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On-Road Vehicle Emission Inspection System with E-mail Alert

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***Abstract*— Nowadays traffic is a major issue in the metropolitan cities like New Delhi, Bengaluru, Mumbai, etc,. In this ever increasing traffic there is a need to control the pollution issues as well as traffic accidents by implementing some smart embedded systems in to the vehicles. In this work, an automatic emission inspection system has been designed which will inspect the carbon monoxide level emitted by the vehicle. Moreover some of the safety related abnormalities like drink and drive, not wearing seat belt and high speed are also addressed. An alcoholic sensor, slot sensor and accelerometer sensor will serve the respective purpose. The continuous scanning of these abnormalities is done by the emission inspection system and if any abnormality is found, that abnormality along with the vehicle registration number is sent to the remote sensing unit which is installed in the traffic signals. The remote sensing unit sends a trigger message to the android device which in turn sends an email to the vehicle owner.**

The complete setup is implemented using ARM Cortex M0 LPC 1115/303 microcontroller.

Index Terms*— android device, emission inspection sysytem, remote sensing unit.

I. INTRODUCTION

With the ever increasing population and industrialization, the need for fossil fuels is increasing every day. Major portion of the fossil fuels is consumed by the automobiles, with the number of vehicles increasing every day; proportionally the burning of fossil fuels is also increasing every day. When the fossil fuels like petrol or diesel is burnt inside the engine of the vehicle, it produces toxic gases like carbon monoxide, carbon dioxide, oxides of nitrogen, hydrocarbons, etc,. These gases reach the outside environment and causes air pollution.

Various measures have been taken to reduce the concentration of poisonous gases emitted by the vehicles. This include making modifications to the engines of the vehicle, use of bio fuels, periodically making the vehicles to undergo emission testing, etc,. But all these measures have not been so effective in bringing down the levels of poisonous gases concentration in the atmosphere. If the vehicles are tested for emission regularly and if they fail in these emission tests, the vehicles can be repaired so that its emission is within the safety limit. But most of the vehicles which are causing pollution are still on roads. To ensure that the vehicles which are on roads are non-polluting vehicles, it is necessary to test their emission when they are moving on roads.

In this work an emission inspection system is designed to test the emission of the vehicle when it is moving on roads. By doing so, we can identify and analyze the real emission data of the vehicle and if it is causing pollution by emitting poisonous gases, necessary actions like repairing the vehicle can be done. In this project we are testing only for the levels of carbon monoxide emitted by the vehicle since it is of a major concern.

The emission inspection system proposed in this work monitors the level of carbon monoxide emitted by the vehicle and whenever it exceeds a pre determined safety limit, the system sends the corresponding data along with the vehicle registration number to remote sensing unit. Then remote sensing unit transmits the emission data along with the vehicle registration number to the android device of the government authorities in the form of a text message with the help of the GSM unit placed in the remote sensing unit. The android device receives the emission data along with the vehicle registration number and then sends an email to the respective owner of the vehicle. The emails contain the emission data and also date time and location details. Now the vehicle owner can take necessary corrective actions and get his vehicle repaired to ensure that the vehicle emission is within the prescribed safety limits.

The Government authorities can maintain a database of all the vehicles which are failing in the emission tests on road and can give notice to the respective owners to get their vehicle repaired and if they fail to do so in two or three notices, the government authorities can take legal action against the vehicle owner.

One of the major problems we encounter in this system is, to get the emission data of the moving vehicle, the vehicle has to pass through the remote sensing unit. For this purpose the remote sensing units are installed in the traffic junctions. Whenever the vehicle fitted with emission inspection system, comes near traffic junction which has a remote sensing unit installed, the zigbee transmitter of the emission inspection system sends the emission data along with the vehicle registration number to the remote sensing unit via the zigbee receiver installed in the remote sensing unit.

II. SYSTEM DESIGN

The system is divided into two modules to demonstrate the project. One is emission inspection system which is embedded on the vehicle and second one is remote sensing unit which is installed in the traffic junction.

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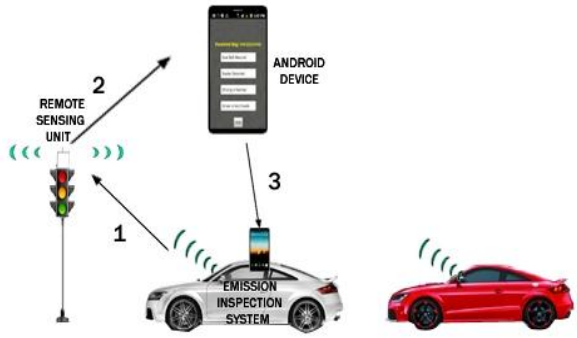

Fig. 1- Proposed System

A. *Emission Inspection System*

The emission inspection system of this project is divided into two parts- one which collects the data and the other which transmits the data. Data collection part consists of ARM Cortex M0 LPC1115 microcontroller which is a 32 bit microcontroller. This microcontroller is interfaced to the MQ 7 carbon monoxide gas sensor. The CO gas sensor monitors the CO gas emitted by the vehicle and transmits the data continuously to the microcontroller via ADC pin of the microcontroller. The microcontroller converts the analog value into digital value and compares it with the preset threshold value. Whenever the sensor value exceeds the preset threshold value, the microcontroller transmits the corresponding data value to the Zigbee transmitter.

The transmission unit consists of zigbee transmitter interfaced to the ARM Cortex M0 LPC 1115 microcontroller. Whenever the zigbee transmitter comes in the vicinity of Remote Sensing Unit which has a zigbee receiver, it transmits the emission data along with the vehicle registration number to the zigbee receiver.

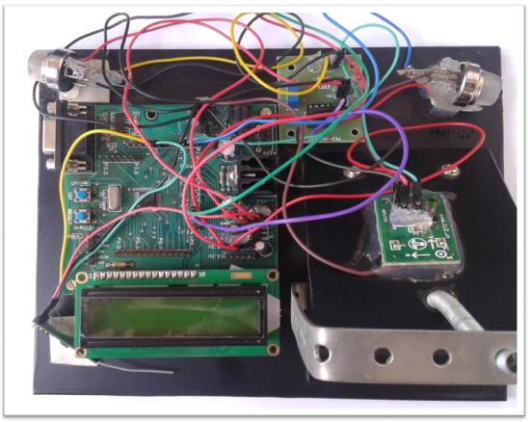

Fig. 2- Prototype of Emission Inspection Sysytem

B. *Remote Sensing Unit Design*

The remote sensing unit consists of ARM Cortex M0 LPC 1115 microcontroller which receives the emission data along with the vehicle registration number via the zigbee receiver and processes the data and generates a text message. This text message is sent to the android device with the help of GSM modem which is interfaced to the ARM Cortex M0 LPC 1115 microcontroller of the remote sensing unit.

The android device receives the text message which contains the emission data and the vehicle registration number. Then the android device fetches the email address of the corresponding vehicle owner and generates an email which contains the emission data indicating that the vehicle emission is within the set standard limit or not. Along with this emission information, the email also contains the location where the vehicle was interrogated. This location information will be helpful in tracking of the vehicle.

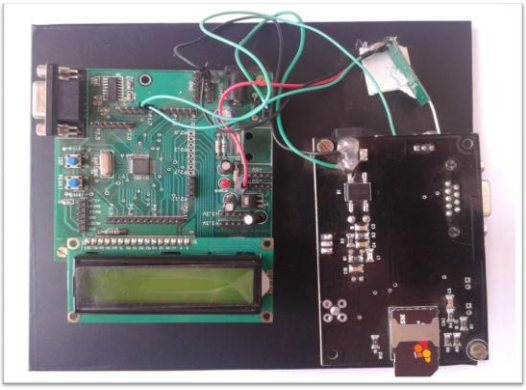

Fig. 3- Prototype of Remote Sensing Unit

C. *Safety features included*

The system contains the following safety features additionally.

1) Drink & Drive:

An Alcohol sensor is used to detect whether the driver is drunken or not. This sensor is interfaced to the microcontroller and whenever the driver is drunk, the sensor sends logic high to the microcontroller via the digital input pin of the microcontroller. This information is passed to the zigbee transmitter.

2) Not Wearing Seat Belt:

Slot sensor is used to detect whether the driver is wearing the seat belt or not. This sensor is interfaced to the microcontroller and whenever the driver is not wearing the seat belt, the sensor sends logic high to the microcontroller via the digital input pin of the microcontroller. This information is passed to the zigbee transmitter.

3) High Speed Detection:

Accelerometer sensor is used to detect high speed/rash driving. This sensor continuously monitors the changes in the y-axis coordinate and transmits the data continuously to the microcontroller via the ADC pin of the microcontroller. The microcontroller converts the analog value into digital value and compares it with the preset threshold value. Whenever the sensor value exceeds the preset threshold value, the microcontroller transmits the corresponding data value to the zigbee transmitter.

In all of the above cases whenever the zigbee transmitter comes in the vicinity of Remote Sensing Unit which has a zigbee receiver; it transmits the data and vehicle registration number to the zigbee receiver. The Remote Sensing Unit then sends the text message to the android device which in turn sends an email to the vehicle owner.

III. Results & Discussions

The proposed system was developed and tested for its working. All the modules were working and the expected results were obtained.

The emission inspection system continuously monitors the emission level and safety related abnormalities of the vehicle and sends the data to the microcontroller, and it is also displayed on the ALCD of the emission inspection system. Whenever the emission level and/or the safety related abnormalities of the vehicle exceed the set limit, the emission inspection system sends the data to the remote sensing unit. The microcontroller in the remote sensing unit generates a message as shown in Figure 5 and sends to the android device via the GSM modem. The text message is sent as "KA01ZZ1234S1", where the first 10 digits is the vehicle registration number and S1 indicates the smoke level is high.

The android device displays "Smoke Detected" along with the vehicle registration number on the screen as shown in figure 6 and then selects the email address corresponding to the respective vehicle registration number and sends an email to the owner indicating that the vehicle emission is exceeding the limit. In addition to this the date, time and location details are also sent via the email as shown in figure7.

Similarly when the safety related abnormalities are found the text messages are generated as KA01ZZ1234A1, KA01ZZ1234B0 and KA01ZZ1234LHS where A1 indicates driver is alcoholic, B0 indicates seat belt is not weared and LHS indicates high speed. Likewise the android device displays the corresponding safety data on the screen and then selects the email address corresponding to the respective vehicle registration number and sends an email to the owner indicating that the safety related abnormalities are found. In addition to this the date, time and location details are also sent via the email.

Fig. 4

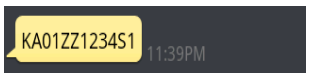

Fig. 5

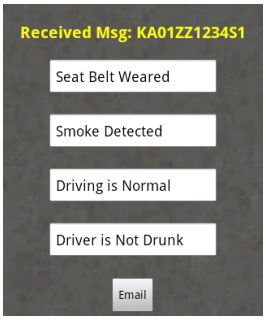

Fig. 6

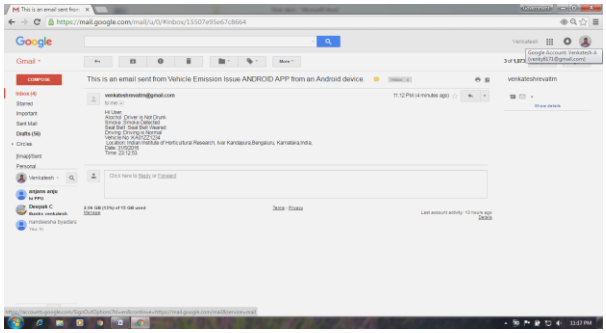

Fig. 7

IV. Conclusion

In this work an automatic emission inspection system is designed which will interrogate the emission level of the vehicle when it is moving and provides a real time emission data. Also some of the safety related abnormalities such as drink and drive, not wearing seat belt and high speed/rash driving are also addressed. All these emission and safety data along with the vehicle registration number is sent to the android device which in turn sends an email to the respective vehicle owner.

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