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# ON BOARD DIAGNOSTICS (OBD) 3 FOR VEHICULAR MANAGEMENT

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**Abstract -** *Air pollution becomes the most important factor of health hazard in cities like Delhi, Mumbai, Calcutta and Chennai. Air pollution is created by means of several industries, automotives emitting Co and other gases. Vehicular transport and traffic issue creates high air pollution problems. Due to increase of vehicles in the cities, the quality of air has become panicky and needs to be acquired, analyzed and policy issues to be checked for limits. Many acquiring, processing, control and policy measures are imposed on the vehicles on various stages but a strong speedy device is required to collect data from the vehicles for analysis. The control measures are absolutely meaningless even though the policies are absolutely perfect. The policies are executable, only if the abnormalities are proven, but, proving is much complicated in the present system. So all measures regarding this becomes waste and doesn't serve to reduce air pollution. We would like to introduce a concept of online data acquiring, processing and policy imposing technology.*

***Key Words***: (Size 10 & Bold) Key word1, Key word2, Key word3, etc (Minimum 5 to 8 key words)…

## 1. INTRODUCTION

Introduction of latest technologies in the field of online emission analysis in the industries serves the purpose very excellent, but air pollution is not only the resultant on industrial pollution alone. Vehicular emissionis the major contributor to air pollution mainly in cities. In case of rural and urban areas its contribution is much less, in this regard, a common analysis system may not be suitable for all places so we need to develop an analyzer, which can be able to acquire online data and predict the overall emission based on the traffic density .Many industries across the globe are making different kinds of instruments to handle this issue a perfect device has to be developed to meet the exact requirement for field analysis.

Many manufacturing companies are producing various kinds of data acquiring system (DAS) for vehicle emission in association with the country where it will be employed. Based on the continent, country, state etc the carbon credits vary and DAS performance has to be defined as per the place and policy. In India, several companies are making DAS for vehicle emission analysis in association with state pollution control boards (PCB).A common and uniform Co2 level is not implemented and is not merely possible because of density of the vehicle traffic differs from place to place.

Several measures implemented in India to control the pollution, are not made mandatory as there are no proper polices. Even the states having effective equipment to analyze this issue ends with fail because of poor online updating non communication between authorities of various departments associated with this issue. Even after attaining excellent technologies, the communication and resource sharing is not achieved, the communication among the authorities is not made mandatory. Unless this gap is filled, controlling of air pollution could be a forlorn dream only.

## 2. PROPOSED TECHNOLOGY

By understanding Indian traffic conditions, vehicle maintenance and management system, we would like to propose an implementable, inexpensive and robust technology. Any technology used to analyze online variables must work with good communication protocols and latest electronic hardware technology. Reliable"On-boardDiagnostics" (OBD) can solve the existing problem and can communicate with authorities to take effective policy decision. These systems must have reliable onboard sensors to acquire variable data like engine, safety and emission related data and put forward to the decision making system with appropriate communication technology.

The proposed technology utilizes state of art radio frequency identification tag (RFID) and IoT or IoT-pro to identify and to acquire vehicle related data. A centralized national data centre will have details of the vehicle date of registration, year of make, manufacturer details, type of vehicle, owner details and periodic approval certification(fitness certification) and emission check details .The above data acquiring system will be networked with national data processing center to identify the vehicle and its updated details etc. The receiver must be kept at predefined places, network to be connected and Transceiver will be kept on the vehicle which transmits complete technical and commercial data. The enforcement authorities will be networked with this to take effective policy for automated control measures by means of mobile computing.

Fig1: Transmitter Module (Vehicle side) of the proposed system collects data, compares, takes decision, creates automated policies, Proposeslegal decision, communicates to the user and authorities

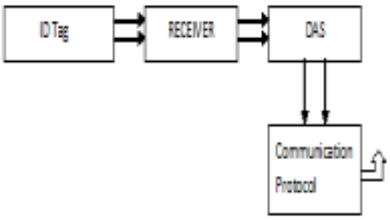


Fig1: Transmitter Module (Vehicle side)

Vehicle identification can be done using RFID Tag, active and passive proximity tags are available in the market to meet challenges on id technology. Active tag requires power source as well as Id receiver where as a passive tag doesn't require any power source with distance limitation. For real time applications active tag is much suitable as it is kept in the vehicle. This RFID tag works with the concept of 26 bit weigand technology. RFID devices are very reliable and rugged in construction; foolproof software can make this application very perfect. In RFID tags unique identification code number will be registered and it can be read by counterpart equipment (Reader).The reader will be kept in the traffic monitoring area and coupled with wireless networking system. The wireless networking can be either radio frequency or GSM, CDMA. This RFID devices can be connected with serial communication with baud rate of maximum 19,200.

Fig2: Receiver Module on road side with communication connectivity. A separate microcontroller can be utilized to convert and communicate to the master network with wireless technologies likeIoT, IoT- pro and Bluetooth.

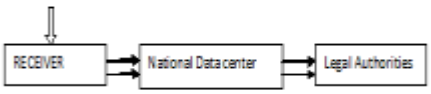


Fig2: Receiver Module (Overall)

The proposed system will have the following sub blocks in the vehicle side

### 2.1.1. Emission sensor

Sensors are made up of electrochemical process to sense variables like Co, Oxygen, Sulphur and Nitrogen. The unburnt fuel which comes out from the exhaust will be emitted which is called emission and this is which that makes air pollution. Various kinds of sensing system like 2,3,4,5 gas analyzer are required to sense appropriate gas emission from different kind of vehicles, whose emission values are different with respect to the place it runs. These sensors are passive in nature and requires excitation power source they can be derived from the battery source. Sensors provide analog values based on the gas emission, which will be fed to the data acquiring system for further processing.

### 2.1.2 Temperature sensor

Temperature sensing is much essential to find out the combustion quality and must be kept within the limit, otherwise; serious damage will happen to the engine. To overcome this, sensing can be arranged using sensors like thermistor, RTD, Thermocouple and solid state semiconductor based sensors.

### 2.1.3 Speed sensor

Speed sensing is required to calculate the efficiency of a machine and must be kept within the limit, beyond which whose emission ratio increases in proportion to the speed. Generally, sensors like dynamo, warm gears, and photoelectric sensors will sense the speed and deliver mechanical or electrical output related to the speed.

### 2.1.4 DAS

It is made up of electronic hardware devices like linear integrated circuits, operational amplifier to process input signals from the sensors to remove noises, amplification, attenuation and enhanced protection for devices like sensors and computing system.DAS is made up of Microprocessor or latest state of art technology like embedded system and VLSI technology. The primary objective of DAS is to work as interfacing device between sensors and computing system.

## 3. Computing system

A real time computing model (Fig3) is used to evaluate our proposed concepts and it will have relays, switches, optical isolated outputs, 8 bit data outputs, RS232converter, On board LCD display and control outputs to keep the parameter within the limits. Embedded-C language can be used to perform computing operation in concurrence with embedded controller, which can accept inputs, compute and deliver control outputs to the wireless system for further networking to execute regulatory measures of emission.

Fig3: Real time embedded system hardware with analog data acquiring

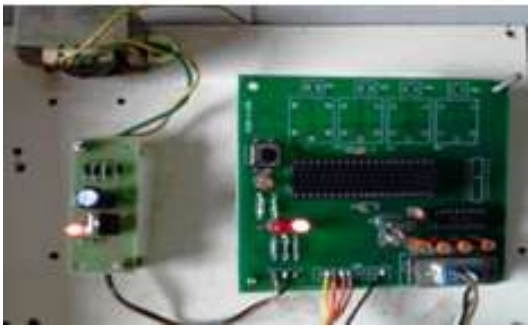

Fig4: RFID data converter

Fig4: Weig and receiver is employed to create identification of tags which are placed on the vehicles. As and when the vehicle crosses on predefined areas, the card comes close to the receiver and data will be collected .The data collected will be fed to real-time application hardware, we need to incorporate advanced and low cost embedded microcontroller to perform varieties of operations from simple acquiring to complicated USART. Microchip's PIC Microcontroller can perform the above set of operation very successfully .Though low end controllers are available, we select middle order 16xx (Series) device like PIC 16F877A .The peripheral features and design constraints are listed below

### 3.1. Peripheral Features

a) Built in ADC and DAC
b) On chip CCPWM
c) On chip USART/UART
d) Built in Data memory, program memory
e) Communication ports
f) Configurable I/O ports
g) Temperature and voltage sensing
h) Sleep mode and safe mode
i) High Performance RISC CPU
j) Operating Speed 9600 baud rate
k) Watch Dog Timer
l) High Sink / Source Current
m) Compatible to all computer language No need of DLL (Dynamic Link Library)

### 3.2. Design Features

a) A perfectly regulated power source is required to avoid roll over error of ADC
b) External crystal oscillator as clock source
c) External data converters for real time applications
d) All analog must be 5Vprotected
e) All digital input must have Schmitt trigger
f) All digital output must be 20mA current protected
g) Automatic power on reset circuit is required

### 4. Wireless devices

As in Fig5, an OBD with wireless interface is designed to work for short range, a PWM based wireless technology can be used to avoid interference within the short limit and transmit the data effectively to the regulatory authority. A most commercial frequency is not required for this application, this being a short distance communication. Unlicensed frequency can be used to avoid congestion on communication sector. To execute this function a perfect carrier frequency has to be defined and its modulation will be the original data delivered from computing system. To avoid tapping of data by unauthorized network, we can define a high precision encryption. The decryption can be used at the receiving end.

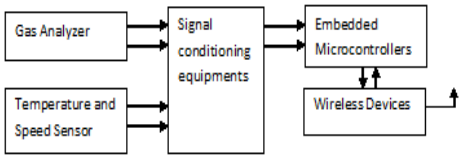


Fig5: OBD –TR Vehicle Side

Apart from the vehicle side, the following will be kept at the receiver side

Fig6: RFID Module to be used on the road side

In Fig6, a passive RFID proximity reader is used in this research for real time evaluation to get results. These devices can work with 12V dc supply and deliver RS232 outputs for communication interface with the distance of 15cm approximately. The distance can be enhanced using active devices.

Fig7 shows the real time application methodology for interfacing with microcontroller. The card need not be on line of sight, this can sense on all direction and deliver data through RS232 converter to the Weygand converter microcontroller. The microcontroller has an interface with wireless devices and to the computing network to show the identity of the vehicle.

Fig7: Application testing of RFID Module with tag

### 4.1. Wireless receiver

Generally wireless receiver is restricted with distance and frequency it works, lower the frequency propagation distance is higher and vice versa. In this research we are proposing 433.92MHz carrier and its modulation is around 36KHz.This will be made with decryption techniques to avoid interference on signal receptions. This will have a demodulator, a decoder to obtain the original data which are sent from the appropriate vehicle code.

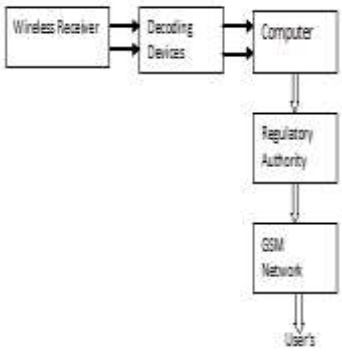


Fig8: Receiver Road Side

### 4.2. Computer network

Fig8 shows the real time implementation of Computer Network can be developed using latest technologies like GSM, GPRS, CDMA etc, each one has its own uniqueness as well as drawbacks. Apart from the above we can use WSN (Wireless Sensors Networking) or WAP (Wireless Application Protocol) network. Most of the wireless networks are leased lines and fully dependent on service providers network speed, which varies on traffic of networks. Wired networks need time for installation and are high cost oriented, yet highly reliable with very high speed, doesn't depend on any network.. So based on the place of installations, wireless/wired network will solve the problem very effectively. Output of this network will be interfaced with database for regulatory authority applications.

### 4.3. Database

Database will be developed at the time of registration, re-registration, while issuing fitness certification, while creating census etc, database could be nationwide, all the data related to the vehicle, vehicle owner control authorities are to be logged. This is interconnected database of all Regional Transport Offices of states. The database has to be taken with image to avoid fraudulent activities on check posts.

### 4.4. Decision making software

The software utilized to make decision can be developed with any GUI languages, sothat the user gets clear and virtual information related to the status of vehicles by means of numerical and graphical representations. This could be in languages like VB,VC++,JAVA and .Net. This software receives data from the vehicles, compares based on the type of vehicles and environment. If the data is well within the limit, it may not create any warning to anyone, at the same time if the real-time values exceed beyond the limitations warning has to be raised to the regulatory authority as well as to the owner of the vehicle.

### 4.5. Regulatory Authority

The role of regulatory authority is very vital. It is the ultimate decision maker to get the vehicle in to the penalty or not. The regulatory authority will be the interface between computer networking and traffic management. The system should have efficient communication model to interact with traffic management, vehicle owner and pollution control agency. This can be developed using latest and smart technologies like GSM, CDMA, RF or INTERNET. The above mentioned technologies are inexpensive and widely available all over India with effective online networking with affordable pricing.

The above set of devices has to be interconnected as discussed earlier to have effective data acquiring. To obtain and to make closed loop pollution monitoring and control to maintain air quality.

## 5. RESULTS AND DISCUSSION

The proposed technology is evaluated using real time sensors, devices, identification tags and wireless technology required. The data collected from the exhaust of the vehicle, is converted into analog data, processed using appropriate controller and transmitted using wireless technology.

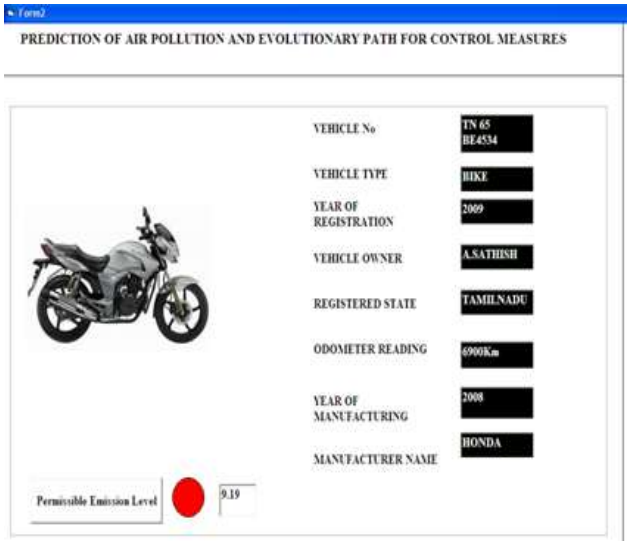


Fig9: Real Time Application 1(Data center)

Fig9 indicates a two wheeler on road which has been evaluated with real time data acquiring system and undergone all the above said process. The final result with its complete records is presented to undertake remedial measures to keep air pollution within its limit. The concerned vehicle emission level 9.2% against its limited value of 5% approximately, so the vehicle should be re-tuned to bring down to maintain the limit to run on road. As soon as the card is read by the system, the complete vehicle data like, year of manufacturing ,year of registered According to the result the vehicle should be penalized or to be regained as per the state environment norms.

Generally incorporating OBD is very costly in two wheelers but once embedded the technology can save the cost part of OBD, and no need to have onboard display on the vehicle.

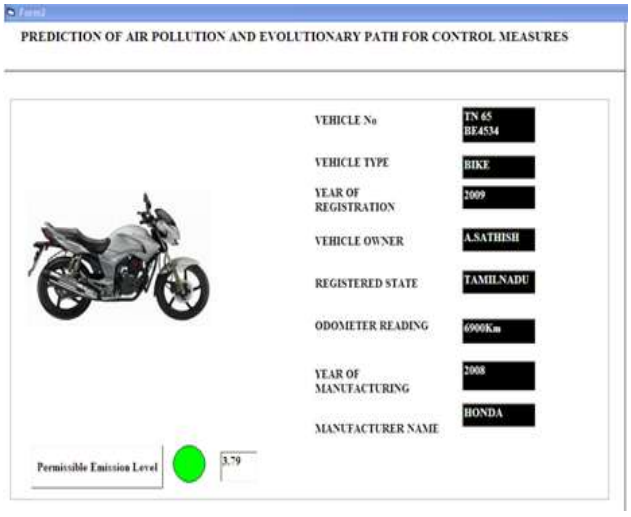


Fig10: Real Time Application 2(Data center)

Fig10 indicates a two wheeler on road which has been evaluated, the concerned vehicle emission level 3.8% within its limited value of 5% approximately, so the vehicle can be allowed to run on road.

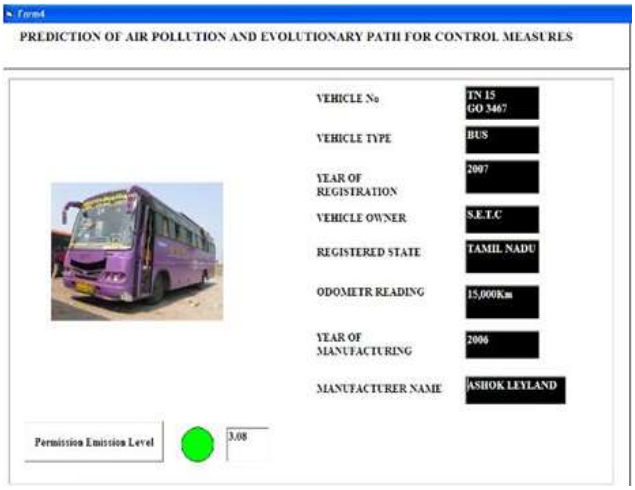


Fig11: Real Time Application 3(Data center)

Fig11 indicates abuse on road which has been evaluated the concerned vehicle emission level 3% within its limited value of 5% approximately, so the vehicle can be allowed to run on road.

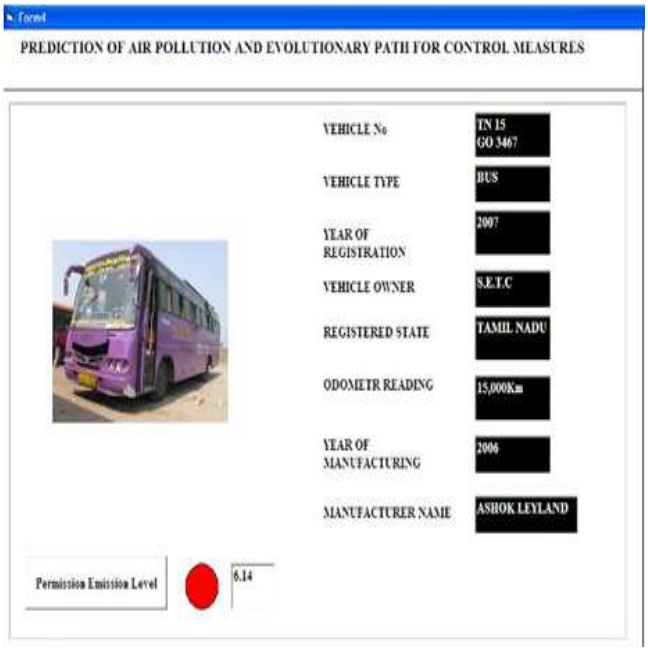


Fig12: Real Time Application 4(Data center)

Fig12 indicates a bus on road which has been evaluated, the concerned vehicle emission level 6% against its limited value of 5% approximately, so the vehicle should be re-tuned to bring down to maintain the limit to run on road.

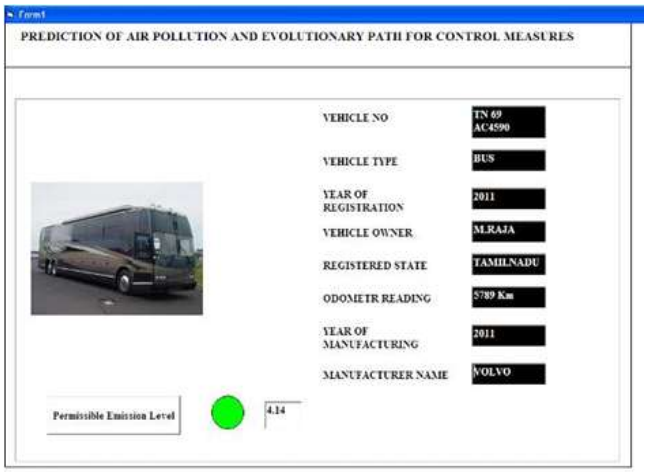


Fig13: Real Time Application 5(Data center)

Fig13 indicates a bus on road which has been evaluated, the concerned vehicle emission level 4% within its limited value of 5% approximately, so the vehicle can be allowed to run on road.


Fig14: Real Time Application 6(Data center)

Fig14 indicates a bus on road which has been evaluated, the concerned vehicle emission level8% against its limited value of 5% approximately, so the vehicle should be re-tuned to bring down to maintain the limit to run on road


Fig15: Real Time Application 7(Data center)

Fig15 indicates a truck on road that had been evaluated, the concerned vehicle emission level 3% within its limited value of 5% approximately, so the vehicle can be allowed to run on road.

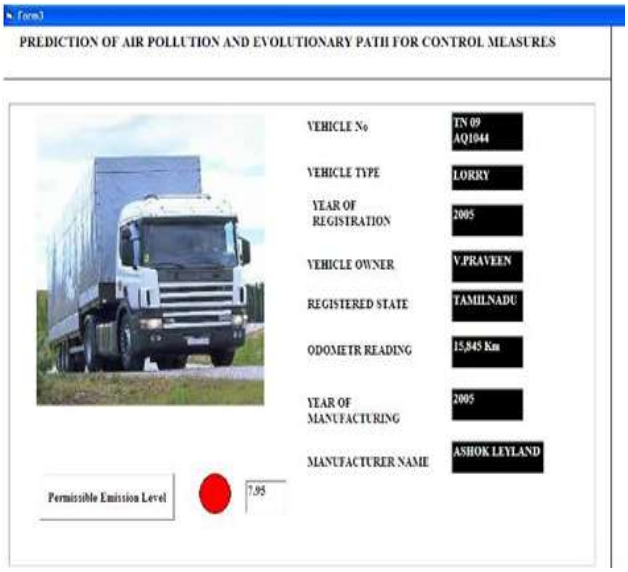


Fig16: Real Time Application 8(Data center)

Fig16 indicates a truck on road that had been evaluated, the concerned vehicle emission level 8% against its limited value of 5% approximately, so the vehicle should be re-tuned to bring down to maintain the limit to run on road.

## 6. CONCLUSION

A real time executable research work had been evaluated to the maximum possible extent for flawless application. The proposed technology can save time and cost along with environment for safe living standard .The proposed devices utilized to achieve this is commonly available everywhere and it can be incorporated with all the vehicle registered in India. This is possible by vehicle certification agencies (ARAI-Automobile Research Association of India) and vehicle manufacturers syndicate (Society of Indian automotive manufacturers association).Once this concept becomes mandatory, saving the environment from the brunt of fossil fuel could be limited and carbon credit can be achieved.

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