is more comfortable in access.

Keywords: Arduino, hazardous pollutants, AQI, Thingspeak, Android

I. INTRODUCTION

Air pollution is the worst environmental problem and it causes a multitude of adverse effects on human health, water bodies and climate. The main source of air pollution in all major cities is due to vehicles and the second major source remain the industries. The massive use of vehicles has resulted in vital increase of toxins in the atmosphere. This is the cause of environmental pollution affecting the human health. It has also resulted in other respiratory problems like asthma attacks and skin rashes. The Central Pollution control board has set a standard to these levels but the public is reluctant to follow them. The pollutants which spoil the air are invisible which has led to the negligence of the people. So, public acknowledgement is the prime requisite of today. Hence the proposed system solves this major issue. The air pollution monitoring system is installed in a particular locality where there are traces of acute air pollution to detect the constituent gases of air which may lead to harmful effects on human health and other living beings This system uses arduino and several gas sensors to predict the level of various harmful gases like CO, NH₃, particulate matter and smoke.

Manuscript published on 30 November 2018.

*Correspondence Author(s)

Yamunathangam, Assistant Professor, Kumaraguru College of Technology, Coimbatore (Tamil Nadu), India.

K.Pritheka, Graduate trainee, AstraZeneca India Pvt Ltd, Chennai (Tamil Nadu), India.

P.Varuna, UG scholar, Kumaraguru college of Technology, Coimbatore (Tamil Nadu), India.

© The Authors. Published by Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP). This is an [open access](https://creativecommons.org/licenses/by-nc-nd/4.0/) article under the CC-BY-NC-ND license <http://creativecommons.org/licenses/by-nc-nd/4.0/>.

Carbon Monoxide is given the highest preference, as it is a greenhouse gas and a major pollutant that is warming the earth. The previous products did not have an advantage of getting the pollution rates up to date. So to overcome this, an android app is used, which the public can install it to get regular updates on the quality of air in the area they live.

The measured air quality level is also displayed in android application which helps the users in getting updates about the current air quality. Users are able to view the air quality level in numerical as well as graphical format. In addition, the Air Quality Index (AQI) for the current pollution level is determined and displayed in the application along with health effects. Thus, this application lets the users to take effective measures in advance to protect themselves from harmful effect.

II. LITERATURE SURVEY

The major cause of air pollution in cities is due to vehicles. Vehicular pollution leads to a vital increase in the emission of loads of myriad toxins into environment. The commercial systems available in the market are devices that use the semi-conductor sensors at the smoke emission outlets of vehicles and this system detects the pollutant levels and also indicates this level to the owner of the vehicle with a meter. When the pollution level increases beyond a particular threshold level, alarm will start ringing in the vehicle to indicate that the limit has been attained and the vehicle will automatically stop running after certain time[3][11]. This type of individual usage system does not help the public to get into an awareness zone. Bharat stage emission standards are the emission standards set by the Indian Government to regulate air pollutants from internal combustion engines in motor vehicles. Also over the years, several regulations have been made by the Government to regulate and reduce the emission from vehicles but in vain.

Also other cost effective measures were introduced to control the air pollution by calculating the levels of each and every pollutant [5][7][10]. Based on the observed values, the air quality index for that region is calculated and the values are made available through a web page. But the main disadvantage of this system is that, users are not provided with a portable application to view pollution levels then and there and also a pictorial format is missing for easy view[8][1].

The real time air pollution monitoring system was developed which measures the levels of almost all the pollutants with good accuracy[2]. Libelium wasp nodes are used for wireless communication and the data is displayed through a web interface both in chart and numerical format.



IOT Enabled Air Pollution Monitoring and Awareness Creation System

But the usage of these libelium wasp nodes have resulted in the production of expensive system for the public usage as it consumes more energy from the batteries [8][4].

Further a low-cost wireless monitoring system was developed to measure the levels of harmful gases based on a multilayer distributed model using Arduino platform and Xbee. In addition, to achieve data transmission, a software component was built using C/C++ language. The data is collected and sent to a webpage to make the data available real time. The system is quite complicated since various software languages have been used in this system i.e. Java for computer system and C/C++ for conversion of analog data to digital form[9][6].

III. DESIGN OF THE PROPOSED SYSTEM

The paper aims at designing an air pollution monitoring system which can be installed in a specific locality and to enhance the system from the previously developed systems beating the earlier disadvantages by developing an android app available for the public. This app can be used by anyone to get in live updates about the pollution in their region. It uses Arduino integrated with individual gas sensors like carbon monoxide, ammonia along with particulate matter, humidity, and smoke which measures the concentration of each gas separately. The collected data is uploaded to the cloud using thingspeak platform at regular time intervals. Ethernet shield is used for connecting arduino and cloud. Pictorial or graphical representation of values can be shown in Thingspeak.

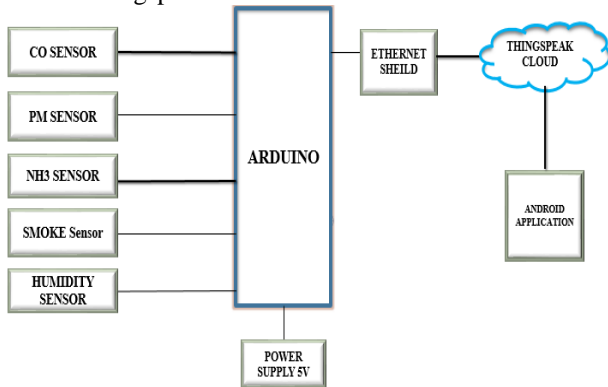


Fig 1: Architecture of air Pollution Monitoring and Awareness Creation System

The users can install an android application through which they get the recent updates and graphical content up to date. The average concentration of each gas is analyzed using matlab. Then certain time control is assigned based on the standard level of each gas measured and the result can be viewed in android application. The architecture of air pollution monitoring and awareness creation system is shown in figure 1.

The concentration level of each gas can be viewed both as a graph and in numerical format. Based on these values the air quality index value is calculated and the nature of the air quality in that area is determined which is also displayed through the app. Along with this, the health effects for the corresponding air quality is displayed to create awareness among the public. Additionally, they could also get to know the temperature and weather in that region. The users will not get disturbed with irrelevant data as the values displayed

are location specific and help them stay tuned to the current status of air pollution. The hardware setup of proposed system is shown in figure 2.

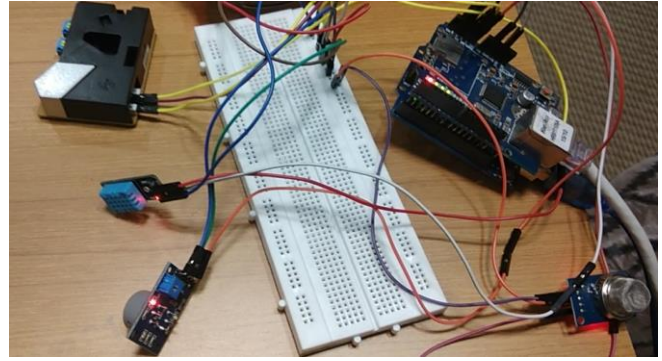


Fig 2: The Setup of Hardware

IV. EXPERIMENTAL SETUP OF THE PROPOSED SYSTEM

A. Arduino Uno board

Arduino is an advanced microcontroller which can work with various communication technologies and sensors. Due to its simplicity and availability of number of hardware extensions, the board can be used with utmost efficiency.

B. Ethernet Shield

The usage of Ethernet shield over Wi-Fi module is an advantage as it provides reliable TCP connection and has a good throughput. It uses Ethernet library to read and write using an SD card.

C. Gas Sensors

Gas sensors like MQ135, MQ7, MQ2 are used along with particulate matter sensor DSM501A and humidity sensor. The gas sensors MQ135, MQ7, MQ2 measure the concentration of hazardous gases like ammonia, carbon monoxide(CO), methane, smoke etc. DSM501A is PM2.5 sensor used to measure particulate matter, which is the mixture of liquid and solid particles with diameter of 2.5 micrometers or smaller than that floating in air. The concentration of various gases and particulate matter can be collected. The collected data is uploaded to cloud. The concentration of gases are obtained in microgram per meter cube and ppm (particles per million).

D. Thing Speak

Thing Speak is a cloud platform for Internet of Things. It allows the users to store the data collected from sensors in different channels. It is also used for real-time data processing, visualizations, and plugins.

V. RESULTS OF SYSTEM OPERATIONS

The concentration of each gas measured using various sensors are observed through serial monitor of arduino. Further, the data will be collected in the respective thingspeak channels by means of Ethernet shield and this data is now available in live for further processing.

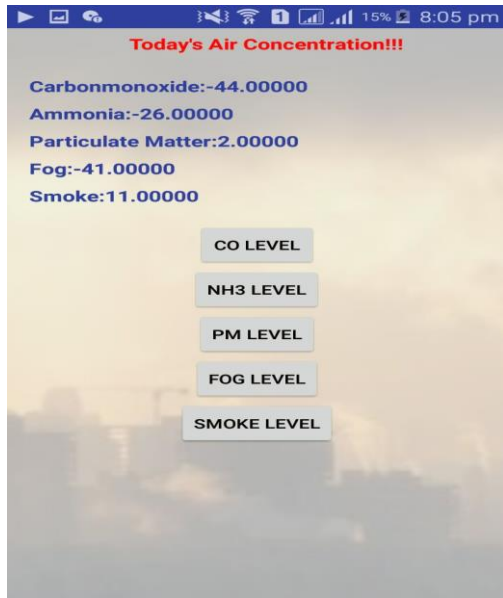


Fig 3: Results Displayed Through Android App

The analyzed results are viewed through thinspeak in a graphical format. Further the average pollution level is calculated using matlab analysis and the time controlled results are viewed through an android app as shown in figure 3 and figure 4.



Fig 4 : Graphical Format of Pollution level

Further based on location, a final air quality index value is obtained through the android app which is much accurate. Along with this, the health effects are also displayed in the app, so that the users can stay aware of the pollution levels. The health effects and air quality index that can be viewed in mobile application is represented in figure 5.

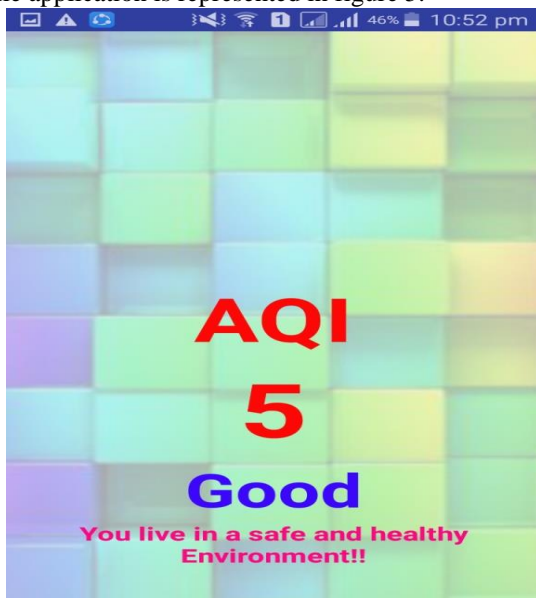


Fig 5: Air Quality Index value of locality

VI. CONCLUSION

The air pollution monitoring system using various gas sensors senses the pollutant levels and uploads the data in cloud, thus making the public get easy access to the pollution level in their area. This is of wide use to offices, factories, residential areas and education institutions, if installed in their premises ,because staying in tune with the changes in our environment is the most necessity of today.

REFERENCES

1. Kgotutjo Simon Elvis Phala, Anuj Kumar, and Gerhard P.Hancke, "Air Quality Monitoring System Based on ISO/IEC/IEEE 21451 Standards", IEEE Sensors Journal, Vol. 16, No. 12, June 15, 2016.
2. Khaled Bashir Shaban, Senior Member, IEEE, Abdullah Kadri, Member, IEEE, and Eman Rezk, "Urban Air Pollution Monitoring System", With Forecasting Models, IEEE Sensors Journal, Vol. 16, No. 8, April 15, 2016.
3. Ramagiri Rushikesh and Chandra Mohan Reddy Sivappagari, "Development of IoT based Vehicular Pollution Monitoring System", International Conference on Green Computing and Internet of Things (ICGCIoT),2015.
4. Dongyun Wang, Chenglong jiang, Yongping Dian, "Design of air quality monitoring system based on internet of things",10th International Conference on Software, Knowledge, Information Management & Applications (SKIMA),2016.
5. Akshata Tapashetti and Divya Vegiraju, "IoT-Enabled Air Quality Monitoring Device - A Low Cost Smart Health Solution",IEEE Global Humanitarian Technology Conference,2016.
6. Navreetinder Kaur,Rita Mahajan ,Deepak Bagai, " Air Quality Monitoring System based on Arduino Microcontroller",International Journal of Innovative Research in Science,Engineering and Technology Vol. 5, Issue 6, June 2016.
7. Marin B. Marinov, Ivan Topalov, Elitsa Gieva and Georgi Nikolov, "Air Quality Monitoring in Urban Environments", 39th International Spring Seminar on Electronics Technology (ISSE),2016.
8. Santosh G Bhandarakawathe, Prof.S. B. Somani, "A Survey on WiFi Based Air Pollution Monitoring System", International Journal of Innovative Research in Computer and Communication Engineering Vol. 5, Issue 3, March 2017.
9. Ch.V.Saikumar, M.Reji P.C.Kishoreraja , "IOT based Air Quality Monitoring system",International Journal of Pure and Applied Mathematics Volume 117 No. 9 2017, 53-57.
10. Neha R. Rewatkar,Prof. Deepali M. Khatri, "A Review: Cost Effective IOT Based Air Pollution Monitoring and Air Quality Analysis", International Journal on Recent and Innovation Trends in Computing and Communication ISSN: 2321-8169,Volume: 5 Issue: 1,2017
11. Siva Shankar Chandrasekaran, Sudharshan Muthukumar and Sabeshkumar Rajendran, "Automated Control System for Air Pollution Detection in Vehicles", 4th International Conference on Intelligent Systems, Modelling and Simulation,2013.