

# Air Quality Monitoring and Prediction System

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**ABSTRACT:** Nowadays, Internet Of Things (IoT) is a positive research approach in many areas like education field, industries and commercial. Smart cities are using IoT based services to create the working urban life. By using information and communication technologies, smart cities associate makes people more aware and synergetic. Smart cities uses IoT applications for long lasting development of the cities. Smart cities data are increasing rapidly so that the quantity of data construct by this application is also increasing enormously. A machine learning model have been used to calculate the problems for prediction. Machine learning techniques are more effective for prediction problems. In this paper we use the machine learning model for future prediction of air quality.

Air pollution is a complex mixture of harmful components with significant impact on humans and for improving life quality of estimating air pollution concentration proceed as priority. In populated and developing countries government consider ordinance of air as consequential task. Traffic problem, industrial variables such as power plant exclusion, home smoke and fossil fuel burning are the reasons for air pollution. out of all particulate matter PM2.5 is the most harmful and needs to be controlled. When it is present high in atmosphere then it is more harmful and causes health related issues to the people. From prior data, Auto regression techniques are used to predict the PM2.5 reading values and recent years, months and weeks it reduces than its harmful level. This auto regression techniques are used to know the reading of PM2.5 and detect the quality of air in a specific area.

**KEYWORDS:** Weather Forecasting, Air Quality, Machine Learning, Regression Analysis.

## I. INTRODUCTION

Air pollution in our country as well as in another countries is the most noxious issue. There is more harmful components are present in air which is outdoor and indoor also which can harm the animals, vegetation and humans. Therefore, it is necessary to control the pollution. Controlling air pollution is the more difficult task and should be handled carefully. In large cities there are more vehicles on road and many industries emitting smoke that's why air pollution crosses the standard limit so that city manager has to look up this issue as serious problem and needs to control it. The city manager has to provide correct information to the people about quality of air from that people can aware and avoid such areas. Correct prediction of air pollution is necessary to make people aware because it causes the health issues. To achieve less pollution, suitable techniques and tools are used.

A machine learning model for a smart cities and their applications need in smart cities are challenging. In smart cities, compared to town pollution is more and it needs to be handled. This machine learning model provides the application which detects the harmful gases like ozone, CO, SO<sub>2</sub>, lead, NO<sub>x</sub> and particulate matter such as PM<sub>2.5</sub> and PM<sub>10</sub> and to aware people about pollution and climate changes by current and future prediction.

## II. RELATED WORK

In this system architecture, for gas detection we use gas detection sensor to detect the harmful gases. Sensors are connected to the controller (ESP8266) which has inbuilt wifi module. By using this we can send data on cloud and also can use real time data. This all information can be detect or predict on ML system through an application or website.

Air pollution sensors contain gas sensor, humidity and temperature sensor which detect the harmful gases present in atmosphere. These sensors we can use in indoors and outdoors also. These sensors are easy to build so that we can build at home or can bought from manufactures also. There are many types of sensors such as air sensor, humidity, temperature sensors and they are specialized in certain aspects, they mainly focuses on five components nitrous oxide, sulphur dioxide, carbon monoxide particulate matter and ozone. In past these sensors are expensive but technologies advancement now they are affordable and widely spread throughout the population. These sensors are helpful to detect the harmful gases which are present in atmosphere.

In this module, we use (MQ6) gas sensor for harmful gas detection. This is liquefied petroleum gas (LPG) sensor which is simple to use, mainly suitable for sensing LPG which is composed of mostly butane and propane. MQ6 sensor can detect harmful gases anywhere from 200 to 10000 ppm. This sensor has high response time and high sensitivity.

In this Module, we use ESP8266 controller which has inbuilt wifi module. The ESP8266 controller which is self contained SoC with integrated TCP/IP protocol stack that give micro controller to access your wifi network. ESP8266 controller which is the most efficient controller which is able to do either offloading all wifi networking functions from another application processors or hosting an application.

In system architecture, prediction is shown in the statistics format. for this linear regression is appropriate algorithm. In our architecture we use gas sensor to sense the harmful gases which are present in air and humidity and temperature sensor to show the humidity and temperature of particular area on application. ESP8266 is used because it has inbuilt wifi module . we store this sensed data on cloud through inbuilt wifi controller ESP8266 and it shows the information on laptop/desktop through website or an application.

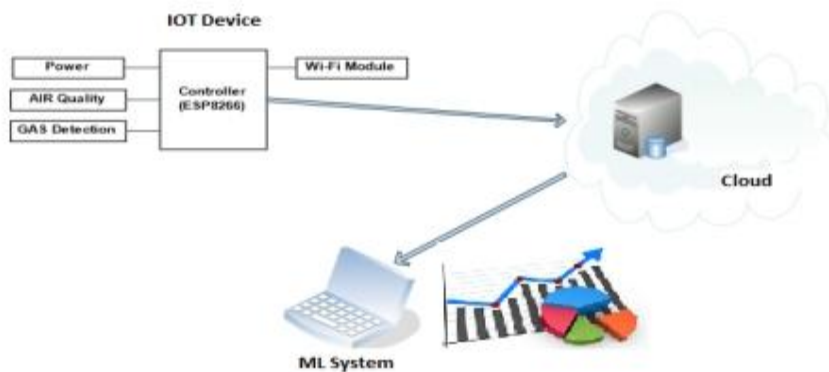


Figure 1. System Architecture

### III. LITERATURE REVIEW

Pollution is the most important issue in the world since recent years. Harmful contents present in air causes dangerous health issues. To control the level of pollution the wireless sensors are used to monitor and predict the pollution which mainly happen in smart city.

In 2015, smart environment monitoring system on vehicle was introduced. The harmful gases are more emitted from vehicle is find out. Many industrial monitoring system for health and safety precaution was introduce to know about harmful gases and their effects.

Pollution monitoring system was introduced to inquire about the quality of air in metropolitan cities. By using mobile GPRS we can also detect the air quality. Air pollution is increases in higher manner. If this problem is increasing day by day then we have to face many issues. So it's our responsibility to decrease the use of things which give rise to pollution. There are more pollution i.e. noise pollution, sound pollution, water pollution, soil contamination and many more .

According to WHO (world health organization), smoke inside home to the haze present in air posses a threat to health and atmosphere. Every year 7 million premature deaths are causes due to indoor and outdoor pollution.

The vital exterior pollution source includes vehicle emitting smoke, industries emitting smoke, power plant emission. In worldwide more than 3 billion people uses homemade fog , fuels, plastics that causes on burn more smoke , household cooking that releases smoke.

WHO approximate in 2016 there were 4.2 million deaths due to environmental pollution. so the idea was people let know about the amount of pollution is present in air and aware people about the toxic gases present in air.

The result is shown on android app as well as on website for the ease of people. There is need to measure the level of pollution to protect people from harmful gases. In this module , we use gas sensors to sense the harmful gases present in atmosphere and humidity and temperature sensor to detect humidity and temperature of particular area which can be shown on laptop/ desktop through an application or website.



Paper Title	Year	Techniques	Advantages	Disadvantages
The hourly prediction of NoX and NO2 concentration using neural network	1999	Neural network	Good at function approximation classification	It slows over time and only detect NOX and NO2 concentration
Using NN techniques prediction of ambient air quality.	2006	NN	Good at function approximation, classification, clustering	Network slows over time undergoes relative degradation
Using FCM-HMM model prediction of air pollution.	2016	FCM-HMM Model	Efficient learning algorithms - learning can takes place from raw sequence data	HMM have a large number of unstructured parameter
Air quality prediction using the most relevant spatial temporal relation based on adaptive deep learning	2018	Deep Learning-spatial temporal	Can overkill for less complex problems	It require very large amount of data .It is extremely expensive to train due to complex data model.

Figure 2.Literature Review

IV. SENSOR SURVEY

Name	Specification	Power supply	Interface type
MQ135	MQ135 is a gas sensor which is sensitive to urban gas, natural gas and LPG. It is less sensitive to smoke and alcohol. On board power indication.	Working voltage :DC 5V Working Current: 150	TTL output AOUT: Analog output
MQ7 - Carbon Monoxide Gas Sensor Module	MQ7 gas sensor has measuring ability ranging from 20 to 2000 ppm. Portable gas detection	NA	Simple drive circuit
MQ5 LPG Natural Gas Sensor Module	Same specification as MQ135 but no on board power indication.		Analog & Digital

Figure 3. Gas Sensor



Name	Specification	Power supply	Range
DHT11	It is combine humidity and temperature sensor which generate correct digital output.	It has power supply from 3.3 to 5.5 v DC And has output in 4 pin single row.	Humidity is between 20-90%RH and Temperature is between 0~50
DHT22	It is the next version of DHT11 and contained correct digital output of humidity and temperature sensor.	Supply voltage: 5V Sequence of the line: VCC ,GND	It has temperature ranging between 40 to 80 resolution is 0.1 and error should be <+0.5 Humidity also ranges between 0 to 100 % RH and resolution is 0.1% RH and error rate should be +-2%RH

Figure 4.Humidity and Temperature Sensor

Name	Specification	Features
ESP8266 WIFI module	It has inbuild wifi module and micro controller. It can send the serial port instruction to cell APP within LAN.	It has AP mode which can connect to 5 clients at a time. It has inbuild wifi module. Diode effusion protection; Short response time. Transmission Distance : 400m (max) Baud Rate: 9600.
ESP8266 controller	It is the new version of ESp8266 wifi module which has remote serial port wifi transceiver . Its low-cost and easy-to-use features which makes this module so popular.	Serial UART Interface It run LWIP This module is build in TCP/IP On board PCB Antenna

Figure 5. Controller Sensor

V. RESEARCH GAP

- All the existing systems deal about the detection and intimation to the authorities of the leakage but no control action is taken. This system overcomes this serious drawback and it controls the automated action in case of a leakage.
- We are sending the gas leakage information to owner. At last the awareness system is provided for improving the nearest about the leakage.
- In India till date we are using only manual technologies, we are proposing new technique of using wireless sensors.



- In other countries there are agencies like EPA which is taking care of monitoring air quality and taking respective actions. Also they use mobile based air monitoring method which uses the Geo spatial Measurement of Air Pollution (GMAP) research program.

## VI. CONCLUSION

This paper present the smart way to control the pollution as well as harmful gases present in air at low cost and in efficient way. In the proposed architecture working of sensors and procedures were discussed. Their work, how they work and their efficiency also discussed in this paper. The harmful gases is monitor and notify to aware people about pollution. The machine learning model provides application for this purpose. Our project device demonstrate the efficient and cheap and some highly reliable working sensors which is really reliable to everybody and it's data is key to take necessary steps for betterment of people as it will identify the harmful and affected areas so that we can take to fast steps to protect from pollution and reduce damages for futures.

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## REFERENCES

- [1] M. I. Ali, N. Ono, M. Kaysar, Z. U. Shamszaman, T.-L. Pham, F. Gao et al., "Real-time data analytics and event detection for IoT-enabled communication system;, Web Semantics: Science Services and Agents on the World Wide Web, vol. 42, pp. 19-37, 2017
- [2] H. B. Sta, "Quality and the efficiency of data in "Smart-Cities"", Future Generation Computer Systems, 2016
- [3] "State of Global Air 2017", Institute for Health Metrics and Evaluation (IHME), 2017.
- [4] X. L. L. P. Y. H. J. S. T. Chi, "Deep learning architecture for air quality predictions", Environ Sci Pollut Res, vol. 23, pp. 22408-22417, 2016.
- [5] R. S. P. Awkash, Kumar Anil Kumar Dikshit, Rakesh Kumar, "Application of AERMOD for short term air quality prediction Clean Techn Environ Policy, vol. 19, pp. 1955-1965, 2017.
- [6] Z. Yang, J. Wang, "A new air quality monitoring and early warning system: Air quality assessment and air pollutant concentration prediction", Environmental Research, vol. 158, pp. 105-117, 2017
- [7] J. Wang, X. Zhang, Z. Guo, H. Lu, "Developing an early-warning system for air quality prediction and assessment of cities in China", Expert Systems with Applications, vol. 84, pp. 102-116, 2017
- [8] S. Munawar, M. Hamid, M. S. Khan, A. Ahmed, N. Hameed, "Health Monitoring Considering Air Quality Index Prediction Using Neuro Fuzzy Inference Model A Case Study of Lahore Pakistan", Journal of Basic & Applied Sciences, 2017
- [9] L. Wang, X.-y. Xiao, J.-y. Meng, "Prediction of air pollution based on FCM-HMM Multi-model" 35th Chinese Control Conference, 2016
- [10] E. Pardo, N. Malpica, "Air Quality Forecasting in Madrid Using Long Short-Term Memory Networks", Biomedical Applications Based on Natural and Artificial Computing, vol. 10338, 2017
- [11] George Y. Lu, David W. Wong. An adaptive inverse-distance weighting spatial interpolation technique. Computers & Geosciences, 34,9 (2008), 1044-1055.
- [12] Tobler, Waldo R., 1970. A computer movie simulating urban growth in the Detroit region Economic Geography 46, 2 (1970), 234-240.
- [13] Junbo Zhang, Yu Zheng, and Dekang Qi. 2017. Deep Spatio-Temporal Residual Networks for Citywide Crowd Flows Prediction. In AAAI, 1655-1661.[14] Sepp Hochreiter, and Jurgen Schmidhuber. 1997. Long short-term memory. Neural Computation 9, 8 (1997), 1735-1780.
- [14] J. Wang and S. Ogawa, "Effects of meteorological conditions on PM2.5 concentrations in Nagasaki, Japan," Int. J. Environ. Res. Public Health, vol. 12, no. 8, pp. 9089-9101, Aug. 2015.
- [15] Y. Wang, Q. Ying, J. Hu, and H. Zhang, "Spatial and temporal variations of six criteria air pollutants in 31 provincial capital cities in China during 2013-2014," Environ. Int., vol. 73, pp. 413-422, Dec. 2014.