Trends and Impact of Vehicular Tailpipe Emission using Big Data Analytics under Smart City Environment

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Abstract-Internet of things (IoT) was the transformation from embedded networking where the real focus likes in networking through real world objects. Intension of the conventional transformation is that it should be user friendly. As a vehicle user most of us are unaware when the vehicle has to be serviced and maintenance. If there is an automatic indicator that the vehicle emission level is above the standard then everyone will understand the need for maintenance. Such that the vehicle will be serviced regularly and the emission level can also be reduced. Unique identification of every object was a major burden and resolving their identity was the issue. Identity in the sense where the object is, how the object can be accessed, what are actual data we are concentrated from those object, when those data has to be transferred to the end point intern its time interval. When we speak about the above mentioned four w's there comes the role of technology which projects in the research direction.If I can sit somewhere control some other object which is not nearer, we say we are working towards smartness. Integration of smartness with the real time networking object was the key role as part of smart city concept. Getting to a smart city meant it can be any application, we are confined to but this research paper focus on smart self-automobile monitor and control application which has recent discussion in the day of pollution environment. The paper provides the detailed view to the reader about the need for the pollution analysis, networking in the vehicular transmission and the big data analytics.

Index Terms— Pollution, smart city, network, Toxic gas, Vehicular emission, big data, Internet of things.

1 INTRODUCTION

Rapid Urbanization has resulted in higher vehicle density and increased mobility woes. The world is facing increasing urbanization while simultaneously; major cities have become a magnet for talent and a driver of economic growth. The challenges is to use the power of data to create smart solutions that address real needs of city users and are perceived as meaningful by them. Smart automobile pollution less environment was the ultimate goal of government and many automobile and automotive companies. When we include minimum number of sensor to provide the sensed data to the end applicant through the internet then the role of IoT gets into picture. Its quiet obvious that the sensed data has to be pre-processed and transmitted or transmitted and processed, where the final processed data are passed through the internet for end analysis. As we transmit data what's the protocol stack that we follow to get accurate real time data has to be taken care. Processing the information should not change the actual concept for which the data is being used. Though IoT says that any object can communicate with any other object our primary focus is on how we provide a smart automobile travel for the pollution less environment. The reason for such type of service is on demand tie saving assist for the regional transport office [9]. The primary focus of the paper is to conduct the survey based on three major areas. One related to the effectiveness of smart city for the pollution free environment from the vehicle. Second related to the pollution level segregation based on what means, actual data collected through various forms. Third discussion how well the network communication is best suited for the real time data processing.

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2 SMART CITY

A city is smart when investments in

1. Human and social capital.
2. Traditional infrastructure.
3. Disruptive technologies.Fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance.

When we stress on smart its extra intelligent along with the already existing scenario of livelihood was the one expected by most of the individual. It has to make things easier than what we have now in any of the system that one follows. Easier as par of our discussion pollution free environment, were we having a less or no toxic content (Green House gases - GHG) enter our respiratory system. What was the smarter way or methods that we are going to follow to make smart city is the discussion about. The survey discusses the steps taken by India and all around the world for the pollution free environment.

Cities in India face a range of challenges in urban regions in such areas as water, waste management, energy, mobility, the built environment, education, health care and safety. The challenges may exacerbate further if timely and adequate action is not taken if neglected they could even derail India's growth. AMRUT (Atal Mission for Rejuvenation and urban transportation) cities should usher in a structured approach towards urban management. Smart cities initiatives announced by the government of India are a great validation of society and policy makers to vastly adopt hi-tech ideas into people's daily lives.

Mr.Kelly [3] astronaut in any press meet informed that the pollution level existing in places like China and India were almost quite shocking. According to WRI (World Resources Institute) spewing pollution [2] of GHG, India tops four in the world followed by china, US, EU. NGT (National Green Tribunal) was directing to ban vehicle with greater than and equal to ten years diesel vehicle and greater than and equal to fifteen years petrol vehicle from the flight [4].One of the steps taken towards the vehicle smartness is the introduction of RFID tag[1] in every vehicle from 2013 at the manufacturing side.The above four daily news are some of the article that we can found in our daily news of air pollution that focus the issues of vehicle towards air pollution.

Menon et al [5] identified the IoT in existing bus transport system how the Radio frequency identification (RFID) or Bluetooth low frequency (BLE) sensors to collect and transmit signals through the mobile phone to the cloud server.

According to ICCT's (The International council on Clean Transportation) comprehensive analysis of the policy context, it has been decided to have fuel sulphur content as 10ppm by the end of 2016 and the beginning of 2017, but the pollutant that has been released still has not yet reduced. It has identified that the vehicle sold in 13 cities meet BSIV standard while the rest follow BS III standards [6].The various values of air quality standard are provided according to central pollution control board (CPCB), Govt. of India, in the table 1below [8]. The table discusses the various pollutants and its concentration in ambient air in various areas for the weighted time.

Real time pollution management marked by [7] infers that sensors mounted on poles can monitor the ambient air Quality (AAQ) of cities. Citizens can monitor the pollution concentration on each street of the city or they can receive automatic alarms when the pollution level rises beyond the certain level.

Monitoring of traffic in the real time scenario was done with the sensors and GPS as on the component installed in modern vehicles along with acoustic sensor for the air quality along the road.

Table 1

National Ambient air Quality standard

S.No	Pollutant	Time Weighted Average	Concentration in Ambient air	
			Industrial, Residential, Rural and other area	Ecological Sensitive area (notified by central government)
1.	Sulfur dioxide (SO_2),µg/m^3	Annual* 24 hours**	50 80	20 80
2.	Nitrogen dioxide (NO_2),µg/m^3	Annual* 24 hours**	40 80	30 80
3.	Particular Matter PM_{10},µg/m^3	Annual* 24 hours**	60 100	60 100
4.	Particular Matter $PM_{2.5}$,µg/m^3	Annual* 24 hours**	40 60	40 60
5.	Carbon Monoxide (CO), mg/m^3	Annual* 24 hours**	02 04	02 04

* Annual arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals.

** 24 hourly or 08 hourly or 01 hourly monitored values as applicable shall be compiled with 98% of the time in ayear. 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.

The author [10] purely focuses on the technological perspective of the IoT smart city implementation for the health care smart grid in Padova, Italy. Started with generalized architectural view moved towards the protocols used in various levels and concluded with analysis of temperature, humidity, light and benzene data collection of Padova smart city.

Whenever we focus to construct the smart city what are the key constraint involved in the construction or the key features needed to be focused starting from the data collection, architecture, knowledge about the data, reusability of the nodes, how far the nodes can be accessed through which, challenges faced as part of human intervention has been discussed [11].

3 AIR POLLUTION

Monitoring system for achieving smart pollution free environment can be achieved with the wireless sensor network considering:

1. Stationary / dynamic nodes around the city for collecting data
2. Networking, type of topology, communication involved and the final analysis.
3. Applied to public transportation – heavy duty vehicle, light duty vehicle.

World Health Organization (WHO)in its global urban air pollution database 2016 states that air quality in a living environment is polluted and the region of pollution was more than 80% in an urban area. Maximum of the Indian cities lies in the top twenty most polluted cities according to the report by world health Organization. Of this ten of the places are from India, utmost all are from north India. When we mean by air pollution the various sources that leads to it are primary on automobile, industry, home application, agriculture burning, others. The main concentration of this paper was related to automobile or pollution due to transportation. When we speak about transportation pollution is caused by both on road and off road vehicle.

Table 2

World's 20 Most Polluted Cities – Source WHO

Country	City	$PM_{2.5}$level	Country	City	$PM_{2.5}$level
Iran	Zabol	216.7	India	Delhi	122.1
India	Gwalior	176.1	India	Ludhiana	121.9
India	Allahabad	169.7	Saudi Arabia	Dammam	120.9
Saudi Arabia	Riyadh	155.5	China	Shijazhuang	120.6
Saudi Arabia	Al Jubali	151.7	India	Kanpur	114.9
India	Patna	148.9	India	Khanna	113.8
India	Raipur	143.7	India	Firozabad	113.3
Cameroon	Bamenda	132.0	India	Lucknow	112.9
China	Xingtai	128.0	China	Handan	111.8
China	Baoding	126.0	Pakistan	Peshwar	111.0

The automotive research association of India has issued a booklet considering the calculation of fuel consumption assuming thefactors - limits, regulations and measurement of exhaust emissionsof both on and off road vehicles and engine by September 2016 [14]. The sample data for the standard emission standard has been provided over here. In a country like china [12] were the pollution is very high during the eve of Olympic, they proved as Green Olympic by following various strategies in cutting down the pollution level. Due to the heavy impact on coal burning and vehicle emission, where the vehicle population reached to 5.43million the urban air quality dropped rigorously. The country was in a concentration to conduct green Olympic where it devised certain steps like converting 1500 coal furnace into clean fuels and eliminating 23,000 old automobile from the fleet, thus by cutting down the pollution to 30,000 tons and improving green coverage to 100km^2. The decrease in pollution had a good impact such that in Beijing during the games the actual pollutant was in the lowest level of 2 – 6 months.

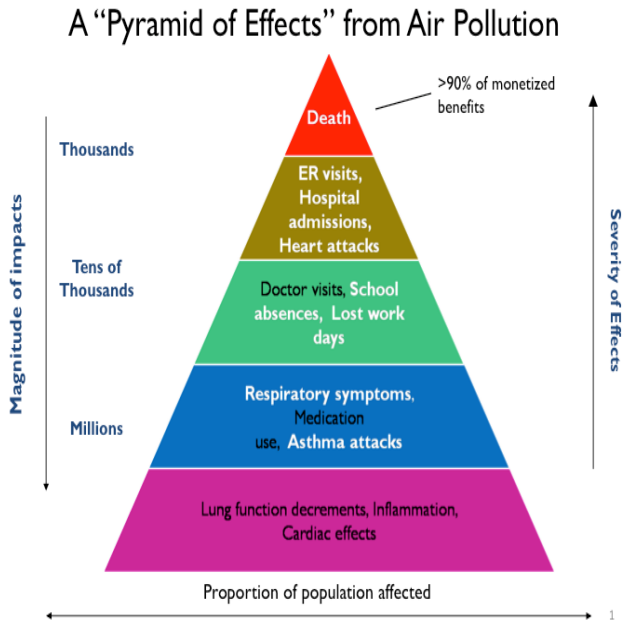


Fig1 Benefits Mapping and Analysis Program - EPA

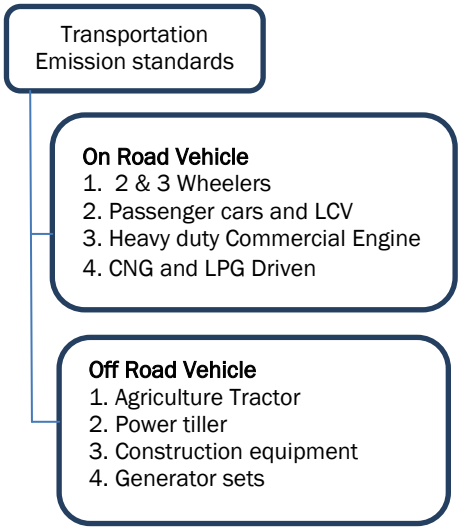


Fig 2 Vehicle – Transportation used –ARAI

Greenhouse gas and air pollution interaction synergies (GAINS) model in South Africa [13] is the energy production technology associated with eight scenarios to control air pollution. GAINS model focuses on the emission calculation with the data entered by the user where the model utilizes cost-optimization, chemical transport, and epidemiological models. Eight scenarios were categorized into two varieties like control and activity. The best applicable technology to control all pollutant includes selective catalytic reduction, flue gas desulphurization, high efficiency dedusters technology. Reduction activity taken care was clean fuel in domestic sector and in electricity generation clean coal technology. This policy frame work of controlling has put to a limitation that high sulfur fuels made persistence use of older automobile.E.Demir et al [13] compared the various fuel consumption models – microscopic and macroscopic model based on various technical factors like vehicle related, environment related, driver related, traffic / travel related, operations related. Based on the model temporal dimension was done on strategic, tactical and operational, they concluded that major and important problem that they found was routing and scheduling at the operational level. The author concluded by the introduction of emission vehicle routing problem, tabu search and simulated annealing algorithm as the solution to the operational level but suggested that multi objective optimization will play a vital role for the studies in future to have green road transportation.In terms of air pollution monitoring [15]started with the basic health effects, followed various regulation used by various government agencies, carried the discussion with various sensors types like solid state, particulate matter, proceeded with various level of sensor network and nodes for monitoring. Survey was based on summarizing twenty systems considering sensor type, system, carrier, WSN type, sensor network type, power source, locating device, computational power of sensor node and concluded the comparison with the various property like ranking and reasoning.

Table 3
Type I Limits (BS - III and BS - IV) Gasoline

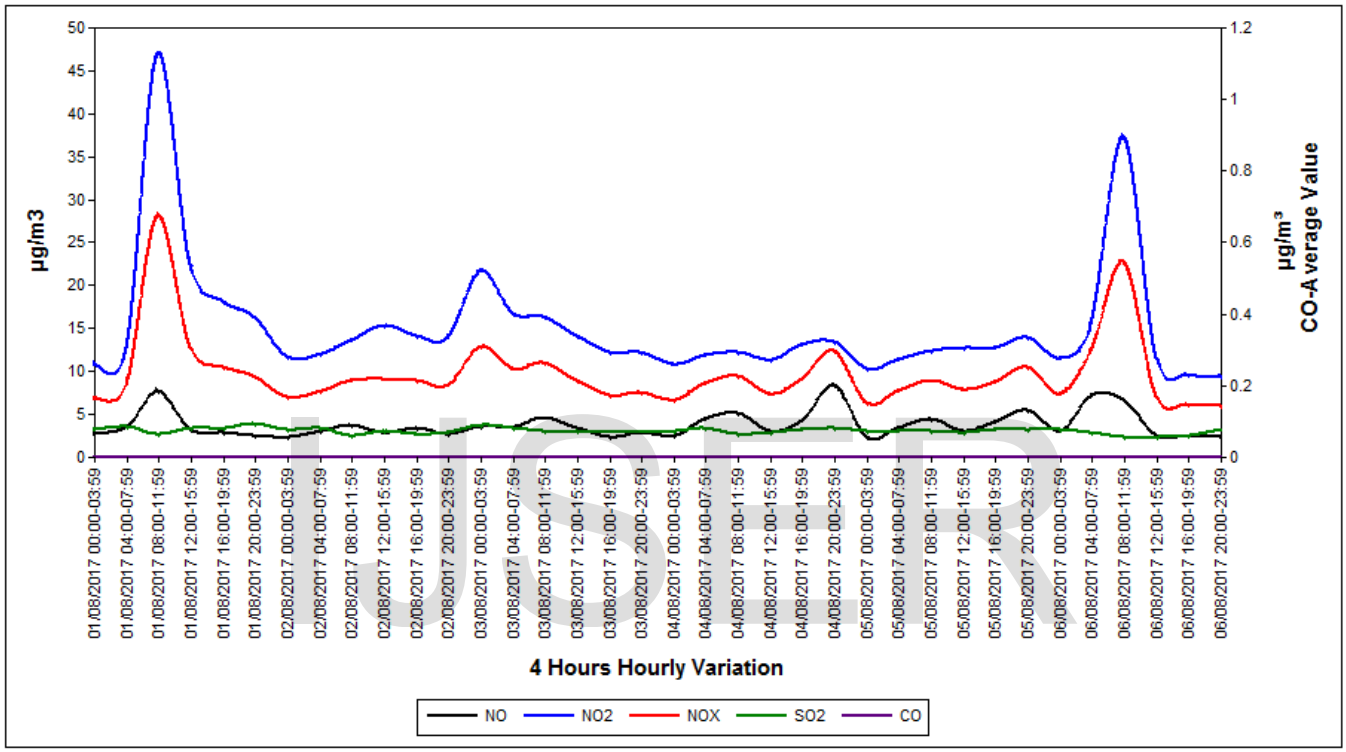
Effective date	Category	Class	RM** (Kg)	CO (g/km)	HC (g/Km)	NOx (g/Km)	HC + NOx (g/Km)	PM (g/Km)	Evap Emission (g/Test)
BS - III 1 April 05 - NCR 11 cities 1 oct 10 - nationwide	M (GVW** ≤ 2500 or upto 6 seater			2.30	0.20	0.15	---	----	2.00
	N1 & M (GVW**> 2500 or above 6 seater)	**I**	RM ≤ 1305	2.30	0.20	0.15	---	----	
		II	1305 < RM ≤ 1760	4.17	0.25	0.18	---	----	
		III	1760 < RM	5.22	0.29	0.21	---	----	
BS - IV 1 April 10 - NCR 13 cities	M (GVW** ≤ 2500 or upto 6 seater			1.00	0.10	0.08	---	----	2.00
	N1 & M (GVW**> 2500 or above 6 seater)	**I**	RM ≤ 1305	1.00	0.10	0.08	---	----	
		II	1305 < RM ≤ 1760	1.81	0.13	0.10	---	----	
		III	1760 < RM	2.27	0.16	0.11	---	----	

**GVW – Gross Vehicle Weight
**RM –Reference Mass

Graph 1 provides the report by the CPCB – IIT, Chennai, Tamilnadu, for the month of Jan 2017. It was clear that during the heavy traffic day the pollution level rises to the maximum. During the week end if the traffic is less than the level of pollution is also low, which is evident from the fact the vehicles turn out as the cause of major pollution.[20] Consideration was given for January month since it contains the various discipline of holiday and traffic range also varies due to the above reason.

4 NETWORK COMMUNICATIONS

When we aim at collecting data from various nodes then we have to look in how to integrate the various data thatare available in a region, depending upon the distance and way how to interconnect, then there comes the role of networking. Data dissemination in vehicular sensor network can be based on three architecture as shown in the figure 3. Architecture can be vehicle to vehicle communication (V2V), Infrastructure to vehicle (V2I) and Hybrid architectureThe nodes that are available to us are surely a sensor node that access the data from vehicle, the accessed data is most probably the air pollution level. The various feature based cluster algorithm models [16] are connectivity based clustering, centroid based, distributed based, density based, meta-heuristics, probability models and almost all the model uses data envelopment analysis. Re-affiliation of vehicle from cluster to cluster has to be reduced. To form a better cluster the average cluster size should be large with minimal cluster head change that is clustering ratio should be large. Author concluded that mathematical algorithm was much better than the meta-heuristic algorithm.



Graph 1 CPCB report on air pollution for Jan 17

Efficient cluster head selection scheme for data aggregation in wireless sensor network was found to be better assuming the energy consumption and cluster head selection [17]. There are various algorithms available for vehicle traffic routing system, maximum of the papers discussed about the meta-heuristic and heuristic algorithm. Few of the algorithms considered by researcher are neural network related and meta-heuristic like ant based algorithm, tabu search, chukku search, simulated annealing, others.

Vehicle traffic routing system assuming the fuel consumption, ant based vehicle congestion avoidance system that uses signalized intersection design was used by [18] to reduce the greenhouse gas emission.

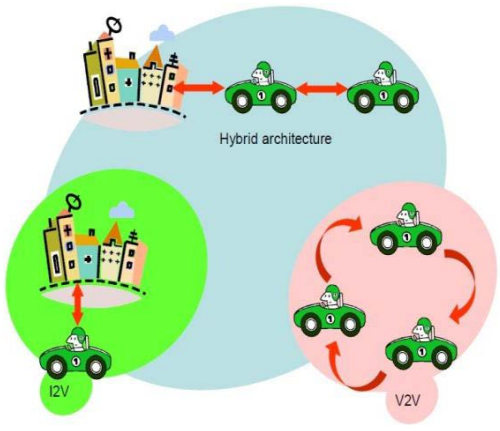


Fig 3 Vehicular communications Network

The author concluded that the average travel time at low vehicle density remains to be the same for all system, but metric varied at higher density.

As par of the real time consideration vehicle fuel consumption was affected by speed and acceleration on the road. Le Zhang et al [19] had done a study related to IoT for monitoring the wild life environment, where the author assumed a heterogeneous communication network. The author gave a basic study of the system from sensing the data, processing and deliver the control commands from processing to actuator module, based on performance employed three categories of nodes. The system was under development with an improvement stage by stage with optimizing the working and improving the power management strategy.

5 CONCLUSION

This paper will give on overview of the basic construction of smart city construction that needs some basic essential. Beginning with what is smart to how far the communication level has been implemented by various others its true living was provided for their future reference. Since in our today scenario the focus is more on implementation of smart city, this paper gives on overview for the beginners who are involved in development of IoT concept for the smart city.

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