

# Paryavaran Mitra (पर्यावरण मित्र)

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## I Abstract

Rapid growth of cities has resulted in a large number of vehicles. The road infrastructure has been unable to keep up with the growth of the vehicles. Delhi has more than a crore Vehicles registered with the Transport Department; In addition to this, lakhs of vehicles enter in the city for business or transit purposes. At present, Delhi has 1000+ centers to issue “Pollution Under Control Certificate (PUC)” under Central Motor Vehicle Rule (CMVR) 115(7) to those vehicles passing the pollution checks.

Internal Combustion Engines need sporadic maintenance and checks lest they become one of the major source of air pollution. Most parts of India has no standard mechanism to issue a PUC though it is very well defined under CMVR 115 (7). There is a need to have a comprehensive system.

There is an urgent need to control air pollution. It calls for strict monitoring of vehicles. Vehicles without a valid Pollution Under Control Certificate (PUC) should not be allowed to ply on the roads. Delhi is home to more than a crore of vehicles. A real time monitoring of vehicles will not only help the environment but also generate a lot of data for scientists, activists and the government to further analyze and improve upon the subject.

This paper analyses the opportunities of using contemporary and future technologies to streamline the process of pollution check of the vehicles. The current solution developed for Transport Department has been in usage to issue online Pollution Under Control Certificate (PUC) to the vehicles in Delhi. On an average, around 14,000 vehicles are issued an online PUC every day.

Index Terms: CMVR; Vehicles, Pollution Checking, Urban Planning, Technology, IoT.

## II. Background

Transport Department of Delhi Government had been issuing the PUC to the vehicles. Earlier, they engaged an agency to issue the PUC. The earlier system was client server base. The PUC data used to get transferred to a server in the Transport Department on a regular interval. All the data of each PUC Center was kept on a local central computer.

There was no control and monitoring system except the field inspectors. Because, the system of getting reading was manual, the operators had option to freeze the readings at desired point of time. Most of the Pollution Checking Units had a common password. The data entry of the vehicle was manual. Therefore, operators used to take more time to enter the details of vehicle. The Pollution check was not possible without Registration Certificate (RC) of vehicle. Based on the details of the vehicle entered from RC, the PUC checking was performed and processed on local computer.

To modernize the entire process, the Transport Department decided to go online for issuing the PUC. Delhi e-Governance Society (DeGS), a 100% owned society by Department of Information Technology, GNCTD, was assigned with the task to develop the system to generate online PUC and to provide a user friendly application to the citizens.

## III. Scope of Assignment

The broad scope of work is given below:-

1. To develop a software which will be available to all PUC's to check the pollution level of the vehicle and to issue an online PUC.
2. To use other modes of communication like SMS and Website updates to remind the citizens the due date of pollution check.
3. To provide information on number of pollution checks done every day and number of vehicles filling the website of pollution under control. It will have other citizen facing features like checking the validity of pollution control certificate, verifying the valid PUC's online, seeing the history of vehicle pollution checks etc.
4. To develop various reports required by Transport Department as well as by the PUC owner.

To understand a complex system of conducting pollutions check as per the guidelines defined under CMVR 115(7) and other procedures, following documents were referred –

1. TAP documents regarding test procedures for measurement of CO and HC emission at idling for in-service vehicle fitted with SI (spark ignition)

Petrol/CNG/LPG engine (downloaded from ARAI website).

2. TAP documents regarding test procedures for measurement of smoke levels by Free Acceleration for in-service vehicle, fitted with Diesel engine (downloaded from ARAI website).
3. Compliance, of Emission Standard for Petrol, CNG, LPG and Diesel driven vehicle in view of changes as notified by Ministry of Road Transport and Highways, GOI.
4. Relevant copies of Rule 115(2) of CMVR depicting the measurement and emission testing procedure of Petrol/CNG/LPG and Diesel driven vehicle.
5. Copy of notification No. GSR 103(E) dated 23.02.12 regarding measurement of Lambda and Smoke level of diesel and Petrol driven vehicles complying BSIV Mass Emission norms.
6. TAP documents regarding test procedures (downloaded from ARAI website).

#### IV. Challenges in the System

The biggest challenge was non-uniformity of data format generated by pollution checking devices. There are around

Major Pollution Checking Machines used in Delhi:  
AVL, Indus, Ozone, HORIBA, ARO, I3, Auto Serve, Mars, I3, Sys, Neptune

13 manufacturers of Gas/Pollution Analyzers (27 variants). These analyzers come with proprietary software and do not provide generic drivers. There is also no standardization of output containing reading of gas contents. It was found that the machines used for pollution checking showed readings in different format. Each OEM had its own process to send the data. Non-uniformity of machines forced developers to write connector for each machine to fetch the values of various parameters like CO<sub>2</sub>, OH, etc along with other required procedures like lambda testing to get the testing results. This task was not only cumbersome but also time consuming. It required separate testing of code for all types of fuels (Petrol, Diesel, LPG and CNG).

The other big challenge was to deal with various testing procedures attached with Bharat Status (BS). If the vehicle is BS-IV then the validity of PUC is one year otherwise, it is 3 months from the date of issue. Its associated challenge was data mismatch in VAHAN database.

The operators working at Pollution Checking Centers are generally less educated. They have very little understanding of computers. Most of the Pollution Checking Centers had unsupported legacy version of Windows XP.

None of the gas analyzers (pollution checking equipment) are integrated with the camera. A web camera is to be integrated separately in the computer system to take a photograph of the number plate of the vehicle. It is always

possible to mislead the system by conducting pollution check for one vehicle and taking photograph of another vehicle.

Capacity building of all PUC operators in using new software was a big challenge. Top level management of Transport Department took the lead in building capacity of operators. Various training programs were organized in Delhi at Zone level. A big training program for all operators in Delhi Secretariat was organized to give a big picture of the whole project. A committed, dedicated and motivated team of Transport Department consisting pollution checking inspector, IT support made this difficult task of capacity building in manageable proposition.

Intentionally, the frontend process of checking the pollution and issuing the certificates was kept similar to previous version of software. This helped operators to correlate the workflow.

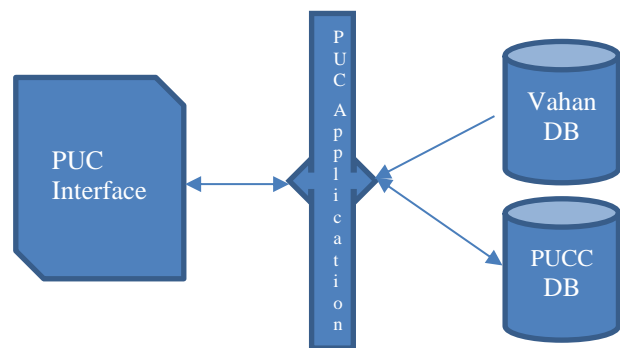
However, new value addition features like fetching information about the Vehicle by typing just the vehicle number was appreciated by the operators at initial stage itself because it reduced the efforts of typing by the operator.

There was no visible benefit to the citizens. Most of them even could not identify the change in the process as nothing was changed in the process except now operator did not ask for the RC.

However, after the implementation of facility of SMS and email reminders for PUC before its expiry period, the citizens started regular pollution checks.

#### V. System Architecture

There are two major components in the overall architecture. The first one is a Java based plug in to be installed in all the PUCs. This component interfaces with the gas analyzers. The PUCs also login into the system using this component.



The integration of the pollution checking machines was a major aspect of the entire project. It was decided to use a Java based local client to access the readings of machine and pass the data to the Transport Servers to process as per the set rules. Based on the results, the proposed system will print the PUC or a Rejection Slip.

The Transport Department decided to go with the cloud service from NIC. Three virtual machines were procured to act as the application server, the backup server and the database server respectively. The back-end server and database servers were clustered to have high availability.

The architecture is based on high availability model. The database servers are clustered. Whenever one database is down, the application shift to another database automatically.

Entire architecture is based on open source software. DeGS has used open source database platform called PostgreSQL. The web services are REST based and developed in Java.

## VI. Benefits

We have leveraged the advantages of Technology in delivering the real time PUCC to the citizens. The system bears following advantages for the Transport Department and to the operators–

- a) Entire control of the PUCC is now real time and online. The credentials of PUC center are verified through database server. There is a provision to change the password for PUCC operators.
- b) The PUC tests are processed at the server. The PUCC is issued based on data available on the server. There is no local repository of data.
- c) The vehicle database of transport department has been linked / accessed to get the vehicle details. Pollution Testing is done on the vehicle data (Vahan). The operator is allowed to enter some missing information if required. As the data of VAHAN will mature, there will be absolutely no intervention from the operator.
- d) This process has also reduced the data entry work. The present software has no provision of stopping tests in between.
- e) There is ease of operations. Merely a 10<sup>th</sup> class pass operator can operate the system
- f) This application brought a “certainty” factor into the system. Now if the pollution factors are under limit then there is certainty to get the certificate. There is minimal human intervention in the system.
- g) Entire operations are now 24x7 base. Many of PUCC in the state border areas operate the PUC round the clock.

The Delhi e-Governance Society has leveraged the latest trends in PUSH and PULL based SMS communication to make the pollution checking a public facing event. The new system has following citizen facing services, which were not in earlier system. Delhi perhaps, is the first state to have the online PUCC with citizen facing services. The official website <http://www.pucc.delhi.gov.in> has been set up. The interaction with vehicle owners is in following ways:-

- a) As soon as the test is over, the details of PUCC are sent on SMS.
- b) Reminder to renew the PUCC owner SMS

- c) Online status of open PUC centers
- d) Online checking of genuine PUCC
- e) Information on failed vehicles in pollution checking

SINo	Description of Activity	of Previously	Now
1	Printing of PUC Certificate using Computer	✓	✓
2	MIS	✓	✓
3	Online transfer of data	✗	✓
4	Integration with VAHAN data	✗	✓
5	Online display of PUC issued on website	✗	✓
6	Online checking of PUCC	✗	✓
7	Total control over PUC centers	✗	✓
8	Availability of PUC data for analysis	✗	✓

## VII. Adoptability of Application

Recently, this system of pollution checking has been further made more robust. Generally in most of the cases, the payment to the operator is made after “successful” pollution check. It put operator under compulsion of passing the vehicle otherwise payment might not be made by the customer.

Now system has been changes in such a way that first the operator ask for the mobile number of the customer and charge a fee to check the vehicle. Once paid, an OTP is received by the customer. After entering the correct OTP, the process of pollution check takes place.

The team of DeGS successfully made changes in the system because of its flexible coding style and architecture.

## VIII. Learning

This project is a classic example of stakeholders’ management. The most influential stakeholder were the operators of PUC. Involvement of operators at early stage ensured their participation in positive direction. They were quick to point out the pain areas.

The inspectors and other employees of Transport Department were critical stakeholders to ensure the business as usual. The product had more dependency on Internet. Thankfully, arrival of 4G data helped in getting a reasonable bandwidth for the operations. Most of the operators nowadays a backup Internet connection to ensure business continuity.

Initially, this project looked like a normal IT based integration project. But soon it was realized that it is one of most complicated project in terms of integration of variety of machines with non-standard data output.

For such projects, a committed team of professionals is required. Before initiating the work, the project must be tested on Cost, Time, Benefits, Risk, Scope and Quality parameters.

Involvement of various stakeholders is must. In this project at mid stage, we could bring all stakeholders together. Capacity building plays a major role in such diversified project involves man, machine, rules, Acts together.

A sound strategy in place is must. Initially, we went ahead with a big bang implementation. But soon, we realized the complexity of operations. Top management very timely changed strategy to phased implementation based on models of machines. The machines covering the larger PUC centres were taken first and machines used in lesser centres were integrated at later stage. The e-Gov implementation mantra “Think Big, start small and scale fast” is best fit in this case.

There is need to standardize the output of pollution checking machines. Few machines have manual controlling of Pollution reading process. Every machine has its own format to throw the output (data of pollution check). There are few models they throw the data as soon as they sense the smoke/gas, whereas there are few other models they only sends the output when triggered to do so. The documentation of these machine is either do not exist or in the poor state.

## IX. The Road Ahead

This is not end of journey but it is a beginning for new experiments. Real time capturing of data has opened various opportunities. Some of them are listed below-

1. Work on removing paper base issuing of PUC. As everything is available in real time basis. The field inspectors may validate the PUC using any handheld device.
2. Data containing values of various parameters like CO<sub>2</sub>, CO, etc has been taken. This data may be of great use for activists, scientists. This data may be put on open domain to be used by those who could make better sense of this.
3. Automated challans may be issued online to the defaulters.
4. Paryavaran Mitra may be a tool for the traffic police to track the polluting vehicle in advance.
5. The present version can be replicated in any state.
6. Internet of Things may further make enhance process Pollution Checking to next stage. The entire process is very objective in nature. The vehicle manufacturing companies may add IoT based devices (sensors) at the time of manufacturing of

vehicle itself. At the time selling of vehicle, the server address may be assigned to the vehicle to send reading of the sensors to a server. This server will be able to calculate the pollution level and send the result on regular intervals. Whenever, the levels of pollution are beyond the prescribed limits, the indicator at the dash board will inform the driver. In case, the same is not set within 24 hours, automatic challan or any other control may be exercised by the Department.

## X. References:

1. Automobile Research Association of India-  
<https://www.araiindia.com>
2. Pollution Under Control website  
<http://pucc.delhi.gov.in>