VEHICLE POLLUTANTS CONTROL USING SENSORS AND ARDUINO

R.Priyanka, S.K. Thai Bhuvana, Archanaa Raveendran, Dr. R. Kavitha

SASTRA University, Thanjavur, Tamil Nadu

priyankadiiva96@gmail.com,bhuvisankar97@gmail.com, archan1996@gmail.com, srmkavitha@gmail.comm

Abstract- *The basic objective of this paper is to control the vehicle effluents like carbon dioxide, sulphur dioxide, carbon monoxide that may harm the ecosystem. We are also focussing on avoiding disasters due to fire and harmful gases using the appropriate sensors.Hence, this will be useful for Pollution Control Board to monitor the emission rate of harmful effluents from vehicles.*

Keywords: Arduino; GSM module; Threshold level;Watson IoT Platform.

I. INTRODUCTION

Technology and automation is at its peak but with the compromise of polluting the environment due to harmful vehicle effluents. So, the basic idea is to control the rate of emission of carbon dioxide (CO_2), carbon monoxide (CO), hydro carbon (HC) using corresponding sensors at the outlet. If the amount of pollutants is higher than the threshold level then the siren is turned on automatically, which is controlled by Arduino. The data, i.e., the emission rates will be continuously sent to the IBM Watson IoT Platform using the GSM Module which can be linked to Pollution Control Board for monitoring the emissions from vehicles.

II. NEED TO CONTROL VEHICLE POLLUTANTS

A. CARBON DIOXIDE

Since transportation sector accounts for carbon dioxide emissions in a very large amount i.e, about 22% (fossil fuel related) around the world, there arises a need to control emission. Also, this rate has increased to 45% in the past two decades[6].

Sources of carbon dioxide emission from transportation sector that includes road transport such as automobiles, freight and light duty trucks produce 72%.Also other sources of emissions are marine shipping and global aviation.

Light duty vehicles such as cars and vans account for 15% of EU's carbon dioxide emissions. For cars and van fleets binding emission targets has been set up by EU legislation and because of these targets average emissions have been reduced.

About a quarter of CO_2 emission is produced by heavy weight vehicles like trucks and buses which accounts for about 6% of EU emissions.

These emissions are mainly increasing due to increasing road freight traffic. A comprehensive strategy is worked upon by commission to reduce these emissions.

B. CARBON MONOXIDE

Carbon monoxide is produced due to incomplete combustion of carbon containing fuels such as gasoline, wood, coal and natural gas. It is odourless, tasteless and colorless toxic air pollutant and one of the largest source of CO is vehicle emission.

Breathing of high concentrations of CO leads to reduction in level ofoxygen that is being transported in hemoglobin and causes many health problems like nausea, headache ,chest pain for heart patients and impaired reaction timing, As compared to 1960's there is 21% decrease in the unhealthy environment caused due to CO emissions

from vehicles because and this is because of introduction of emission controls especially automotive catalysts.

In locations where concentration of CO emission is more generally exhibits topographical or meteorological conditions that exacerbate pollution like inversion temperature or inhibition of pollutant dispersion due to nearby hills.

And also during summer concentration of ozone (O_3) and year-round particulate matter (PM).is more[1] Low temperatures also contribute to high CO concentrations. Engines and vehicle emissions-control equipment operate less efficiently when cold: Air-to-fuel ratios are lower, combustion is less complete, and catalysts take longer to become fully operational. The result is the formation of products of incomplete combustion, CO, in higher concentrations.

B. HYDROCARBONS

Hydrocarbons are basically toxins which may be partially or fully burned and contributes majorly to smog causing problems in urban areas.Exposure to hydrocarbons in a long run causes asthama, lung diseases, liver diseases and cancer.

Based upon the type of engine and jurisdiction there can be regulation of 'non methane hydrocarbons' or ' total hydrocarbons'.

Though methane is not directly toxic, but its difficult to break in a catalytic converter and thus regulation of non methane hydrocarbon is far easier. Methane is basically a greenhouse gas so its emission control is need of the hour.

Methane is emitted even when the engine is off and comes from fuel tanks and lines ,24 hours a day, complex system of fuel vent lines and a charcoal canister is meant to collect and contain fuel vapours and route them either back to the fuel tank or, after the engine is started and warmed up, into the air intake to be burned in the engine.

III. PROPOSED METHODOLOGY

A. SENSORS AND THRESHOLD LEVELS

The sensors are fixed in the smoke outlet of the vehicle and its output is given as input to the Arduino board. Ks0045 sensor keyestudio MQ-7 for Carbon monoxide, MQ-2 for hydrocarbon gases, MQ-135 for carbon dioxide are used to obtain the amount of the respective gases emitted from the vehicle[3],[4],[5],[1].According to

Table1. Sensors used for Gases

GASES TO BE DETECTED	SENSOR USED
Carbon monoxide	MQ-7
Hydrocarbon gases	MQ-2
Carbon dioxide	MQ-135

information collected from CPCB, vehicular exhaust emission standards for CO_2, CO and hydrocarbons are listed in table II.

Table 2. Threshold levels of gases

Gases	Threshold
Mass of Hydrocarbons (HC), max. gm/ kWH	305
Mass of Carbon Dioxide (CO_2), max. ppm	500
Mass of Carbon Monoxide (CO), max, gm/kWH	14

B.PROGRAMMING ARDUINO

Here, Arduino is programmed to get the sensor reading as input and comparing it with the threshold level of each of the gases that can be emitted from the vehicle[7],[8].

SIMULATED CODE

```
IntledPin = 13;      // select the pin for the LED

int sensorValue1[5]={1200,2600,3400,2000,4500};

//output from CO sensor

int sensorValue2[5]={1200,2600,3400,2000,4500};
```

```
// output from hydro carbon sensor
Int sensorValue3[5]={1200,2600,3400,2000,4500};
// output from CO2 sensor


void setup() {
  // declare the ledPin as an OUTPUT:
pinMode(ledPin, OUTPUT);
}
void loop()
{
 // read the value from the sensor:
Inti;
for (i = 0; i< 5; i = i + 1) {
 //compare with threshold value
if((sensorValue1[i]>2500)|(sensorValue2[i]>2500)
|(sensorValue3[i]>2500))
//assumed threshold level=2500
{
digitalWrite(ledPin, HIGH);// turn on led
 // stop the program for <sensorValue>
milliseconds:
delay(1000);
 }
else
  {
  // turn the ledPin off:
digitalWrite(ledPin, LOW);
 // stop the program for for<sensorValue>
milliseconds:
delay(1000);
  } } }
```

Here, for simulation we check the code by glowing LED if the values cross the threshold levels.

REAL TIME CODE

Here,only one of the sensor is considered and the threshold value is taken to be 500 ppm. The serial port is used to send data to the GSM module for further processing.

```
int sensor Value;
int pin8 = 8;
void setup()
{
Serial.begin(9600);  // sets the serial port to 9600
pinMode(pin8, OUTPUT);
}
void loop()
{
sensorValue = analogRead(0);  // read analog input
pin 0
Serial.print(sensorValue, DEC);  // prints the value
read
Serial.println("ppm");
if (sensorValue> 500) {
   // Activate digital output pin 8 - the LED will
light up
digitalWrite(pin8, HIGH);
  }
else {   // Deactivate digital output pin 8 - the LED
will not light up
digitalWrite(pin8, LOW);
  }
elay(5000);  // wait 100ms for next  reading
}
```

Fig 1. LED on condition when the threshold level is crossed

Fig 2. LED off condition when the emission rate is within limits

C. ALARM AND GSM MODULE

In the simulated program, instead of LEDs, we use siren or alarm to indicate that the threshold has been crossed.

If the threshold value is reached the emission rate will be send through the GSM Module to the IBM Watson IoT platform.Your vehicle must have been registered with the IBM Watson IoT Platform organization[2]. User credentials will be provided after registration. Emission events are recorded by using codes of these types:

Emission Event:
iot-2/evt/emission/fmt/json

{ "d": { "hc": "32", "co": "32","co2": "32" }}

The data retrieved from each vehicle (using GSM module) is viewed by logging in using user credentials on the dashboard. This data can be used by the CPCB to monitor the emission of gases from vehicles and to reduce global warming in near future.

D. SENSOR SPECIFICATIONS

	MQ-2[4]	MQ-7[3]	MQ-135
Using temperature	20□±2□	-20□-50□	-10^0C-45^0C
Sensing Resistance	2KΩ-20KΩ(in 2000ppm C3H8)	2KΩ-20KΩ	30KΩ-200KΩ (100ppm NH3)
Features	High sensitivity to LPG, Propane and Hydrogen	Stable and long life	Wide detecting scope
Application	Domestic gas leakage detector	gas detecting equipment for carbon monoxide	used in air quality control equipments

IV.CONCLUSION

This particular system includes sensors that detects the parameters causing pollution from vehicles. The sensors used are carbon dioxide, carbon monoxide and hydrocarbons detecting sensors

where carbon dioxide (CO_2) emission is the major cause for global warming. Whenever there is an increase in the level of these parameters the sensors detects the situation and an alarm or indication is given. The emission rates are sent to CPCB through GSM module and IBM Watson IOT platform and necessary actions can be taken by the board.

V.FUTURE WORK

This system is monitoring only three parameters and hence can be expanded by considering more parameters that cause the pollution especially by the vehicles. This system gives availability of viewing the sensor outputs through internet. It can be made to control the emissions by giving commands from distance. Many pollutants do not have sensors that sense them if available they are very expensive and hence building sensors for different parameters might be a future and very challenging task.

VI. REFERENCES

[1]D.Patrnabis."Sensors and transducers", Second edition.

[2]CunoPfister"Getting Started with the Internet of Things " First edition -17 May 2011

[3] MQ-7 Data Sheet

[4] MQ-2 Data Sheet

[5] MQ- 135 Data Sheet

.[6] Olsthoorn X. "CO_2 emissions from international aviation: 1950–2050", Journal of Air Transportation Management , vol. 7, pp. 87–93, 2001.

[7] Michael McRoberts, Beginning Arduino,22 dec,2010.

[8]Simon Monk, Programming Arduino,8 nov,2011.

[8] Agarwal, Anil, and Sunita Narain. Global Warming in an UnequalWorld. New Delhi: Centre for Science and Environment, 1991.

[9] UNWTO and UNEP and WMO. Climate Change and Tourism:Responding to Global Challenges (prepared by Scott, D., Amelung, B.,Becken, S., Ceron, JP., Dubois, G., Gössling, S., Peeters, P. andSimpson, M.C.). Paris: UNWTO, Madrid, and UNEP, 2008.

[10] Camelia Monica Tepelus, Rolando Castro Cordoba. "Recognitionschemes in tourismfrom 'eco' to 'sustainability'?", Journal of CleanerProduction, vol. 13 , pp. 135–140, 2005.

[11] Jones, R.N. "Managing uncertainty in climate change projections issuesfor impact assessment". Climatic Change, Vol. 45, pp.403-419, 2000.

[12] Norgaard, K.M. "'We Don't Really Want to Know' -EnvironmentalJustice and Socially Organized Denial of Global Warming in Norway',Organization & Environment, Vol. 19, pp.347-370, 2006.

[13] Hall, C.M. & Williams, A.M. Tourism and Innovation. London:Routledge2008.

[14] Simpson, M.C. "Community Benefit Tourism Initiatives: A ConceptualOxymoron?", Tourism Management, Vol. 29, pp.1-18, 2008.

[15] Simpson, M.C., Gössling, S., Scott, D., Hall, C.M. and Gladin, E.Climate Change Adaptation and Mitigation in the Tourism Sector: Frameworks, Tools and Practices. UNEP, University of Oxford,UNWTO, WMO: Paris, France, 2008, pp.65-100.

[16] Gössling, S., Hall, C.M., Lane, B. Weaver, D. "The HelsingborgStatement on Sustainable Tourism", Journal of Sustainable Tourism,Vol.16, pp.122-124, 2008.

[17] UNEP. Switched on: Renewable Energy Opportunities for the TourismIndustry. Paris: UNEP, 2003.

[18] Cavallaro, F. & Ciraolo, L. "A multicriteria approach to evaluate windenergy plants on an Italian island". Energy Policy, Vol.33, pp.235-244 ,2005.