



Cloud Technology FOR Real Time Vehicular Pollution Monitoring and Management in India

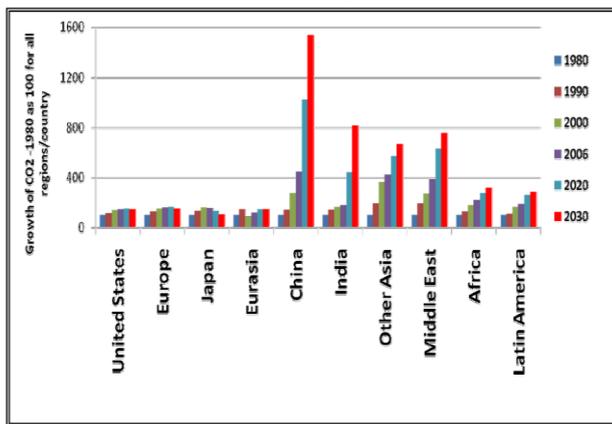
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Abstract : Global warming has reached alarming proportion. Climate change is rapidly on the rise. India is one of the worst affected countries by this malaise. All this has been due to the rapid rise in greenhouse gases. These gases have been contributed by both the industries and the multitude of vehicles running on fossil fuel. Both are an evil necessity but the exponential growth of old polluting vehicles have contributed to a big chunk of the vehicular pollution. This paper attempts to provide a technological solution to monitoring these vehicles on a real time basis and preventing these vehicles to be on the road till the pollution is addressed to. It also helps alert the authorities on the minute details of the polluting vehicle, including pinpointing its present location.

Keywords : Vehicular pollution, pollution monitoring, cloud technology in pollution, real time pollution monitoring, GPS technology, pollution measurement

I. INTRODUCTION:

Global warming has reached alarming proportion. Its effect can be seen in the melting of polar ice-caps. Low farm produce, vanishing of certain species of wildlife are other effects of the climate change. Violent surges of hurricanes is another concerning reason to understand how global warming can effect so many faucets on planet earth. Global warming doesn't just mean that our environment is getting hotter, it also means that social, economic, and physical health areas are greatly distressed. While global warming has been on the rise since the last 20 to 30 years, its effect has been dramatic in the last few years.



CO₂ Emissions from the transport Sector 1980-2030[1]

One of the major reasons of global warming has been the exponential rise in CO₂ emissions. Industries and transportation are the two sectors which have been heavily dependent on fossil fuel for their operation. While use of fossil fuel cannot be wished away, development in technology can greatly reduce its harmful effects. Regular monitoring, use of upgraded technology can vastly reduce the toxic gas emission from industries.

Vehicular pollution is another top contributor to the rising pollution levels. Internal combustion engine drives the majority of the vehicles running on the road. These engines burn fossil fuel of some form or the other. The emission of these engines consists of pollutants.

The following are the major pollutants associated with motor vehicles:

- **Ozone (O₃).** The primary ingredient in urban smog, ozone is created when hydrocarbons and nitrogen oxides (NO_x)—both of which are chemicals released by automobile fuel combustion—react with sunlight. Though beneficial in the upper atmosphere, at the ground level ozone can irritate the respiratory system, causing coughing, choking, and reduced lung capacity.
- **Particulate matter (PM).** These particles of soot, metals, and pollen give smog its murky color. Among vehicular pollution, fine particles (those less than one-tenth the diameter of a human hair) pose the most serious threat to human health by penetrating deep into lungs. In addition to direct emissions of fine particles, automobiles release nitrogen oxides, hydrocarbons, and sulfur dioxide, which generate additional fine particles as secondary pollution.
- **Nitrogen oxides (NO_x).** These vehicular pollutants can cause lung irritation and weaken the body's defenses against respiratory infections such as pneumonia and influenza. In addition, they assist in the formation of ozone and particulate matter. In many cities, NO_x pollution accounts for one-third of the fine particulate pollution in the air.
- **Carbon monoxide (CO).** This odorless, colorless gas is formed by the combustion of fossil fuels such as gasoline. Cars and trucks are the source of nearly two-thirds of this pollutant. When inhaled, CO blocks the transport of oxygen to the brain, heart, and other vital organs in the human body. Newborn children and people with chronic illnesses are especially susceptible to the effects of CO.

Manuscript published on 30 September 2019

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- **Sulfur dioxide (SO₂).** Motor vehicles create this pollutant by burning sulfur-containing fuels, especially diesel. It can react in the atmosphere to form fine particles and can pose a health risk to young children and asthmatics.
- **Hazardous air pollutants (toxics).** These chemical compounds, which are emitted by cars, trucks, refineries, gas pumps, and related sources, have been linked to birth defects, cancer, and other serious illnesses. The EPA estimates that the air toxics emitted from cars and trucks account for half of all cancers caused by air pollution.

II. PRESENT SCENARIO OF VEHICULAR POLLUTION.

The Central Pollution Control Board (CPCB) of India report presents an alarming picture of vehicular pollution in the major cities of India.

S.No.	Parameter	Delhi			Mumbai		
		Transport	Industrial	Domestic & other sources	Transport	Industrial	Domestic & other sources
1.	CO	76% to 90%	37% to 13%	10% to 16.3%	92%	8%	Nil
2.	NOx	66% to 74%	13% to 29%	1% to 2%	60%	40%	Nil
3.	SO ₂	5% to 12%	84% to 95%	Nil to 4%	2% to 4%	82% to 98%	Nil to 16%
4.	PM	3% to 22%	74% to 16%	2% to 4%	Nil to 16%	34% to 96%	53% to 56%

Source: Auto Fuel Policy Report

Table - 1

As can be seen from the above table[2] vehicular pollution is the major contributor to pollution in the two major cities of the country, Delhi and Mumbai. There has been a conscious effort to shift the fuel use to alternative fuels. These shifting was supposed to reduce the pollution levels from the vehicles. The table below shows the pollution generated by different fuels being used by the transport sector in India.

Greenhouse Gas	Gasoline	Methanol from Natural Gas	Ethanol from Corn	Compressed Natural Gas	Liquefied Petroleum Gas
Carbon Dioxide (CO ₂)	7.9	8.7	7.4	5.64	6
Methane (CH ₄)	0.22	0.35	0.39	0.91	0.17
Nitrous Oxide (N ₂ O)	0.54	0.54	2.98	0.54	0.54
Nitrogen Oxide (NOx)	1.06	1.45	2.33	0.97	0.92
Carbon Monoxide (CO)	0.99	0.98	0.78	0.97	0.96
Total	10.71	12.02	13.88	9.03	8.61

Table - 2

As can be seen from Table 2 [3], the reduction in pollution from the vehicles has not been significant enough.

III. PRESENT SCENARIO OF VEHICULAR POLLUTION MONITORING:

Most of the cities in India have a computerized pollution checking system standardized by the transport department. The system is shown in the figure-1 below.

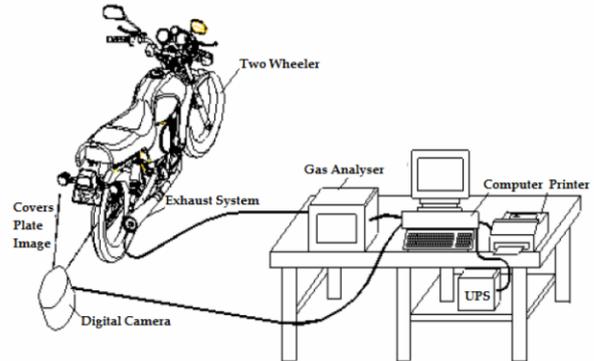


Figure - 1

All vehicles, both private and commercial undergo pollution checking at least 4 times a year. They are issued Pollution Under Control(PUC) Certificate. A number of pollution monitoring stations are available in city. Present monitoring is done BS-III standards. The measurement is done on idling conditions.

The traffic police check the on road vehicles on a random basis. Not all the vehicles are checked. Further the traffic police check only the validity of the PUC certificate. Penalty is levied for not having a PUC or having an invalid PUC.

IV. DRAWBACKS OF THE PRESENT MONITORING SYSTEM.

The major fault of the system is the test under idle conditions and not on real time conditions. The load factor of the vehicle is not taken into account. Neither is the road condition and the driving style of the driver is taken into account. Under real life conditions, the pollution generation of the vehicle is much different from the idling conditions. Further idling condition can be manipulated, as was amply demonstrated by the illegal pollution control exhibited by a German car manufacturer. It can also be manipulated at the test level, by adjusting the fuel and air mixture of the engine. This again changes under real life driving conditions.

The random checking of vehicles by traffic police for pollution certificate, also defeats the purpose, as vehicles without PUC, generally escape such random checks.

The Regional Transport Office (RTO) in the present case does not have any data on the pollution of a vehicle.

V. CLOUD TECHNOLOGY :

Cloud Technology, is a revolutionary computing technology that has been developed and refined over the years. It has matured over the years and has reached a stable state now.

Cloud technology provides a large number of services over the internet. One needs a simple internet connection to avail these services. Services can be provided by anyone with the requisite hardware. These services can be hardware services or can be software services or it can also be a combination of both.

VI. PROPOSED METHOD OF POLLUTION MONITORING :

This paper presents a method based on technology, which will provide a real time data of the pollution level of a vehicle. The proposed method consists of the following setup. This is shown in figure-2.

1. Semiconductor based pollution detection kit [4],[5], connected in the vehicle.
2. The kit includes a GPS system and also an internet connection.

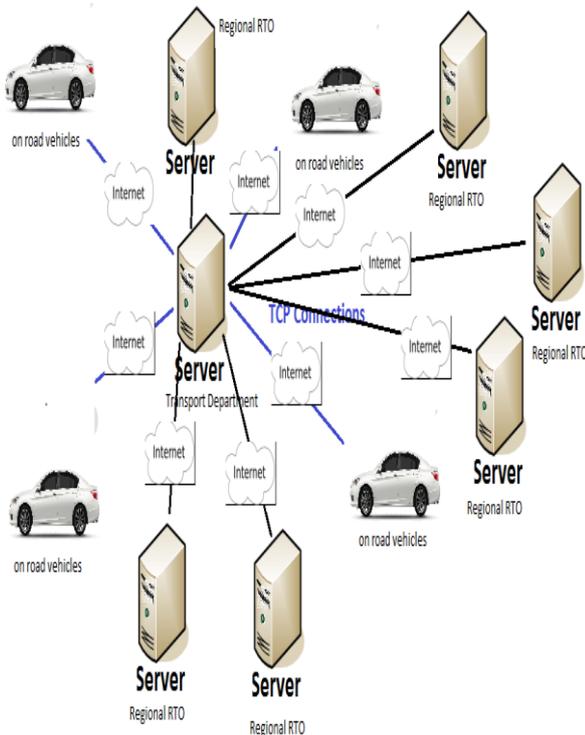


Figure – 2

3. A centralized cloud server is setup at the transport department for the entire country.
4. This cloud server is connected to all regional transport offices.
5. Each regional transport office server has a database of all the vehicles registered with them along with their registration number.
6. Each kit is configured with the vehicle details like the registration number and model.
7. Each kit is configured to connect to the centralized cloud server as soon as the ignition is switched on.
8. Each kit then sends the exact location of the vehicle, the registration number, the time and the pollution data to the centralized server.
9. At the centralized server level, a specialized software then compares the pollution data with the standard specification automatically on a real time basis.

10. As soon as the software detects a vehicle with a pollution level greater than the specified value, it send a message to the corresponding Regional Transport Office where the vehicle is registered.
11. The regional transport office can then initiate action against the polluting vehicle as per the existing law.

VII. ADVANTAGES OF THE METHOD:

The above method has a lot of advantages over the present system. The proposed method leads the present method in the following ways.

1. The method proposed is automated. Hence there is less scope for non compliance.
2. Proposed method presents a real time monitoring system over the idle conditions of the present system.
3. Vehicle tracking and penalization does not involve manual intervention. Hence there is no scope for manipulation.
4. Vehicle tracking and monitoring is independent of geographical limitations. A vehicle from any state can be tracked anywhere in India.
5. Proposed method can be expanded to cover other services also.
6. Proposed method can be useful in emergency situations also.

VIII. DRAWBACKS OF THE METHOD:

The present system has outlived its utility. But this does not mean that the proposed system is without any short comings.

1. Internet connectivity is an issue. Presently there are vast areas in India, which are in internet shadow zone. In such places the method will not work.
2. Replacing or tampering with the control module, either by switching of the power or by completely removing it from the vehicle will render it useless.
3. Reconfiguring the module settings to show pollution under control when it actually is not, will render it meaningless.

IX. CONCLUSION:

Pollution is a major issue that concerns all of us. Vehicular pollution, which has been on the rise on the backdrop of easy financial solutions, can be controlled to a great extent using technology. While technology has its own limitations, it still helps in bringing transparency to the system. Irrespective of the drawbacks, this proposed method can bring about a drastic fall in the non-compliance of the polluting vehicles. The result will be a cleaner and less polluted environment. The need of the hour is to embrace this method for the betterment of the earth and its inhabitants.

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