IOSR Journal of Engineering (IOSRJEN) **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
Special Issue || Dec. 2019 || PP 53-56
International Conference on Management Practices, Innovations & Research 2019

Design and Implementation for detecting environmental hazardous gases from automobile system

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Abstract: *There are number of dangerous gases in environment, this gases damage the nature. It is big problem for every point of view. Hence, the exhaust gas analyzer (PUC machine) has developed for detecting hazardous gases from automobile system but it is more expensive and bigger in size. Our project reduces this issue. We have decided to make a small, compact electronics circuit same as gas analyzer which is implemented in car, motorbike, and other vehicle engines. With the help of our project every person will know the level of exhaust gases and take action immediately.*

Keywords: *Gas sensor(CO, CO2, NOx), PCB circuit, Microprocessor, ADC, LED, Resistors, etc.*

I. Introduction

Millions of vehicles on roads in the India and around the world may be operating without properly certified on-road emission controls as a result of test manipulation. An automobile is a self propelled vehicle that travels on land. It consists an internal combustion engine which provides the power to the vehicle and the vehicle runs on the road. But when the engine provides power to vehicle it releases hazardous gases which is harmful for people, plants, and animals. Following parameter and gases as shown,

A. CO (carbon monoxide)

A colorless, odorless gas, carbon monoxide is produced by incomplete combustion of fuels. Because it interferes with the blood's ability to deliver oxygen to the body, very high levels of carbon monoxide can cause death. It is estimated that 1,000 people each year die of carbon monoxide poisoning while thousands of other suffer non-fatal poisoning. When carbon containing fuels –such as coal, wood, natural gas, and fuel oil are incompletely burned, carbon monoxide is emitted. The carbon monoxide enters the air from from the combustion source that may not be properly installed or maintained or not adequately ventilated, such as:

- Unvented heaters (kerosene or gas space heaters)
- Furnaces
- Woodstoves
- Gas stoves
- Fireplaces
- Gas water heaters
- Automobile exhaust from attached garages
- Tobacco smoke
- Gasoline-powered equipment, such as emergency generators.

B. CO2 (carbon dioxide)

Carbon dioxide (CO2) is released into Earth's atmosphere mostly by the burning of carbon containing fuels and the decay of wood and other plant matter. Under all conditions found naturally on Earth, CO2 is an invisible, odorless gas. It is removed from the atmosphere mostly by plants, which extract carbon from CO2 to build their tissues, and by the oceans, in which CO2 dissolves.

Carbon dioxide emissions impact human health by displacing oxygen in the atmosphere. Breathing becomes more difficult as carbon dioxide levels rise. In closed areas, high levels of carbon dioxide can lead to health complaints such as headaches, insomnia.

C. NOx (Nitrogen oxide)

Nitrogen dioxide is an irritant gas, which at high concentration causes inflammation of the airways. When nitrogen is released during fuel combustion it combines with oxygen atoms to create nitric oxide (NO).

This further combines with oxygen to create nitrogen dioxide (NO2). Nitrogen dioxide and nitric oxide are referred to together as oxides of nitrogen (NOx). NOx gases react to form smog and acid rain as well as being central to the formation of fine particles (PM) and ground level ozone, both of which are associated with adverse health effects.

NOx can decrease the lungs functioning, increase the risk of respiratory conditions and increases the response to allergens. High levels of NOx can have a negative effect on vegetation, including leaf damage and reduced growth. NOx also reacts with other pollutants in the presence of sunlight to form ozone which is damage vegetation at high concentrations.

D. Hydrocarbon

Hydrocarbon emissions are composed of unburned fuels as a result of insufficient temperature which occurs near the cylinder wall. At this point, the air–fuel mixture temperature is significantly less than the center of the cylinder. Hydrocarbons consist of thousands of species, such as alkanes, alkenes, and aromatics. They are normally stated in terms of equivalent CH_4 content. In Diesel engines, the fuel type, engine adjustment, and design affect the content of hydrocarbons. Besides, HC emissions in the exhaust gas depend on irregular operating conditions. High levels of instantaneous change in engine speed, untidy injection, excessive nozzle cavity volumes, and injector needle bounce can cause significant quantities of unburned fuel to pass into the exhaust

Hydrocarbons have harmful effects on environment and human health. With other pollutant emissions, they play a significant role in the formation of ground-level ozone. Vehicles are responsible for about 50 % of the emissions that form ozone. Hydrocarbons are toxic with the potential to respiratory tract irritation and cause cancer.

E. Particulates matter (PM)

Particulate matter emissions in the exhaust gas are resulted from combustion process. They may be originated from the agglomeration of very small particles of partly burned fuel, partly burned lube oil, ash content of fuel oil, and cylinder lube oil or sulfates and water. Most particulate matters are resulted from incomplete combustion of the hydrocarbons in the fuel and lube oil. In an experimental study, typical particle composition of a heavy-duty diesel engine is classified as 41 % carbon, 7 % unburned fuel, 25 % unburned oil, 14 % sulfate and water, 13 % ash and other components. In another study, It is reported that PM consists of elemental carbon (≅31 %), sulfates and moisture (≅14 %), unburnt fuel (≅7 %), unburnt lubricating oil (≅40 %) and remaining may be metals and others substances.

Above described gases are major pollutant gases which is always harmful for environment and automobile vehicle engine regularly emits this gases day by day. So this gases is detected by the gas detector, our project help the people to maintain the gas level in environment.

II. Hardware Component

A. Carbon monoxide detector (CO detector)

A carbon monoxide detector or CO detector is a device that detects the presence of the carbon monoxide (CO) gas to prevent carbon monoxide poisoning.

Fig.(a) CO detector

B. Carbon dioxide detector (CO2 detector)

A carbon dioxide detector or CO2 detector is an instrument for the measurement of carbon dioxide gas.

Fig.(b) CO2 detector

C. Nitrogen oxide detector(NOx detector)

A nitrogen oxide detector or NOx detector is typically a high-temperature device built to detect nitrogen oxides in combustion environments such as an automobile, truck and tailpipe or smokestack.

Fig.(c) NOx detector

The above three gas detector (CO, CO2, NOx) will be implemented on a single PCB circuit by using microprocessor. This will further be implemented on muffler of vehicles.

D. Muffler

A muffler is a device which is used to release this gases in the form of black dust in environment and also use as to reduce the noise emitted by the exhaust of an internal combustion engine.

Fig.(d) Muffler

III. Block diagram

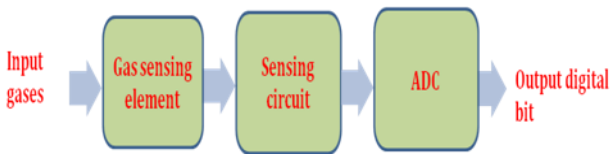

Fig. Block diagram of sensing circuit

Fig shows the block diagram of sensing circuit which consists of input gas, gas sensing element, sensing circuit, ADC, output digital bit. Input gases come from automobile system such as carbon monoxide (CO), carbon dioxide (CO2), and nitrogen oxide (NOx) is detected by the gas sensing element in which CO detector detects CO gas, CO2 detector detects CO2 gas and NOx detector detects NOx gas. This detected gases are given to sensing circuit which converts the gases into analog signal. In this section we are using microprocessor gives output to ADC. Analog to digital converter is used to convert analog signal to digital bit stream.

IV. Working

The Indian government has mandated the Pollution Under Control (PUC) certificate under the Central Motor Vehicle Rule, 1989. The PUC test assesses the emission of a vehicle and checks if it follows the standard pollution regulation. Now, PUC test procedure by government of India for vehicle user, In case of diesel vehicles, the acceleration is fully pressed and the reading of pollution levels are observed. This is repeated five times and the average constitutes the final reading. For petrol vehicles, the car is kept idling without pressing the acceleration. Only one reading is taken and this constitutes the final reading. PUC testing can be done at any authorized petrol pumps or independent testing centers, but the above PUC system is all about manually we have to do that in which people makes the fake PUC certificate and cheat to environment.

Hence, working of our project design system is automatically and implemented in vehicle. When rider or driver starts the vehicle, vehicle engine releases the gases which is detected by gas detected, this gas detector is implemented in vehicle due to this, process is automatically done after starting the vehicle. The sensing circuit sense all the gases after detecting and process through microprocessor and output of microprocessor is given to ADC. The analog signal is converted into digital bits by using ADC. The amount of gases in percentage (%) is displayed on LCD display. We are going to fix a threshold value of gases for individual CO, CO2, NOx gases. For example there is fix or threshold value of CO gas is 4.5%. In this system we will indicate gas level after threshold value by using red signal and buzzer can also be used for sound indication.

V. Result And Conclusion

In this section, the experimental results of project is presented. The input gases are detected from environment by sensing circuit and output is displayed on LED screen also indicated. We will mention the threshold value of gases, after the threshold value red led signal will be indicated this will help RTO officer to take action on vehicle owner or rider. Our project is also helpful for environment and every person will know the present condition and PUC level of vehicle to take immediate action.

VI. Advantage And Application

The advantage of this system is small and compact in size as compare to PUC machine. The biggest advantage of this system is less expensive and easy to implement in vehicle. This system also reduces the complexity of gas analyzer circuit. The application of this system is very helpful for environment and RTO can easily check PUC level of vehicle because this system is implemented in vehicle. Future application of this system is every automobile industry can implement the system in vehicle because now a day pollution is not consider as a joke, and PUC certificate is required to every vehicle customer.

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