

# Traffic Management based Air Pollution Monitoring System

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**Abstract:** The major source of atmospheric pollution happens due to vehicles. The fast-growing population and urbanization result in the population concentrated in certain areas. Heavy transportation may lead to poor air quality and inhaling pollutants for a long time also causes damages in human health. The main objective of this paper is to introduce an equipment which manages the road traffic based on monitoring the air pollution level by pollutant gas sensor. In this work an Analytical Hierarchy Process has been employed to select the least polluted path by comparing various road junctions and then the vehicles are diverted to the least polluted path. The experimental results show that the proposed system can provide least polluted path and reduces air pollution by diverting the road traffic dynamically.

**Keywords:** Arduino Microcontroller, Air Quality Sensor (MQ135), Analytical hierarchy Process, Traffic Light Control.

## I. INTRODUCTION

Environmental monitoring is a systematic approach for observing and studying the condition of the environment. The healthy human being requires to breath in a clean air but it doesn't due to increasing the transportation system, fresh air get polluted. With tremendous development of the urbanization process in the world, environmental pollution problems become more common. At present, environment

contains pollutions like air pollution, water pollution and soil pollution etc worldwide. Air pollution is the presence of contaminants in the air that interferes with human health and produce harmful environmental effects. The World Health Organization (WHO) states that 2.4 million people passes away each year because of impurity of air. Pure air and human health goes hand in hand. Air pollution is harmful to human health. It causes difficulty in health issues like breathing, wheezing, and many respiratory problems. Major source of air pollution is road traffic emission which emits the 97% of CO and 75% of NO<sub>x</sub>. Therefore, air quality monitoring is needed in order to provide useful information about the pollution and can take appropriate measures to mitigate the negative impact whenever it is necessary. The purpose of monitoring the air quality is not only to collect the data but also provide the information which is required by the scientists, researchers to make a decision on improving and managing the environment. Therefore in-order to reduce or control the air pollution in the environment a dynamic traffic management system is deigned.

### A. Pollution Parameters

Air pollution means presence of one or more contaminants for temporal duration that can become injurious to human life, vegetable, and animal. The air contaminants include smoke, gases, dusts, paper hashes, poisonous chemical products and many polluted materials. Certain polluted materials react with each other and produces other pollutants. These pollutants

called secondary pollutants. Carbon dioxide and nitrogen dioxide produced by automobiles motors, lead to the development of ozone. Air pollution has consequences for human health. It causes respiratory harms and even fatality. It also contributes the acid rain and reduction of ozone layer. Some of the pollutants are as follows.

1) *Carbon Monoxide (CO)* – a colourless, odourless, tasteless, and toxic air pollutant and it is produced in the incomplete combustion of carbon-containing fuels, such as gasoline, natural gas, oil, coal, and wood. The largest anthropogenic source of CO is vehicle emissions. **WHO** states that breathing more than 35ppm (parts per million) leads to health issues. Breathing the high concentrations of CO typical of a polluted environment leads to reduced oxygen (O<sub>2</sub>) transport by haemoglobin and has health effects that include headaches, increased risk of chest pain for persons with heart disease, and impaired reaction timing.

2) *Alcohol* – The burning of alcohol (family of ethanol) can potentially add more smog forming pollution to the atmosphere, however it can also exacerbate the ill effects of such air pollution. Burning of ethanol can potentially add 22 percent more hydrocarbons to the atmosphere than do burning gasoline and this would lead to nearly two parts per billion increases in troposphere ozone.

3) *Nitrogen Dioxide(NO<sub>2</sub>)* – One of the Nitrogen Oxides (NO<sub>x</sub>), a group of air pollutants produced from combustion processes. In urban outdoor air, the presence of NO<sub>2</sub> is mainly due to traffic. Nitric oxide (NO), which is emitted by motor vehicles or other combustion processes, combines with oxygen in the atmosphere, producing NO<sub>2</sub>. **WHO** states that NO<sub>2</sub> crosses 200µg/m<sup>3</sup>, it causes health issues. Nitrogen dioxide and other nitrogen oxides are also precursors for a number of harmful secondary air pollutants such as Ozone and Particulate Matters (PM), and play a role in the formation of acid rain.

So, the development of a system to measure these pollutants have become a basic necessity nowadays. The implementation of such a system is discussed in this paper.

## II. NEED FOR MONITORING

Clean air in the environment is a vital need for every human being in this world. Polluted air causes many health related problems and several damages. Therefore to make any step for controlling the pollution rate, it is necessary to monitor the air quality which may help us to make a right decision at the right time. There are various causes of increasing the pollution such as smoke, automobile exhaust, chemical discharge from industries, radioactive substance etc. These are main reason of decreasing the air quality. The main gases which directly affect the human health are carbon monoxide (CO), hydrogen sulphide, sulphur dioxide (SO<sub>2</sub>), Nitrogen dioxide (NO<sub>2</sub>) and the main contribution of these gases are traffic related pollutant emission. Huge efforts are required to improve the quality of air in the environment. Environmental Monitoring has been controlled from manual to the automatic control step by step.

## III. RELATED WORK

In the past few years, many researches were centered around the use of static air quality monitoring stations along with crowd sourcing and participatory sensing. RFID and GSM based system manages the traffic signal dynamically according to the average speed of vehicles. They required large energy because RFID tag continuously read the values. The maintenance of that system is also tedious and systems have some problem like installation problem and cost. They are not cost effective than our system. But this system manages traffic according to the air quality and minimizes the airpollution and save human life [9]. RFID identifies larger object easily but small vehicles cannot be easily identified. There are some problems like Heavy Traffic Jams, No traffic, but still need to wait and Lack of Traffic Information to users. The system based on the microcontroller and it is placed on the board. The traffic signal adjusted on the board. This system uses fixed time of interval for each signal. There is no remote services provided to the user and only provided to that location. It uses predefined hardware and functionality according to program. Due to fixed signal time, vehicles emits more fuel, so the more chances of air pollution on that location which effect on the

human health. This system is not providing recent data to the user [7]. The micro controller light control signal uses conventional light signal red, amber and green. Red for stop the vehicle, amber for readiness to stop and green means now move. Software embedded controller system has developed. Dynamic change of state using background differentiating method was successfully in solving of fixed timing of controller in control traffic and minimizes congestion. Real time data obtained by image processing serves as input to traffic controller. Social network like Twitter is used to spread the news of traffic condition of particular location. Any user can tweet the current traffic condition of any location. In that System, NLP used for extracting the information of traffic signal from twitter. If user gives wrong condition of traffic on the social media like twitter, then it will be affected on the whole system, so it gives incorrect results and so vehicles density of that road will be increased. Accessing information from twitter user required twitter account, get certain information that user need regarding the traffic [14], put those information in the form template. It will not provide air quality information and not gives the alert to particular authority.

#### IV. PROPOSED METHOD

In this system, we have used MQ135 Air Quality Sensor for sensing and monitoring air quality in the surrounding environment.

This MQ135 Air Quality Sensor gives the concentration of different gases. Micro-controller helps in controlling Traffic Signal Lights by the use of Arduino Microcontroller and also used for transferring sensor data towards the cloud to the server, where the Algorithm is processed. After particular timespan it sends gas concentrations of pollutant gases to the Server. Cloud Server receives data from Arduino Microcontroller by the air quality sensor which is placed in the traffic light lamp at various junctions and does processing on it.

The proposed systematic block diagram is given below.

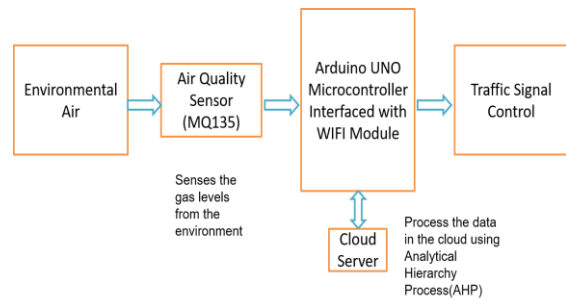


Figure: Proposed Block Diagram

The Air Quality Sensor is placed at the various road junctions of the city. The data sensed by the sensor is collected and given to the Cloud through the Arduino. Initially the set of data which is already collected by the Airquality Stations is trained by specific Machine Learning Algorithm. This process will compare the sensed data with the threshold value in all the junctions. Then the Least polluted path is identified by an algorithm named Analytical Hierarchy Process. This Algorithm will compare all the junctions which have crossed the threshold limit and selects the least polluted path. The traffic lights are controlled based on the least polluted path chosen by the above Algorithm.

#### ANALYTICAL HIERARCHY PROCESS

1. Define the Objective
2. Structure the Components in criteria, Sub-criteria, Alternatives, etc.
3. In Each Group, make a pairwise comparison of alternatives.
4. Calculate the weighting and consistency of alternatives.
5. Evaluate the alternatives according to the weighting.
6. Get ranking or set the priority.

The least weighted path will be assigned higher priority and named as least polluted junction or path to which the vehicles should be diverted to and consequently the highly polluted junction is controlled in an efficient manner.

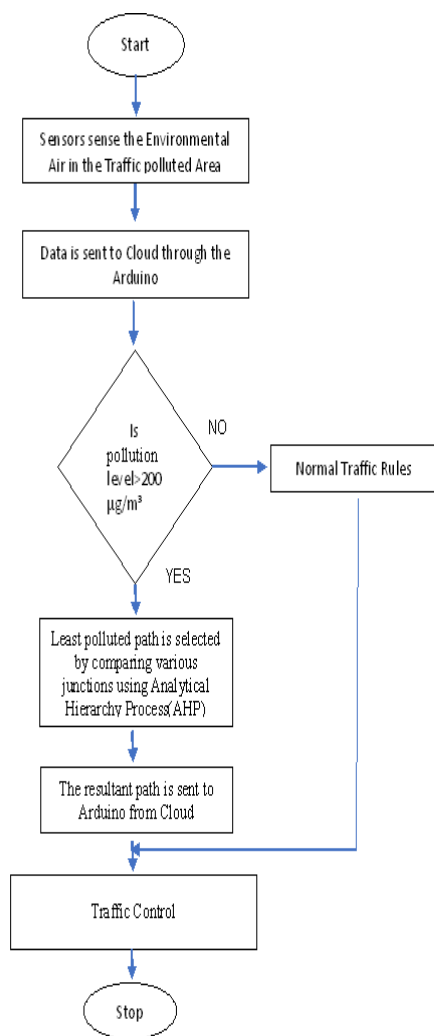


Figure: Flow Chart

## V. CONCLUSION AND FUTURE WORK

We have designed a system in which Traffic Signal Time will be adjusted dynamically, due to which Air Pollution will get reduced and also designed Gas Monitoring or controlling System from unhygienic or hazardous Gases. This manages traffic and avoids congestion. In future an Android Application can be developed to Mobile users having internet connection can retrieve real time information for their use. End user can able to request the server via an Android Application for knowing the real time situation about traffic & air quality of remote location. One of the technologies that gives Accurate reading for the estimation of vehicle counts is Ultrasonic waves sensors which are bit costly and robust for any medium through which waves can passed. For the further extension for more accuracy, there will be use of ultrasonic

wave's sensors. Also, a series of Gas sensors can be combined by the chemical reactions which can sense all the air pollutants by a single sensor. In the smart city each vehicle having RFID tag and at the Traffic Signal reader would be more communicative in nature for exchanging their messages. On the basis of data for Vehicle density and air quality, there could be prediction for future using Various Predication Algorithms. That would be useful in taking future decision for reducing many problems.

## VI. REFERENCES

- [1] Abdelaziz El Fazziki, Djamel Benslimaney, Abderrahmane Sadiq, Jamal Ouarzaziz and Mohamed Sadgal, "An Agent Based Traffic Regulation System", IEEE ACCESS, VOL. XX, NO. X, XXXXX 2016.
- [2] Andrea Zanella, Nicola Bui, Angelo Castellani, Lorenzo Vangelista and Michele Zorzi, "Internet of Things for Smart Cities", IEEE INTERNET OF THINGS JOURNAL, VOL. 1, NO. 1, FEBRUARY 2014.
- [3] Anju D, Dr. Vinodkumar Jacob, "WSN Method of Pollution Monitoring System", Anju D et al, / (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 7 (1), 2016, 353-359.
- [4] Heather E. Volk, PhD, MPH; Fred Lurmann; Bryan Penfold; Irva Hertz-Picciotto, PhD; Rob McConnell, MD, "Traffic-Related Air Pollution, Particulate Matter, and Autism", JAMA Psychiatry. 2013;70(1):71-77, November 26, 2012.
- [5] M. Pardo, G. Faglia, G. Sberveglieri, M. Corte, F. Masulli, M. Riani, "A time delay neural network for estimation of gas concentrations in a Mixture", Sensors and Actuators B 65 \_2000. 267-269.
- [6] Maria Christina Carotta, Giuliano Martinelli, Luigi Crema, Massimiliano Gallana, Marco Merli, Giovanna Ghiotti, Enrico Traversa, "Array of thick film sensors for atmospheric pollutant monitoring", Sensors and Actuators B 68 \_2000. 1-8.
- [7] Promila Sinhar, "Intelligent Traffic Light and Density Control Using IR Sensor

**and Micro-controller**", IJATER, Vol.2, Issue 2, March2012.

[8] Rong Yu, Guangdong University of Technology Yan Zhang and Stein Gjessing, **"Toward Cloud-Based Vehicular Networks with Efficient Resource Management"**, IEEE Network • September/October 2013.

[9]Saverio De Vito, Marco Piga, Luca Martinotto, Girolamo, **"CO, NO2 and NOx urban pollution monitoring with on-field calibrated electronicnose by automatic bayesian regularization"**, Sensors and Actuators B: Chemical.

[10]Siuli Roy, SomprakashBandyopadhyay, Munmun Das, SuvadipBatabyal, Sankhadeep Pal, **"Real time traffic congestion detection and management using Active RFID and GSM technology"**, IIT Kharagpur, India.

[11] Suganya E, Vijayashaarathi S, **"Smart Vehicle Monitoring System for Air Pollution Detection using Wsn"**, International Conference on Communication and Signal Processing, April 6-8, 2016, India.

[12] Sonal Deshmukh, Aditya Jagtap, Sameer Inamdar, Ganesh Mahadik, **"Real Time Traffic Management and AirQuality Monitoring System Using IoT"**, International Journal of Innovative Research in Computer and Communication Engineering Vol. 4, Issue 4, April 2016.

[13] SoufieneDjahel, Ronan Doolan, Gabriel-Miro Muntean and John Murphy, **"A Communications-oriented Perspective on TrafficManagement Systems for Smart Cities: Challengesand Innovative Approaches"**, MANUSCRIPT SUBMITTED TO IEEE COMMUNICATIONS SURVEYS & TUTORIALS.

[14] Sri Krishna Endartono, Sonny Pradipta, James Purnama, **"Traffic Condition Information Extraction and Visualization from Social Media Twitter for Android Mobile Application"**, International Press on EE, Indonesia, 2011.

[15]Zhiguang Cao, Siwei Jiang, Jie Zhang, and Hongliang Guo, **"A Unified Framework for Vehicle Rerouting and Traffic Light**

**Control to Reduce Traffic Congestion"**, IEEE TRANSACTIONS ON INTELLIGENT TRANSPORTATION SYSTEMS.