# Design of Eco Friendly System in Automobile for Environmental Safety

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**Abstract -** *The major source pollution in the environment the exhaust gases from the vehicles and it is increasing day by day. This is leading to many environmental problems such as global warming. This effects plants and animal life's. There is no awareness to the people who use vehicles. One of the innovation to provide awareness to this s problem is to design and develop an emission monitoring for automobiles to monitor the emission level in engine exhaust for environmental safety and sustainability. By using sensors, the exhaust gases are measured and the measured emission level of the gases will be displayed to the driver via OLED display which will provide information and awareness about the health condition of the engine of the vehicle. In this project, major gases carbonmonooxide(CO), nitrous oxide(NOx), Hydrocarbon(HC), Oxygen(O) are monitored and the level of gas is noted for both Petrol and Diesel engines. When the emission level of the vehicle is high the power is cutoff by using a controller from the ignition.*

***Key Words*: Emission, gases, awareness, controller, Ignition.**

## 1. INTRODUCTION

Environmental air pollution may be described as contamination of the atmosphere by gaseous, liquid, or solid wastes or by-products that can endanger human health and welfare of plants and animals, attack materials, reduce visibility and produce undesirable odors. Although some pollutants are released by natural sources the effect of this pollution is very small when compared to that caused by emissions from industrial sources, power and heat generation, waste disposal, and the operation of internal combustion engines. Fuel combustion is the largest contributor to air pollutant emissions, caused by man, with stationary and mobile sources. Direct exhaust emissions of hazardous substances like carbon monoxide, nitrogen oxides and small particles are important contributors to many environmental problems like smog creation and biodiversity disturbances. Those emissions affect the natural ecosystem at a more local level.

The rapid urbanization in India has resulted in a tremendous increase the number of motor vehicles. The vehicle fleets have even doubled in some cities in the last one decade. As the number of vehicles continues to grow and the consequent congestion increases, vehicles are now becoming the main source of air pollution in India. Although, the air quality can be improved through a combination of technical and nontechnical measures, legislative reforms, institutional approaches and market-based instruments, there are certain unique challenges which the country has to face in tackling the problem of environmental air pollution. In recent years, air pollution has acquired critical dimensions and the air quality in most Indian cities that monitor outdoor air pollution fail to meet WHO guidelines for safe levels. The levels of PM2.5 and PM10 (Air-borne particles smaller than 2.5 micrometers in diameter and 10 micrometers in diameter) as well as concentration of dangerous carcinogenic substances such as Sulphur Dioxide ($SO_2$) and Nitrogen Dioxide ($NO_2$) have reached alarming proportions in most Indian cities, putting people at additional risk of respiratory diseases and other health problems.

## 2. PREVIOUS DESIGN

***Shi-gui Lv, Li Yang, Qian Yang*** *This paper introduced the basic principles, the methods and the applications of infrared technique in the diagnosis and prediction of diesel engine exhaust faults. . It was found that the application of infrared inspection and diagnosis to the identifying of diesel engine exhaust faults is feasible and effective*.

***Wei Wei,Liu na****This paper compared diesel engine with gasoline engine, explained the producing mechanism of NOX and CO and analyzed the properties of diesel engine exhaust pollution. It introduces the current emission control techniques such as improvement of fuel, supercharging and inter-cooler, exhaust gas re-circulation of four-valve, exhaust gas after-treatment etc.*

***Gerard Dooly, Elfed Lewis, Colin Fitzpatrick*** *A fibre-optic sensor for the monitoring of hazardous vehicle exhaust emissions of the order of parts per million (PPM) is described and tested. The sensor based on absorption in the ultraviolet region is used to simultaneously measure the concentrations of three of the major exhaust emission gases and output them to the vehicle's on-board computer. Experimental results describing the operation of this sensor with nitrogen dioxide ($NO_2$), sulphur dioxide ($SO_2$) and nitric oxide (NO) are shown.*

***G.I. Shaidurova, V. I. Kostyaeva, M. V. Dyagileva.*** *If the exhaust pipe of a gas compressor is made of composite, it may operate at 300— 400°C. The composite considered is fiberglass based on modified polyimide binder. It reduces the smoke emission from exhaust by chemical reaction.*

*G.I. Shaidurova, V. I. Kostyaeva, M. V. Dyagileva The implementation of adsorptive smoother buffers organic solvents during high emission periods, while a discharge from the storage increases the output level during low emission periods. Additionally, the cut off of emission peaks has the advantage of an easier compliance with safety requirements. Modelling results as well as experimental data show the effect of adsorptive smoothers for exhaust gas flows. Defining a degree of smoothing it can be shown that the amplitude of peaks can be reduced up to over 90 % depending of the adsorbent.*

## 3. MATERIALS AND METHODOLOGY

### 3.1 Proposed Methodology

By using sensors, the exhaust gases are measured and the measured emission level of the gases will be displayed to the driver via led display that will give awareness about the health condition of the engine.

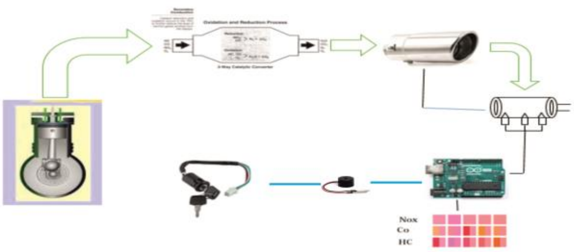


**Figure 1. Proposed design**

### 3.2 COMPONENT SELECTION

The components are selected based on the gas emitted by the SI engine od the vehicle. The output gases are monitored and sensors are selected. The following sensors are used CO Sensor, NOx Sensor, HC Sensor, $O_2$ sensor.

### 3.3 CO SENSOR

The CO sensor, otherwise known as CO, is commonly used to detect for CO. This sensor is a combination of both a carbon monoxide sensor plus a hydrogen sulphide sensor, with both sensors being built into a single housing.

Figaro Electrochemical-type gas sensor are amperometric fuel cells with two electrodes. The basic components of two electrode gas sensors are a working (sensing) electrode, a counter electrode, and an ion conductor in between them. When toxic gas such as carbon monoxide (CO) comes in contact with the working electrode, oxidation of CO gas will occur on the working electrode through chemical reaction with water molecules in the air (see Equation 1).

$$CO + H_2O \rightarrow CO_2 + 2H^+ + 2e^- \ldots (1)$$

Connecting the working electrode and the counter electrode through a short circuit will allow protons (H+) generated on the working electrode to flow toward the counter electrode through the ion conductor. In addition, generated electrons move to the counter electrode through the external wiring. A reaction with oxygen in the air will occur on the counter electrode (see Equation 2)

$$(1/2)\, O_2 + 2H^+ + 2e^- \rightarrow H_2O \ldots (2)$$

The overall reaction is shown in Equation 3. Figaro Electrochemical-type gas sensor operate like a battery with gas being the active material for this overall battery reaction.

$$CO + (1/2)\, O_2 \rightarrow CO_2 \ldots (3)$$

By measuring the current between the working electrode and the counter electrode, this electrochemical cell can be utilized as a gas sensor.

### 3.4 HC *SENSOR*

The HC-SR04 Ultrasonic Distance Sensor is a sensor used for detecting the distance to an object using sonar. The HC-SR04 uses non-contact ultrasound sonar to measure the distance to an object, and consists of two ultrasonic transmitters (basically speakers), a receiver, and a control circuit. **HC-SR04 distance sensor** is commonly used with both microcontroller and microprocessor platforms like Arduino, ARM, PIC, Raspberry Pie etc. The following guide is universally since it has to be followed irrespective of the type of computational device used.

Power the Sensor using a regulated +5V through the Vcc ad Ground pins of the sensor. The current consumed by the sensor is less than 15mA and hence can be directly powered by the on board 5V pins (If available). The Trigger and the Echo pins are both I/O pins and hence they can be connected to I/O pins of the microcontroller. To start the measurement, the trigger pin has to be made high for 10uS and then turned off. This action will trigger an ultrasonic wave at frequency of 40Hz from the transmitter and the receiver will wait for the wave to return. Once the wave is returned after it getting reflected by any object the Echo pin goes high for a particular amount of time which will be equal to the time taken for the wave to return back to the sensor.

The amount of time during which the Echo pin stays high is measured by the MCU/MPU as it gives the information about the time taken for the wave to return back to the Sensor. Using this information the distance is measured as explained in the above heading.


**Fig 4 HC sensor**

### 3.5 MICROCONTROLLER

A microcontroller is a small computer on a single integrated circuit. In modern terminology, it is similar to, but less sophisticated than, a system on a chip (SoC); an SoC may include a microcontroller as one of its components. A microcontroller contains one or more CPUs (processor cores) along with memory and programmable output peripherals. Program memory in the form of ferroelectric RAM, NOR flash or OTP ROM is also often included on chip, as well as a small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in computers or other general purpose applications consisting of various discrete chips.

Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other embedded systems. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes. Mixed signal microcontrollers are common, integrating analog components needed to control non-digital electronic systems. In the context of the internet of things, microcontrollers are an economical and popular means of data collection, sensing and actuating the physical world as edge devices.

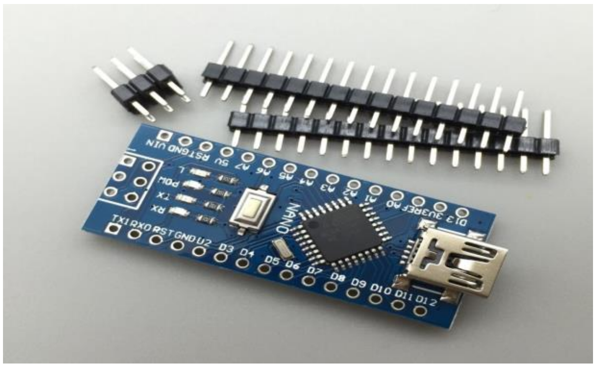


**Fig 5 microcontroller**

Some microcontrollers may use four-bit words and operate at frequencies as low as 4 kHz, for low power consumption (single-digit milliwatts or microwatts). They generally have the ability to retain functionality while waiting for an event such as a button press or other interrupt; power consumption while sleeping (CPU clock and most peripherals off) may be just nanowatts, making many of them well suited for long lasting battery applications. Other microcontrollers may serve performance-critical roles, where they may need to act more like a digital signal processor (DSP), with higher clock speeds and power consumption.

## 4. WORKING PRINCIPLE

By using sensors, the exhaust gases are measured and the measured emission level of the gases will be displayed to the driver via oled display that will give awareness about the health condition of the engine. The microcontroller sends and receives signals from the sensors.

The sensors constantly detect the exhaust smoke from the vehicle and sends signal to the controller unit. The controller unit receives the signal and sends output to the display.

When the emission level of the gas is high the controller shut downs the ignition power using a relay module and the vehicle stops moving thereby alerting the driver about the vehicle health status.

The sensor modules are attached to the end of the exhaust of the vehicle with an outlet pipe in which the sensors are installed. The circuit is connected to the battery of the vehicle from which the circuit gets the power supply of maximum of 12V. There is a transistor attached to the circuit that maintains the constant power supply to the circuit. The function of transistor is to cut off the power supply during power fluctuations.

The ignition line is attached to ignition switch of the vehicle. The ignition line is connected to the microcontroller through a relay.

The OLED display is connected to the microcontroller that shows the reading of the exhaust gas in the display. The sensors from the exhaust pipe are connected to the microcontroller.

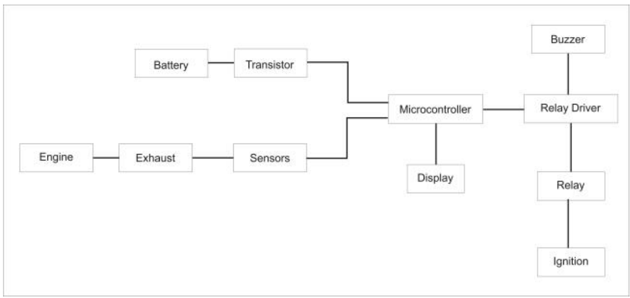
There is a buzzer attached to the PCB board. All the components are mounted on the PCB board. The buzzer is controlled by the microcontroller.

When the vehicle is turned on the sensors at the end of the exhaust pipe starts detecting the amount of smoke expelled out from the vehicle. Individual sensors detect individual gas expelled out from the vehicle.

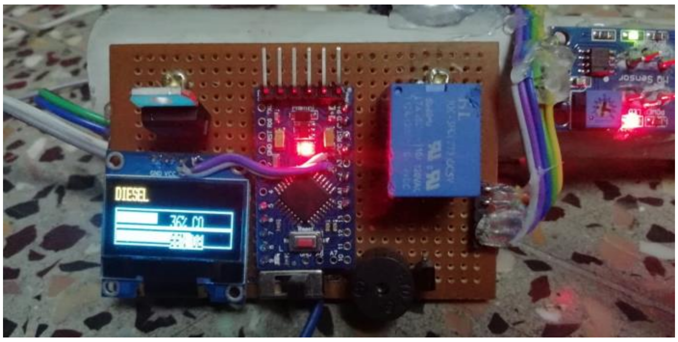
The emission level is continuously monitored by the sensors and the level of the emitted gas is displayed in the OLED display.

When the level of the gas is above 60% the microcontroller sends signal to the buzzer and the buzzer starts functioning at a particular level. The function of the buzzer is to alert the driver about the emission level of the vehicle. It just acts as an initial level indicator of the system.

Layout :




When the emission level is above 90% the microcontroller sends signal to the relay module which is connected to the ignition and shutdowns the power in the ignition and the power supply to the vehicle is cut off.




There is and switch that switches the module from petrol to diesel or diesel to petrol.

The program used to operate the circuit:

```
#include <SPI.h>

#include <Wire.h>

#include <Adafruit_GFX.h>

#include <Adafruit_SSD1306.h>

#include "OLED_I2C_128x64_Monochrome.h"

#include "OLED_I2C_128x64_Monochrome_Font.h"

#define OLED_RESET 4

Adafruit_SSD1306 display(OLED_RESET);

#define NUMFLAKES 10

#define XPOS 0

#define YPOS 1

#define DELTAY 2

#define LOGO16_GLCD_HEIGHT 16

#define LOGO16_GLCD_WIDTH  16

#if (SSD1306_LCDHEIGHT != 32)

#error ("Height incorrect, please fix
Adafruit_SSD1306.h!");

#endif

const int petrol = 9;

const int diesel = 8;

int buttonState1 = 0;

int buttonState2 = 0;

int limit;

int value;

int sensorValue, sensorValue2,sensorValue1;

int sensorValuee = 0;      // the sensor value

int sensorMin = 1023;

int sensorMax = 0;

int sensorValuee2 = 0;       // the sensor value

int sensorMin2 = 1023;

int sensorMax2 = 0;

int sensorValuee3 = 0;       // the sensor value

int sensorMin3 = 1023;

int sensorMax3 = 0;

void setup()  {

 Serial.begin(9600);

 lcd.init(true);

  lcd.setHorizontalMode();
```

```
 display.begin(SSD1306_SWITCHCAPVCC, 0x3C);  //
initialize with the I2C addr 0x3D (for the 128x64)
 display.display();
 delay(20);
  display.clearDisplay();
 pinMode(petrol, INPUT);
 pinMode(diesel, INPUT);
// pinMode(DOUTpin, INPUT);
 pinMode(7, OUTPUT);
 pinMode(5, OUTPUT);
 digitalWrite(5, LOW);
 digitalWrite(7, LOW);
 Serial.begin(9600);
}
void loop()
{
 buttonState1 = digitalRead(petrol);
 buttonState2 = digitalRead(diesel);
 sensorValue = analogRead(A0);
 sensorValue1 = analogRead(A1);
 sensorValue2 = analogRead(A2);
   sensorValuee = map(sensorValue, sensorMin,
sensorMax, 0, 100);
    sensorValuee2 = map(sensorValue1, sensorMin2,
sensorMax2, 0, 100);
     sensorValuee3 = map(sensorValue2, sensorMin3,
sensorMax3, 0, 100);
 if (buttonState1 == HIGH)
 {
 // digitalWrite(5, HIGH);
 display.display();
   display.clearDisplay();
  display.setTextSize(1);
 display.setTextColor(WHITE);
 display.setCursor(0,0);
 display.print("PETROL");
  drawPercentbar( 0, 10, 128, 10,sensorValuee);
  drawPercentbar1( 0, 20, 128, 10,sensorValuee2);
display.display();
if( sensorValuee > 100) sensorValuee =0;
  if( sensorValuee2 > 100) sensorValuee2 =0;
  delay(100);
  if (sensorValuee==100 && sensorValuee2==100)
  {
    digitalWrite(5, HIGH);
    Serial.println("Relay ON");
  }
  if (sensorValuee>=75 && sensorValuee2>=99)
  {
   digitalWrite(7, HIGH);
    Serial.println("Buzzer ON");
    delay(100);
    digitalWrite(7, LOW);
        Serial.println("Buzzer ON");
    delay(100);
  }
}
if (buttonState2 == HIGH)
{
  //digitalWrite(6, HIGH);
 display.display();
  display.clearDisplay();
 display.setTextSize(1);
 display.setTextColor(WHITE);
```

```
 display.setCursor(0,0);
 display.print("DIESEL");
  drawPercentbar( 0, 10, 128, 10,sensorValuee);
  drawPercentbar2( 0, 20, 128, 10,sensorValuee3);
 display.display();
 if( sensorValuee > 100) sensorValuee =0;
   if( sensorValuee3 > 100) sensorValuee3 =0;
   delay(100);
    if (sensorValuee==100 && sensorValuee3==100)
   {
     digitalWrite(5, HIGH);
     Serial.println("Relay ON");
        }
   if (sensorValuee>=75 && sensorValuee3>=95)
   {
    digitalWrite(7, HIGH);
     Serial.println("Buzzer ON");
     delay(100);
     digitalWrite(7, LOW);
         Serial.println("Buzzer ON");
     delay(100);
   }
 }
}
void drawPercentbar(int x,int y, int width,int height, int progress)
{
  progress = progress > 100 ? 100 : progress;
  progress = progress < 0 ? 0 :progress;
  float bar = ((float)(width-4) / 100) * progress;
  display.drawRect(x, y, width, height, WHITE);
  display.fillRect(x+2, y+2, bar , height-4, WHITE);
 // Display progress text
 if( height >= 10){
  display.setCursor((width/2) -3, y+3 );
  display.setTextSize(1);
  display.setTextColor(WHITE);
  if( progress >=50)
   display.setTextColor(BLACK, WHITE); // 'inverted' text
   display.print(progress);
   display.print("% CO");
  }
 }
void drawPercentbar1(int x,int y, int width,int height, int progress1)
{
  progress1 = progress1 > 100 ? 100 : progress1;
  progress1 = progress1 < 0 ? 0 :progress1;
  float bar = ((float)(width-4) / 100) * progress1;
   display.drawRect(x, y, width, height, WHITE);
  display.fillRect(x+2, y+2, bar , height-4, WHITE);
 // Display progress text
 if( height >= 10){
  display.setCursor((width/2) -3, y+3 );
  display.setTextSize(1);
  display.setTextColor(WHITE);
  if( progress1 >=50)
   display.setTextColor(BLACK, WHITE); // 'inverted' text
   display.print(progress1);
   display.print("% Qty");
  }
```

```
}

void drawPercentbar2(int x,int y, int width,int height, int
progress2)

{

  progress2 = progress2 > 100 ? 100 : progress2;

  progress2 = progress2 < 0 ? 0 :progress2;

  float bar = ((float)(width-4) / 100) * progress2;

   display.drawRect(x, y, width, height, WHITE);

  display.fillRect(x+2, y+2, bar , height-4, WHITE);

 // Display progress text

 if( height >= 10){

   display.setCursor((width/2) -3, y+3 );

   display.setTextSize(1);

   display.setTextColor(WHITE);

  if( progress2 >=50)

    display.setTextColor(BLACK, WHITE); // 'inverted' text

    display.print(progress2);

    display.print("% O2");

 }

}
```

## 5. RESULT AND DISCUSSION

The emission level of the environment is reduced and the vehicle health condition is known to the owner or driver of the vehicle. Awareness about the exhaust emission is known to the driver of the vehicle.

## 6. CONCLUSIONS

This implementation will reduce the usage of gasoline which helps to use an alternate power source instead of regular gasoline and helps to decrease the emission and the cost factor.

Now with the implementation of this system will create awareness among the driver and also helps to know the vehicle health condition along with reducing pollution of the vehicle.

## 7. CONTRIBUTION TO THE SOCIETY

By using this project, we can reduce the emission of the vehicle with respect to the distance travelled. The operating cost is also reduced and is more economical than other systems.

## REFERENCES

[1] Kunzli N, Kaiser R and Medina S 2000 Public-health impact of outdoor and trafficrelated air pollution: a European assessment Lancet 356 795–801

[2] European Union Emission Standards 2006 Available: http://www.dieselnet.com/standards/eu/ld.html

[3] Vandaele A C, Simon P C, Guilmot M, Carleer M and Colin R 1994 $SO_2$ absorption cross section measurement in the UV using a Fourier transform spectrometer J. Geophys. Res. 99 25599–605

[4] Nakayama T, Kitamura M T and Watanabe K 1959 Ionization potential and absorption coefficients of nitrogen dioxide J. Chem. Phys. 30 1180–6

[5] Hall T C and Blacet F E 1952 Separation of the absorption spectra of $NO_2$ and $N_2O_4$ in the range of 2400–5000 ˚ A J. Chem. Phys. 20 1745–9

[6] Kummer W 1995 Photochemische Bildung von $NO_2$ in der Reaktion von $NO_2$ mit $N_2$ Diploma Thesis University of Essen, Germany

[7] Bass A M, Ledford A E and Laufer A H 1976 Extinction coefficients of $NO_2$ and $N_2O_4$

J.Res. Natl Bur. Stand. 80 143–66

[8] Schneider W, Moortgat G K, Burrows J P and Tyndall G S 1987 Absorption crosssections of NO2 in the UV and visible region (200–700 nm) at 298 K J. Photochem. Photobiol. 40 195–217

[9] Thompson B A, Harteck P and Reeves R R Jr 1963 Ultraviolet absorption coefficients of

CO2, CO, H 2O, N2O, NH3, NO, SO2, and CH 4 between 1850 and 4000 ˚ A J. Geophys. Res. 68 6431–6

[10] Merola S S, Vaglieco B M and Mancaruso E 2004 Multiwavelength ultraviolet absorption spectroscopy of NO and OH radical concentration applied to a high-swirl diesel-like system Exp. Therm. Fluid Sci. 28 355–67

[11] Davidson J A, Cantrell C A, McDaniel A H, Shetter R E, Madronich S and Calvert J G

1988 Visible-ultraviolet absorption cross sections for NO2 as a function of temperature J. Geophys. Res. 93 7105–12

[12] Amoruso A, Crescentini L, Fiocco G and Volpe M 1993 New measurements of the $NO_2$ absorption cross section in the 440- to 460-nm region and estimates of the $NO_2$-$N_2O_4$ equilibrium constant J. Geophys. Res. 98 16857–63

[13] Harwood M H and Jones R L 1994 Temperature dependent ultraviolet–visible absorption cross sections of $NO_2$ and $N_2O_4$: low-temperature measurements of the equilibrium constant of $2\ NO_2 \leftrightarrow N_2O_4$ J. Geophys. Res. 99 22955–64

[14] Coquart B, Jenouvrier A and M´erienne M F 1995 The NO2 absorption spectrum. II. Absorption cross-sections at low temperatures in the 400–500 nm region J. Atmos. Chem. 21 251–61

[15] Kubota 2006 v1505 Diesel test engine. Available: http://www. kubotaengine.com/drawings/v1505-e.htm

[16] Ouenou-Gamo S, Ouladsine M and Rachid A 1998 Measurement and prediction of diesel engine exhaust emissions ISA Trans. 37 135–40