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## Vehicular Air Purifier – IoT Enabled System with Artificial Intelligence to Prevent Air Pollution

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### Abstract

*Air Purification is considered to be the vital function to implement in our society for effective and healthy environment. Today, most of the countries are suffering from air pollution which may be caused by Industrial Exhaust, Agricultural activities, Mining operations, Transportations, etc. In these causes, the majority of the pollution occurred in Urban and rural areas are mainly because of Vehicles. To fulfil our daily basic needs, we are all dependent on the transportations. So the pollution caused by the vehicles is inevitable. It is the hardest Challenges to the government to overcome these situations. There are so many technologies for monitoring the air pollution level caused by vehicles and also to control pollution. Still, there is a problem for society which in evoking everyday as because of air pollution. Government is in search for better system for handling and controlling this problem. Here The Proposed System is to target the minimizing level of air pollution, which is caused by the vehicles.*

**Keywords:** Air pollution, Artificial Intelligence, Machine Learning, MQ135, Arduino Tools, Support vector regression, Air Quality Index, Sensors, IoT

### 1. Introduction

In the proposed Vehicular Air Purifier, the exhaust gases produced by the vehicle through the exhaust system is being purified by the use of filter and purifier with artificial intelligence, which is going to be placed in, after the silencer of the vehicle along with the arduino board for providing alert. Here the exhausted gases out of the engine will already get through the catalytic converter, where the extremely toxic and harmful gases like HC, CO, NOX (Unburned Hydro Carbons, carbon monoxide, Oxides of Nitrogen) are purified and converted as less harmful gases H<sub>2</sub>O and CO<sub>2</sub> (Hydrogen dioxide and carbon monoxide). These gases are then be purified with our system with activated carbon filter with artificial intelligence and released as pollution free gas to the Environment. The quality of the air which is

released will be sensed by the O<sub>2</sub>, CO<sub>2</sub>, N<sub>2</sub> and PH Sensor then the alert will be sent to the vehicle owner through message, regarding the air quality level. It is the responsibility of all the citizens to known their cause of air pollution to the environment. So if they get any emergency alert regarding reducing level of air quality by their vehicle, they should take immediate action like filter change or any other fault. If the action is not taken by the vehicle owner within the specific time limit, the same message will be forwarded to the pollution control authority of that particular area with that vehicle details. Always prevention is better than cure, so for air pollution, taking action before the air gets polluted by any source is the mandatory thing that we need to do.[1-4].

## 2. Research Methodology

The Vehicular air purifier would be having three design stages. The main components of this filter are substrate, wash coat, Activated carbon filter with artificial intelligence, Ozone air sterilizer and ultra violet lamp, control circuit arduino board with sensors which may be connected to pc or android platform. As per Fig 1. First the body of the filter Substrate would be fabricated by using metallic material, which is used to bring maximum contact with exhaust gases. [5-8].

The Second Stage of design phase would be the wash coat with titanium material to observe particulates and then for conversion of pollutants, activated carbon filter with artificial intelligence would be fixed inside with ozone air steriliser. The usage of ultra violet lamp inside the metallic body will be used to destroy particulate matter after filtration process. The emitted gases from the

exhaust of vehicles are H<sub>2</sub>O, CO<sub>2</sub>, N<sub>2</sub> and particulates. From that, the carbon monoxide and the nitrogen gases with particulates are all filtered in activated carbon filter through the air intake channel which is attached with the extension of tail pipe with existing exhaust system.

The Third stage of design phase would be integrating the arduino board with the filter and fixing the PH Sensor, O<sub>2</sub> Sensor, N<sub>2</sub> Sensor, and CO<sub>2</sub> Sensor according to the levels of checking process. Connecting through arduino IDE, through Wi-Fi connection, the owner of the vehicle would be getting the information regarding the pollution levels of air emission, if the air is emitted in a lesser quality. If the action is not taken by the owner regarding filter change for air quality level then the message regarding the pollution cause will be forwarded to the local area pollution control centre.[9-13].

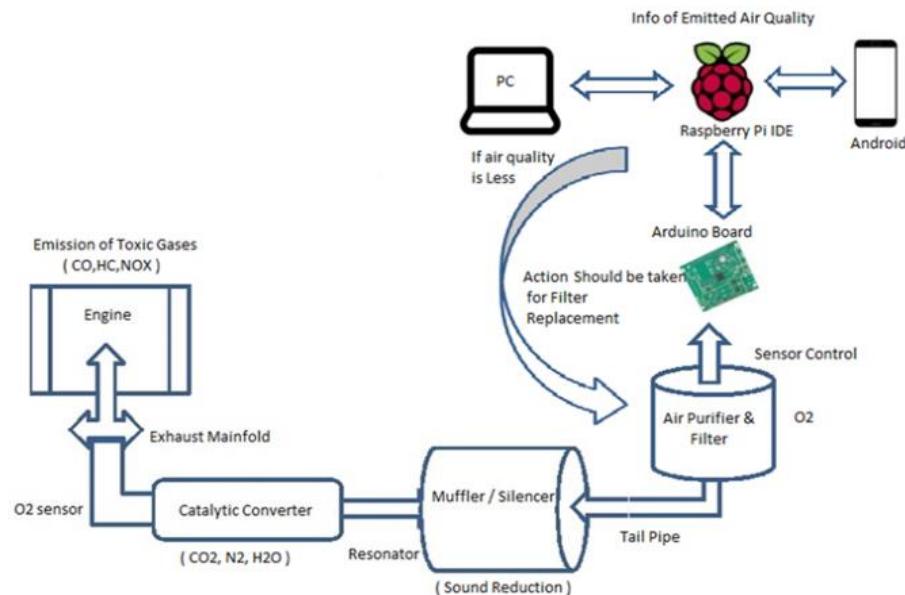


Fig 1. Vehicular Air Purifier Model

## 3. Results and Discussion

### 3.1 Study Motivation

As per the statistics from Ministry of Environment, the past few decades have witnessed some significant measures to control vehicular emissions which contribute to about 28 - 40 % of air pollution. There has been a urge from the government to adopt cleaner fuel and optimal technology in running vehicles.

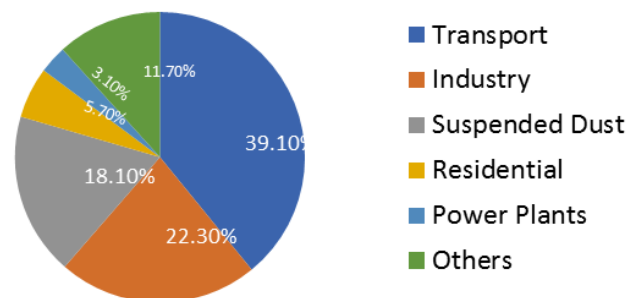


Fig.2. Causes for Air pollution in Delhi 2019

Many countries need very strict actions in law and regulations to reduce vehicles pollutions. New laws may give solution to new manufacturing vehicles, but for the existing vehicles, there is no solution for emission control. It is not possible to stop the usage of old vehicles too. That’s why, we need a system to regularize and purify the harmful vehicle emission gas, which should be suitable for all existing vehicles.[12-16].

**3.2 AQI Standards**

The air quality index (AQI) can be defined as a number used by government agencies to report daily air quality in order to communicate to the public how clean or unhealthy the air is (Air Quality Index). [11]

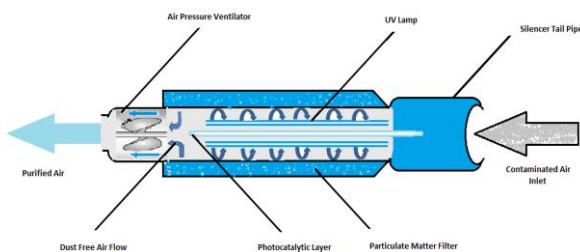
**3.3 Expected deliverables/outcome**

The Vehicular purifier would be having an activated carbon filter, artificial intelligent chip, ozone air sterilizer, ultra violet lamp to purify and filter the vehicle emission and sensors with arduino board interface to provide alert regarding the air quality released. Fig 3, is represented as the model of the filter, which we are going to design.

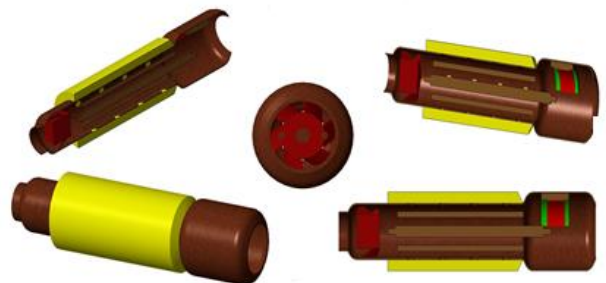
The proposed system would be fixed after the silencer of any vehicle with the extension tail pipe of existing exhaust system. According to the usage of vehicles, the proposed filter system has a life of 3 to 5 years to purify the emitted gas. After that, the filter should be changed. The 3D Isometric views of the filter are given in Fig.4.

**Table.1. Air Quality Index Levels of Health Concern**

Air Quality Index Levels of Health Concern	Numeric Value	Meaning
Good	0 to 50	Air Quality is considered satisfactory, and Air Pollution Poses little or no risk
Moderate	51 to 100	Air Quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
Unhealthy for Sensitive Groups	101 to 150	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
Unhealthy	151 to 200	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
Very Unhealthy	201 to 300	Health warnings of emergency conditions. The entire population is more likely to be affected.
Hazardous	301 to 500	Heath alert: everyone may experience more serious health effects.



**Fig.3. Filter Model**



**Fig.4. Three Dimensional Isometric Views of Filter**

## Conclusions

To fulfil our daily basic needs, we are all dependent on the transportations, so the pollution produced by the vehicles is inevitable. It is the responsibility of all citizens to know the cause of air pollution to the environment. Always prevention is better than cure, so for air pollution, taking action before the air gets polluted by any source is the mandatory thing that we need to do.

Many air purifying systems do exist, but after the air gets polluted through emission, these purifiers will work to suck polluted air and emit fresh air to the atmosphere. Our proposed system is to prevent the air quality in nature before it gets polluted. The proposed system is used to find out the absolute way, to take action by the vehicle owner and also by the pollution control authority of our government regarding the polluted gas which is exhausted by the vehicle. Our system will be considered as an affordable system which provides cost effective solution for the society.

## References

### Journals

- [1].Prof. Ronak R. Patel, Head of the Department, Department of Information and Technology, Sardar Patel College of Engineering, Gujarat.. "IOT Based Vehicle Anti-Collision and Pollution Control System"
- [2].Mitesh Rathod[1], Ranjana Gite[2], Anushka Pawar[3] , Shoomiren Singh[4] , Pranav Kelkar[5] Department of Electronics and Telecommunication, Vidyalankar Institute of Technology, Mumbai . "An Air Pollutant Vehicle Tracker System Using Gas Sensor and GPS"
- [3].V.S.Esther Pushpam, N.S.Kavitha, A.Gokul karthik, Department of Computer Science and Engineering, Sri Ramakrishna Institute of Technology, Coimbatore, "IoT Enabled Machine Learning for Vehicular Air Pollution Monitoring".
- [4].M Tiwari, SP Shukla, NK Shukla, RB Singh, N Mumtaz, VK Gupta, and V Kumar," Emission profile of pollutants due to traffic in Lucknow City, India" International Research Journal of Public and Environmental Health Vol.1 (7),2014, pp. 150-157.
- [5].D V mahalakshmi, P Sujatha, P V Naidu & V M Chowdary," Contribution of vehicular emission from urban air quality: Result from the public strike in Hyderabad", Indian Journal of Radio & Space Physics, Vol43, Dec 2014,pp-340-348.
- [6].P. Partheeban, R. Rani Hemamalini, and H. Prasad Raju," Vehicular Emission Monitoring Using Internet GIS, GPS and Sensors", International Conference on Environment, Energy, and Biotechnology, IPCBEE vol.33,2012 .pp-81-85 ,
- [7].Wataru Tsujita, Akihito Yoshino, Hiroshi Ishida, Toyosaka Moriizumi., " Gas sensor network for air-pollution monitoring", ELSEVIER Sensors and Actuators B 110 (2005),2015,pp- 304–311
- [8].Pramila Goyal, Dharendra Mishra and Anikender Kumar., "Vehicular Emission Inventory of criteria pollutants in Delhi", online journal:<http://www.springerplus.com/content/2/1/216> ,2013
- [9].Central Pollution Control Board ministry of environment & forests., 2010, " national ambient air quality status & trends in india-2010"
- [10].D. Mendez, A. J. Perez, M. A. Labrador, and J. J. Marron., "P-sense: A participatory sensing system for air pollution monitoring and control," in Proc. IEEE Int. Conf. Pervasive Comput. Commun. Workshops (PERCOM Workshops),2011, pp. 344–347 45D V mahalakshmi, P Sujatha, P V Naidu & V M Chowdary," Contribution of vehicular emission from urban air quality: Result from the public strike in Hyderabad", Indian Journal of Radio & Space Physics, Vol43, Dec 2014,pp-340-348.
- [11].Safae Sossi Alaoui\*, Brahim Aksasse and Yousef Farhaoui , "Air pollution prediction through internet of things technology and big data analytics", Int. J. Computational Intelligence Studies, Vol. 8, No. 3, 20
- [12].Ke Hu, Vijay Sivaraman, Member, IEEE, Balanca Gallego Luxan and Ashfaque Rahman, senior Member, IEEE., "Design and Evaluation of Metropolitan Air Pollution Sensing System",IEEE Sensor Journal,vol-16.no.5, March 1,2016,pp-1448-1459
- [13].Mohamed mahmod, Bart van Aerm, Rattaphol, Ronald delange., "Reducing local traffic emission at an urban intersection using ITS countermeasures".IET Intelligent Transport System.,2013, vol.7 Iss.12013.,pp78-86

- [14].A. R. Al-Ali, Member, IEEE, Imran Zualkernan, and Fadi Aloul, Senior Member, IEEE., “A Mobile GPRS-Sensors Array for Air Pollution Monitoring” IEEE SENSORS JOURNAL, VOL. 10, NO. 10,2010, pp- 1666-1671.
- [15].Siva Shankar Chandrasekaran, Sudharshan Muthukumar and Sabeshkumar Rajendran., “Automated Control System for Air pollution Detection in Vehicles” 2013 4th International Conference on Intelligent Systems, Modelling, and Simulation,pp-49- 51
- [16].David Hasenfratz a., Olga Saukha, Christoph Walser a, Christoph Hueglin,Martin Fierz c, Tabita Arna, Jan Beutel a, Lothar Thiele.,” Deriving high-resolution urban air pollution maps using mobile sensor nodes”, Elsevier B.V,2014, pp-1574-1192