"DESIGN AND FABRICATED MODEL OF AN IMPROVED EMISSION MONITORING AND WARNING SYSTEM FOR AUTOMOBILES"

[1]R.Yadagiri Rao
Assoc. Professor, Dept of PHYSICS,
[1]RVR Institute of Engineering, Ibrahimpatnam. AP. Email: ryrao08@gmail.com
[2]Md.Abu Basim
Asst. Professor, Dept of Mechanical,
[1]RVR Institute of Engineering, Ibrahimpatnam. AP. Email: basim89@gmail.com

ABSTRACT

We, the human are always talking about saving the environment, but most of us don't know what the reasons for polluting the environment are. Emission is one of the foremost reason for the pollution, which leads to various hazardous effects like Global warming, Ozone layer depletion, Green house effect, Acid rain etc. Our ultimate aim is to reduce the emissions, because emissions are responsible for decaying of the environment.80% of world's pollution is mainly due to automobile emissions. All the leading manufacturers of automobiles, design their vehicles with the controlling devices for reducing the emissions, but none design their vehicle with emission monitoring system. As a result of this, the person using the vehicle will not get any knowledge about emissions. Keeping this in mind we designed the "**DESIGN AND FABRICATED MODEL OF AN IMPROVED EMISSION MONITORING AND WARNING SYSTEM FOR AUTOMOBILES"** which monitor the emission rates of the vehicle and are displayed in the dashboard. The rates are stored in the microcontroller for the duration of 6/12/18 months and are reset automatically after the programmed duration. There is also an additional feature in this system, whenever the emission rates exceed the safe limit a warning light will glow. From this he/she can judge their vehicle performance and take necessary actions to rectify it.

At present, all the vehicles are inspected by the particular government or by the authorized vehicle testing agency set by the government to obtain the fitness certificate for the vehicles. In India also, the emissions are checked by the authorized emission testing centres situated in various districts. The main problems starts here, presently, all vehicles need to undergo a periodic emission check (3 months/ 6 months) at PUC Centres at Fuel Stations and Private Garages which are authorized to check the vehicles. In addition, transport vehicles need to undergo an annual fitness check carried out by RTOs for emissions, safety and roadworthiness.

Key words: Emission Monitoring and Warning System, Pollution, Emissions and Combustion.

1. INTRODUCTION

1.1 SOURCES OF AUTO EMISSIONS

Emissions from an individual car are generally low, relative to the smokestack image many people associate with air pollution. But in numerous cities across the country, the personal automobile is the single greatest polluter, as emissions from millions of vehicles on the road add up. Driving a private car is probably a typical citizen's most "polluting" daily activity.

Figure 1: - Sources of auto emissions

1. 2. THE COMBUSTION PROCESS

Gasoline and diesel fuels are mixtures of hydrocarbons, compounds which contain hydrogen and carbon atoms. In a "perfect" engine, oxygen in the air would convert all the hydrogen in the fuel to water and all the carbon in the fuel to carbon dioxide. Nitrogen in the air would remain unaffected. In reality, the combustion process cannot be "perfect," and automotive engines emit several types of pollutants.

1.2.1 PERFECT COMBUSTION

FUEL (hydrocarbons) + AIR (oxygen and nitrogen) + CARBON DIOXIDE + water + unaffected nitrogen

1.2.2 TYPICAL ENGINE COMBUSTION

FUEL + AIR UNBURNED HYDROCARBONS + NITROGEN OXIDES+ CARBON MONOXIDE + CARBON DIOXIDE + water

1.3 EXHAUST POLLUTANTS:

1.3.1 HYDROCARBONS

Hydrocarbon emissions result when fuel molecules in the engine do not burn or burn only partially. Hydrocarbons react in the presence of nitrogen oxides and sunlight to form ground-level ozone, a major component of smog. Ozone irritates the eyes, damages the lungs, and aggravates respiratory problems. It is our most widespread and intractable urban air pollution problem. A number of exhaust hydrocarbons are also toxic, with the potential to cause cancer.

1.3.2 NITROGEN OXIDES

Under the high pressure and temperature conditions in an engine, nitrogen and oxygen atoms in the air react to form various nitrogen oxides, collectively known as NOx. Nitrogen oxides, like hydrocarbons, are precursors to the formation of ozone. They also contribute to the formation of acid rain.

1.3.3 CARBON MONOXIDE

Carbon monoxide (CO) is a product of incomplete combustion and occurs when carbon in the fuel is partially oxidized rather than fully oxidized to carbon dioxide. Carbon monoxide reduces the flow of oxygen in the bloodstream and is particularly dangerous to persons with heart disease.

1.3.4 CARBON DIOXIDE

In recent years, the U.S. Environmental Protection Agency (EPA) has started to view carbon dioxide, a product of "perfect" combustion, as a pollution concern. Carbon dioxide does not directly impair human health, but it is a "greenhouse gas" that traps the earth's heat and contributes to the potential for global warming.

1.5 EMISSIONS FROM A CAR

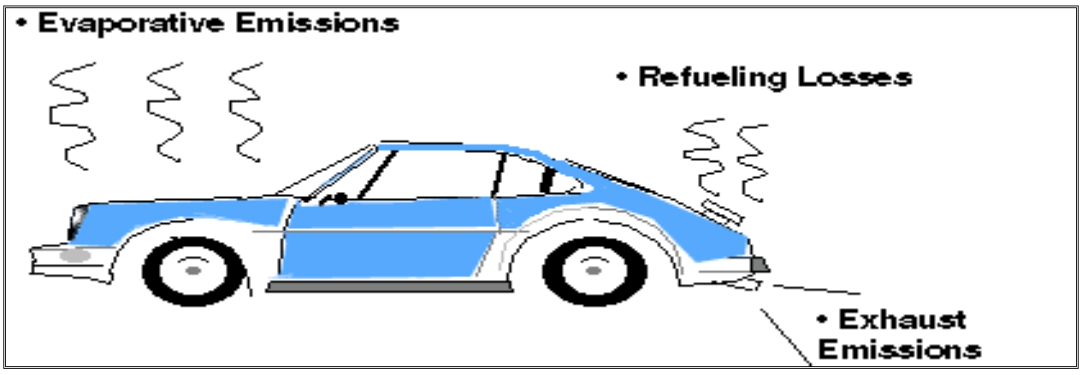


Figure 2: - Emissions from a car

1.6 EVAPORATIVE EMISSIONS

Hydrocarbon pollutants also escape into the air through fuel evaporation. With today's efficient exhaust emission controls and today's gasoline formulations, evaporative losses can account for a majority of the total hydrocarbon pollution from current model cars on hot days when ozone levels are highest. Evaporative emissions occur several ways.

1.6.1 DIURNAL

Gasoline evaporation increases as the temperature rises during the day, heating the fuel tank and venting gasoline vapors.

1.6.2RUNNING LOSSES

The hot engine and exhaust system can vaporize gasoline when the car is running.

1.6.3 HOT SOAK

The engine remains hot for a period of time after the car is turned off, and gasoline evaporation continues when the car is parked.

1.6.4 REFUELING

Gasoline vapors are always present in fuel tanks. These vapors are forced out when the tank is filled with liquid fuel.

1.7 POLLUTION STATUS OF VEHICLES

Figure 3: - Pollution status of vehicles

1.8 OUTLINE OF EMISSION TEST IN INDIA BY THE EXTERNAL AGENCY

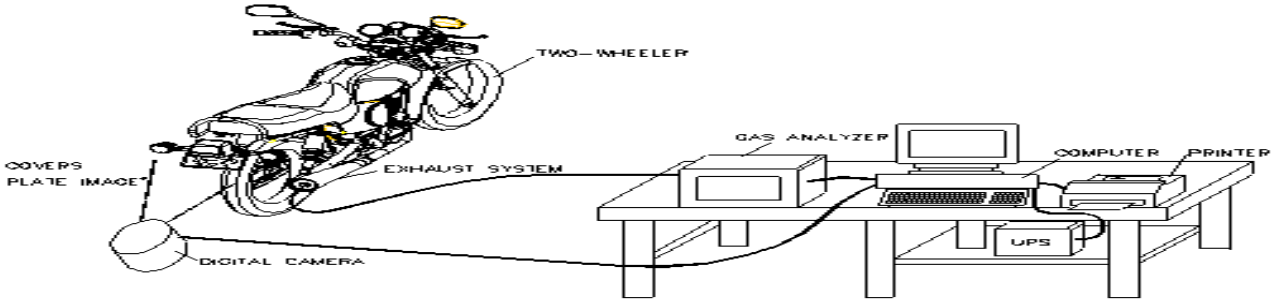
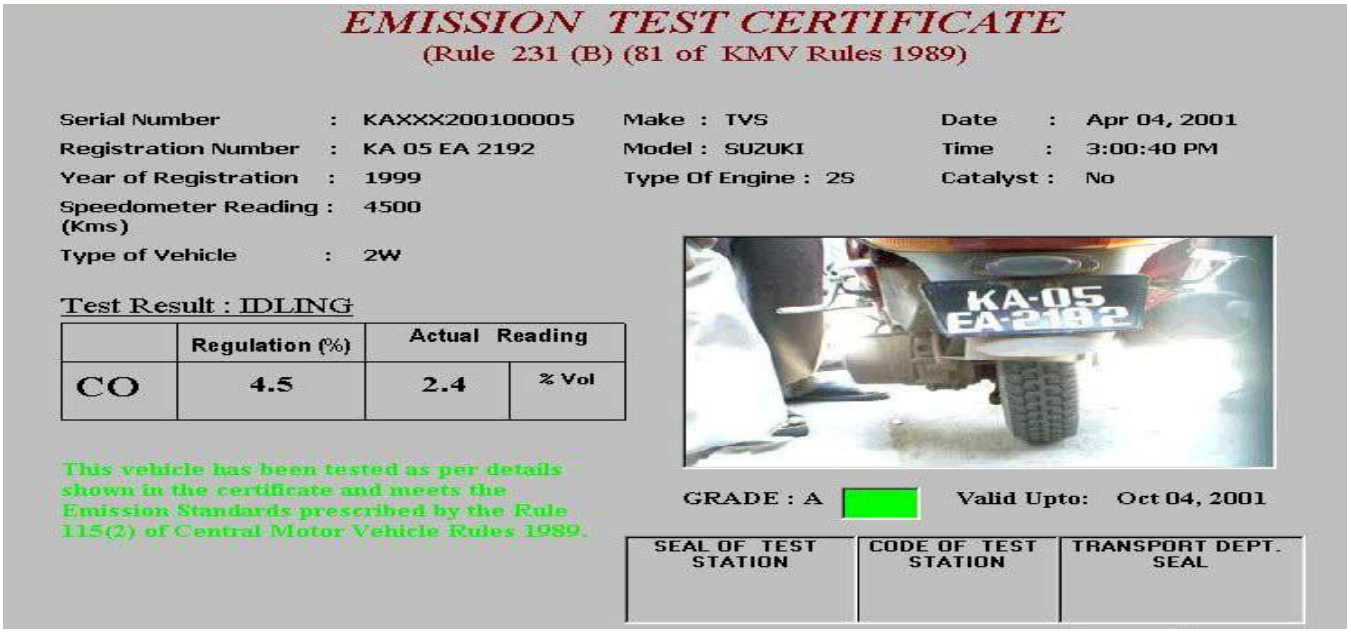


Figure 4: - Outline of emission test in India by the external agency.

1.9 EMISSION TEST CERTIFICATE



EMISSION TEST CERTIFICATE
(Rule 231 (B) (81 of KMV Rules 1989)

Serial Number : KAXXX200100005
Registration Number : KA 05 EA 2192
Year of Registration : 1999
Speedometer Reading : 4500 (Kms)
Type of Vehicle : 2W

Make : TVS
Model : SUZUKI
Type Of Engine : 2S

Date : Apr 04, 2001
Time : 3:00:40 PM
Catalyst : No

Test Result : IDLING

	Regulation (%)	Actual Reading	
CO	4.5	2.4	% Vol

This vehicle has been tested as per details shown in the certificate and meets the Emission Standards prescribed by the Rule 115(2) of Central Motor Vehicle Rules 1989.

GRADE : A

Valid Upto: Oct 04, 2001

SEAL OF TEST STATION	CODE OF TEST STATION	TRANSPORT DEPT. SEAL

Figure 5: - Emission test certificate.

2. EXPERIMENTAL

2.1 NEED FOR EMISSION MONITORING AND WARNING S YSTEM

The objective of reducing pollution not achieved to a large extent by the present system. Some reasons for this are:

1. Old technology vehicles still remain in our roads

2. 70% cars belongs to pre catalytic era
3. PUC Certification does not monitor the real problem of adulteration
4. PUC centers also conduct minor engine adjustment to get vehicle pass through the test.
5. Lack of awareness among our people regarding emissions
6. Independent centres do not follow rigorous procedures due to inadequate training.
7. Equipment not subjected to periodic calibration by independent authority
8. Lack of professionalism has led to malpractice.
9. Association of test centers owners coordinate printing of the certificates and stickers for their members.
10. No document is provided for government by the centers for supervision
11. No variation in graphical design which makes enforcement officer difficult to differentiate between valid and outdated sticker.
12. Indian standards are less stringent than European norms
13. PUC certification administration in India is highly inefficient, inadequate and unreliable
14. Only one standard driving cycle has been prescribed for all possible conditions

There has been criticism of the fact that the Indian norms lag the Euro norms. At present, this lag is around 5 years. Also, there was suggestion from some bodies to implement Euro IV norms after Euro II norms, skipping the Euro III norms totally. This is because the Euro III norms are only a small improvement over Euro II, whereas Euro IV norms mark a big leap over Euro II.

2.2 DESIGN AND FABRICATION OF EMWS SYSTEM

2.2.1 FABRICATED BLOCK DIAGRAM

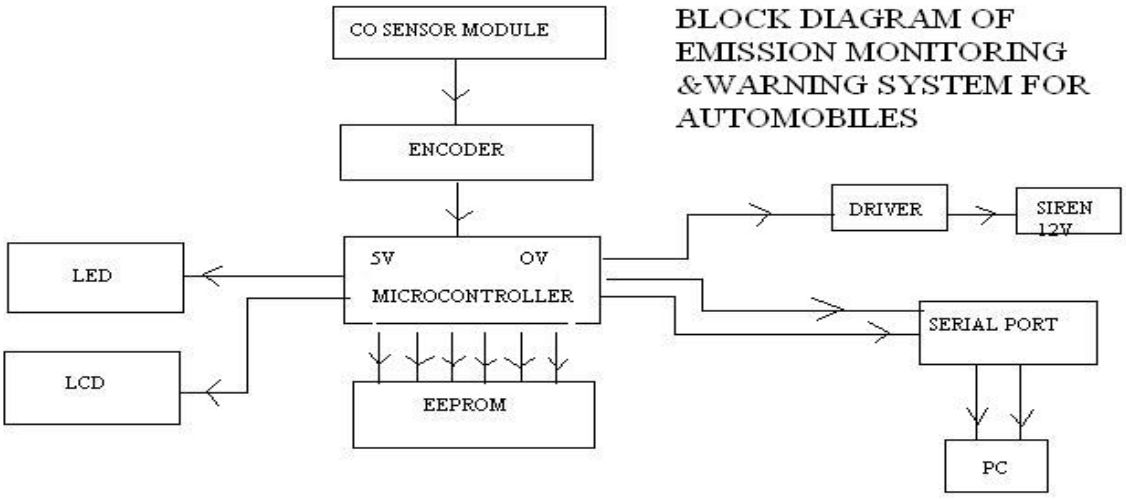


Figure 6: - Fabricated Block Diagram of EMWS for Automobiles

The block diagram is explained below

2.2.2 CARBON MONOXIDE MODULE

The module consists of MQ-7 Gas sensor .The details of MQ-7 Gas sensor is given below:

2.2.3 FEATURES

1. High sensitivity to carbon monoxide
2. Stable and long life

2.2.4 APPLICATION

They are used in gas detecting equipment for carbon monoxide (CO) in family and industry.

2.3 STRUCTURE AND CONFIGURATION - BASIC MEASURING CIRCUIT

Structure and configuration of MQ-7 gas sensor is shown as Fig. (Configuration A or B),sensor composed by micro AL2O3 ceramic tube, Tin Dioxide (SnO2) sensitive layer, measuring electrode and heater are fixed into a crust made by plastic and stainless steel net. The heater provides necessary work conditions for

work of sensitive components. The enveloped MQ-7 has 6 pin, 4 of them are used to fetch signals, and other 2 are used for providing heating current.

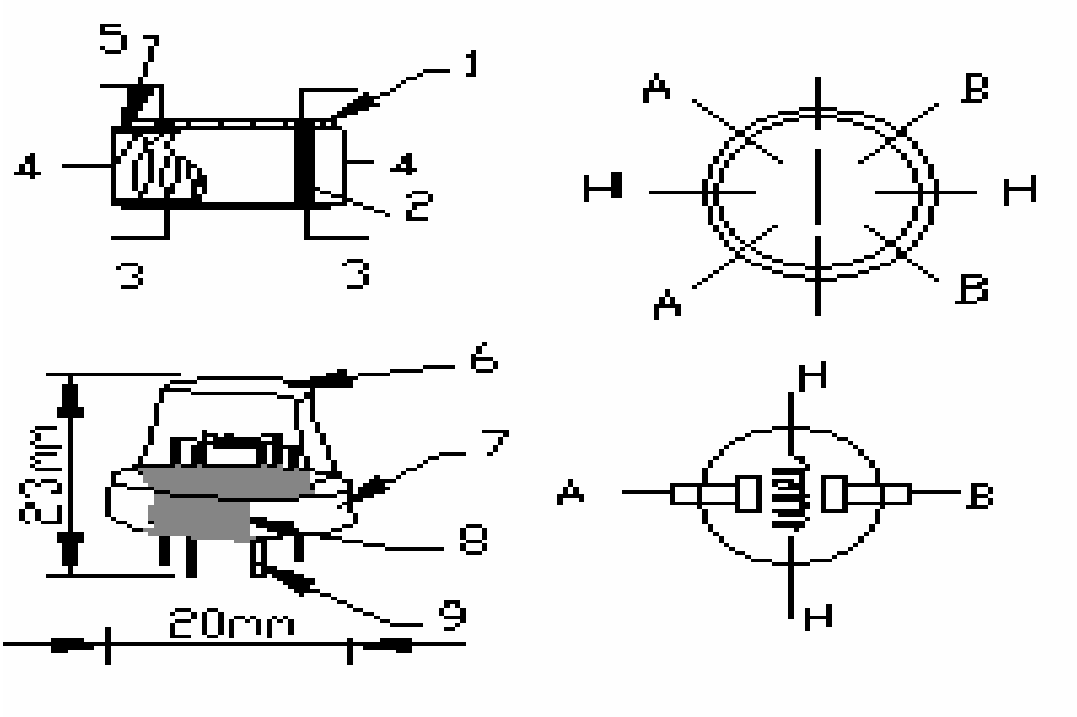


Figure 7:- Structure and configuration of MQ-7 gas sensor

2.4. OPERATION PRINCIPLE

. The surface resistance of the sensor Rs is obtained through effected voltage signal output of the load resistance RL which series-wound. The relationship between them is described:

$$R_s \backslash R_L = (V_c - V_{RL}) / V_{RL}$$

2.5 SENSITIVITY ADJUSTMENT

`Resistance value of MQ-7 is difference to various kinds and various concentration gases. So, when using these components, sensitivity adjustment is very necessary. we recommend that you calibrate the detector for 200ppm CO in air and use value of Load resistance that(RL) about 10 KΩ(5KΩ to 47 KΩ).When accurately

measuring, the proper alarm point for the gas detector should be determined after considering the temperature and humidity influence.

The sensitivity adjusting program is as follows:

1. Connect the sensor to the application circuit.
2. Turn on the power; keep preheating through electricity over 48 hours.
3. Adjust the load resistance RL until you get a signal value which is respond to a certain carbon monoxide concentration at the end point of 90 seconds.
4. Adjust the another load resistance RL until you get a signal value which is respond to a CO concentration at the end point of 60 seconds .

2.6 LED (LIGHT EMITING DIODE)

A light-emitting diode (LED) is an electronic light source. The LED was discovered in the early 20th century, and introduced as a practical electronic component in 1962. All early devices emitted low-intensity red light, but modern LEDs are available across the visible, ultraviolet and infra red wavelengths, with very high brightness.

2.7 LCD DISPLAY

The Liquid Crystal Display displays the balance amount in the account. LCD Display with 2 lines x 16 characters.

2.8 MICROCONTROLLER

The microcontroller which we are using is PIC 16F73. This Microcontroller consists of four ports called Port A, Port B, Port C and Port D. In one port we can use maximum of eight pins. One can configure the I/O pins according to the use.

2.8.1 PIN DIAGRAM

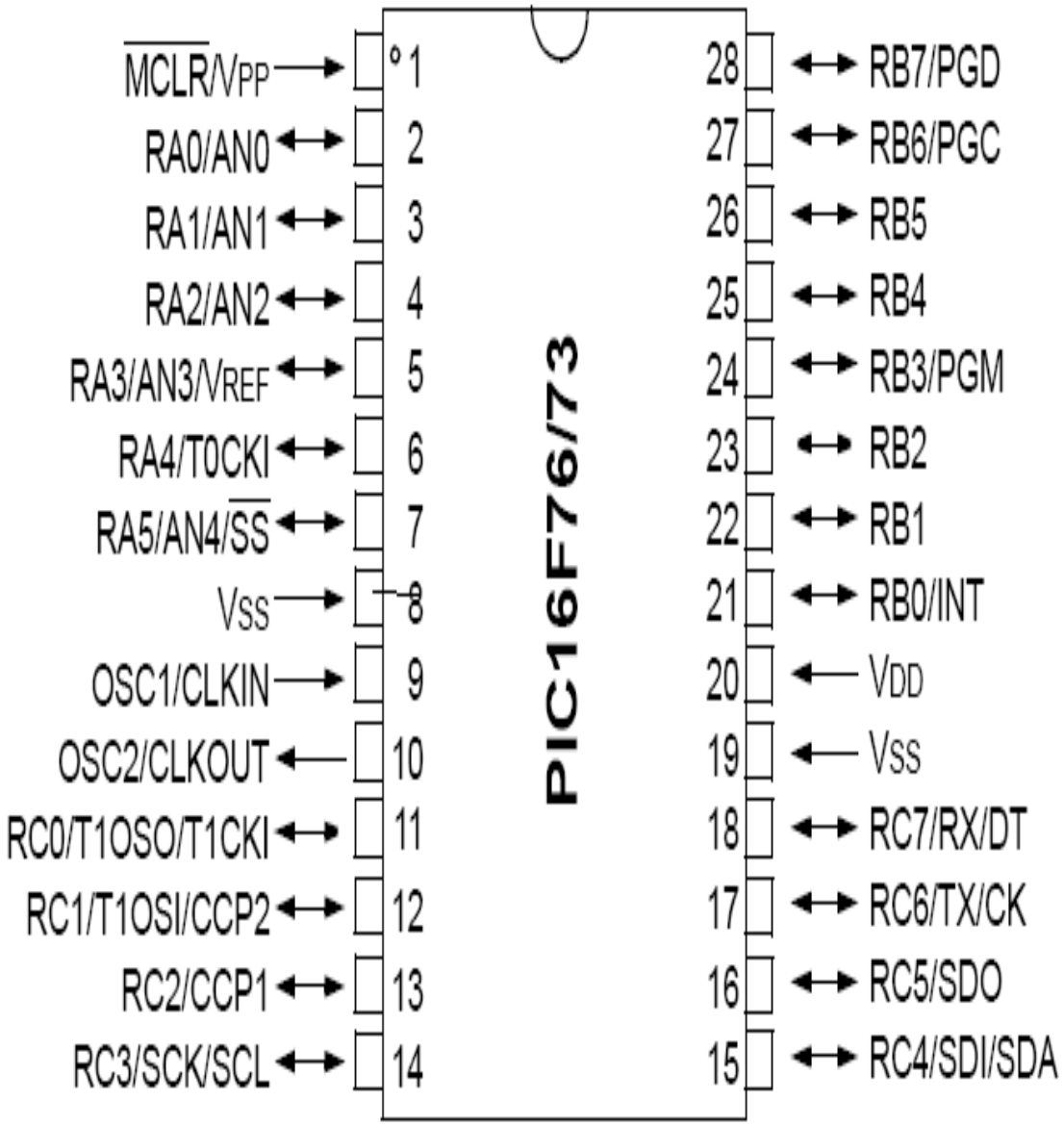


Figure 8: - Pin diagram of PIC16F76 / 73

2.8.2 CIRCUIT DIAGRAM

The circuit diagram of the emission monitoring and warning system is shown below

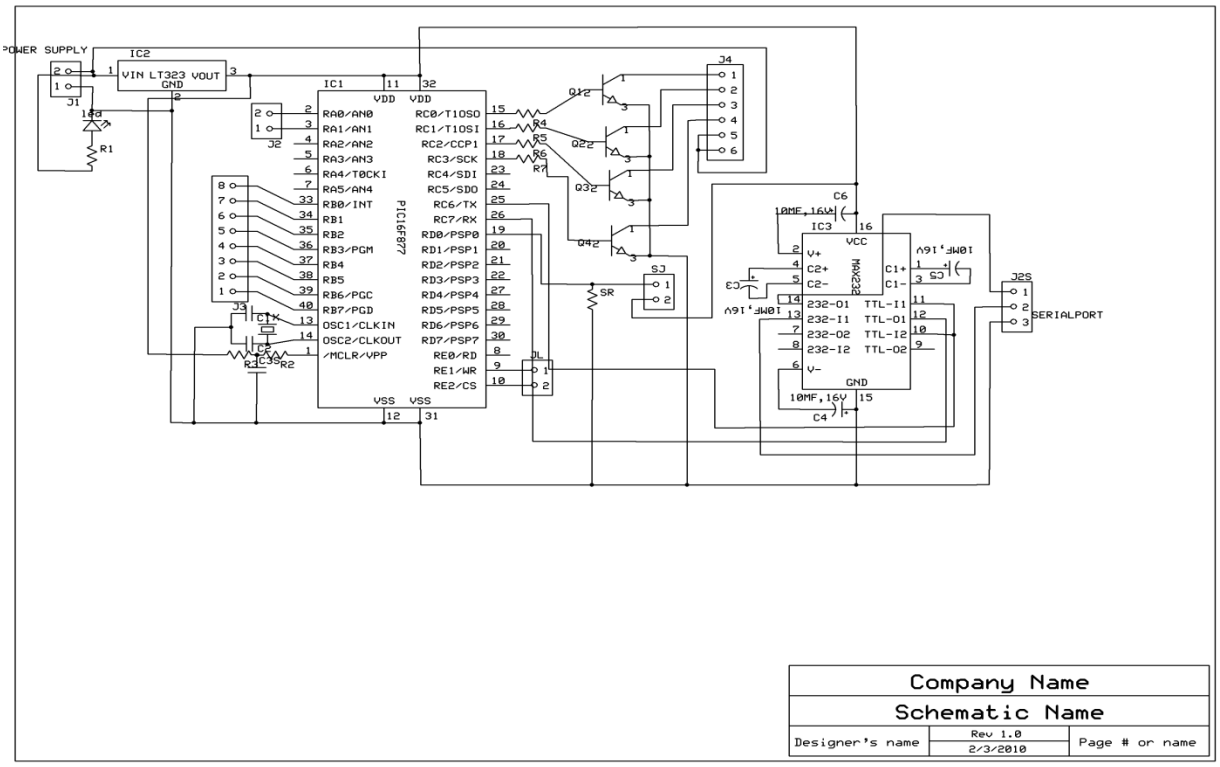


Figure9:- Circuit diagram of EMWS kit.

2.8.3 CIRCUIT DESCRIPTION

The main module in this circuit is microcontroller PIC 16F877. The microcontroller is biased by a regulator IC 7805. It consists of 40 pins with four I/O ports. It has inbuilt peripherals like ADC, LCD driver etc. Pin numbers 11 and 32 are connected with positive 5V and pin numbers12 and 31 are connected with ground. A crystal oscillator is connected in between pin numbers 13 and 14 for external clock. The input from the sensor is given through pin numbers 2 and 3. A LCD display is connected through pin numbers 33 to 40. The computer interfacing IC (Serial port) MAX 232 is connected via pin numbers 9 and 10. The serial port pin is connected through pin numbers 13, 14 and 15 of MAX 232.

The co sensor senses the amount of co present in the particular area. It sends signal to the microcontroller. The data is stored in the ROM of the microcontroller. The kit is connected with the PC through serial port pin. The PC can read the data stored in the ROM of the microcontroller through the serial port.

2.8.4 WORKING OF THE SYSTEM

The CO sensor is connected to the tube and is placed in the tail pipe. Here the burned gas is coming out with high pressure and temperature. The sensor senses the emission and it sends the data in the analog form, in order to convert it to machine readable format encoder is used to convert it. The converted form is then fed to microcontroller and then the data is stored in the EEPROM Electronically erasable programmable memory. The data in EEPROM can be erased by continuous supplying of electric signals. Here the data is erased after the programmed duration (normally 6 months)

The data which are stored in the microcontroller is activated on supplying 5v and deactivated by 0v.Then it is fed to the driver which is utilized for displaying the warning light when the emission rates seems to be increased and also the beep sound will be produced during this situation. The data (emission rates) are finally connected to the serial port of pc through the slot provided, so that the emission rates for the particular vehicle is stored for the particular duration and are displayed in the form of graph.

2.8.5 HOW THE READINGS ARE TAKEN

This is just the prototype system. So we are using only CO sensor for sensing carbon monoxide content in the exhaust. The sensor can be programmed based on vehicle motion.

Here, the emission rate is stored based on the motion of the vehicle. When the vehicle runs for 1 hr, the sensor senses for each 15 secs. Finally at the end of 1 hr there will be 240 emission rate values. When the EMWS is connected through serial port, these values can be viewed in the graphical format. The readings from the sensor output can be obtained in the analog form. These have to be converted into equivalent %(volume).

2.8.6 TABULAR COLUMN

S.No	Sensor	%(volume)
1	37	1.12
2	43	1.29
3	84	2.52
4	137	4.12
5	120	3.61
6	51	1.52
7	57	1.71

Since 0.01% = 100 ppm,

3% from cigarette = 30000 ppm =100(sensor output)

3.4% = ((0.034*100)/0.03) = 113

Therefore 1.12 %=((0.0112 * 100)/0.03) =37.

Similarly we have to calculate for other values.

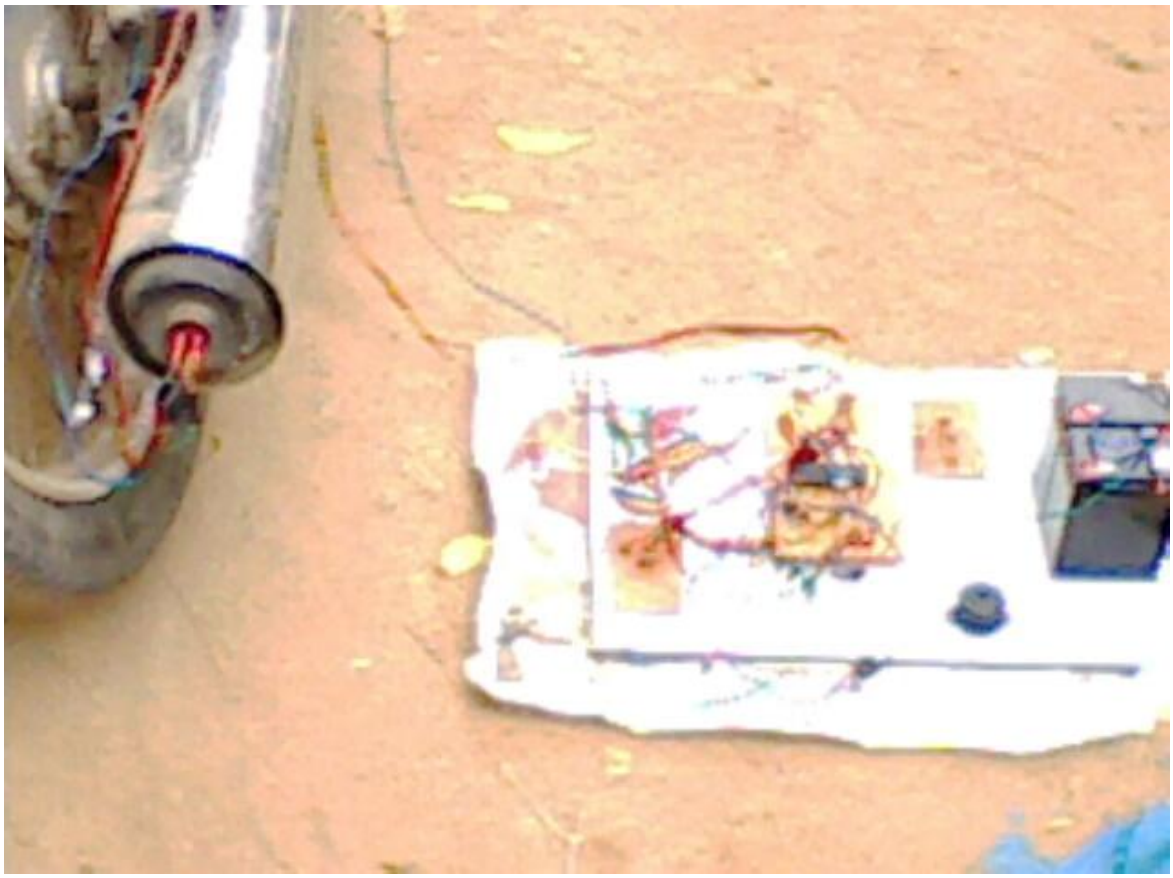


Figure10:- Testing method of EMWS kit.

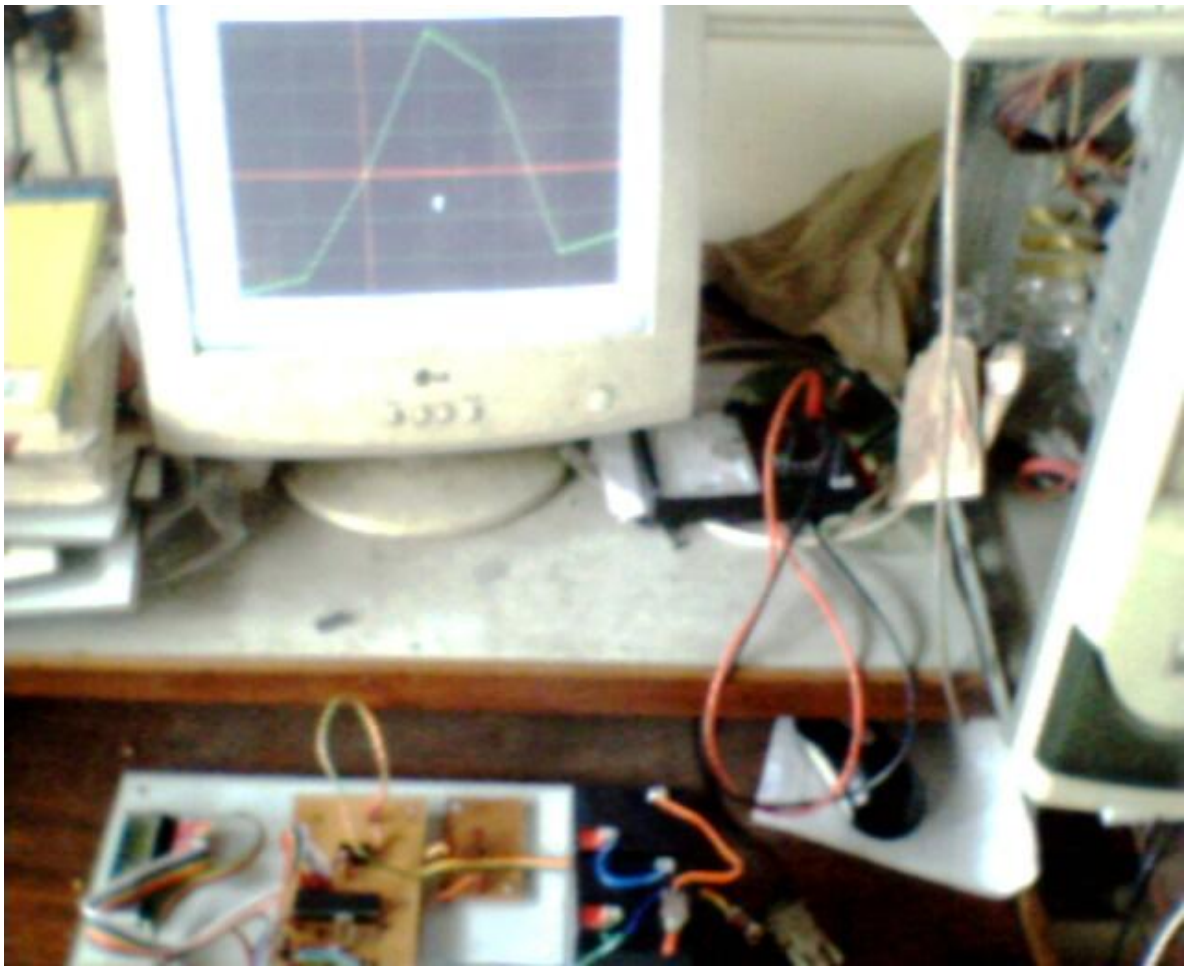


Figure11:- Out put in graphical format of EMWS kit.

2.8.7 MODEL GRAPH

The model graph is shown below

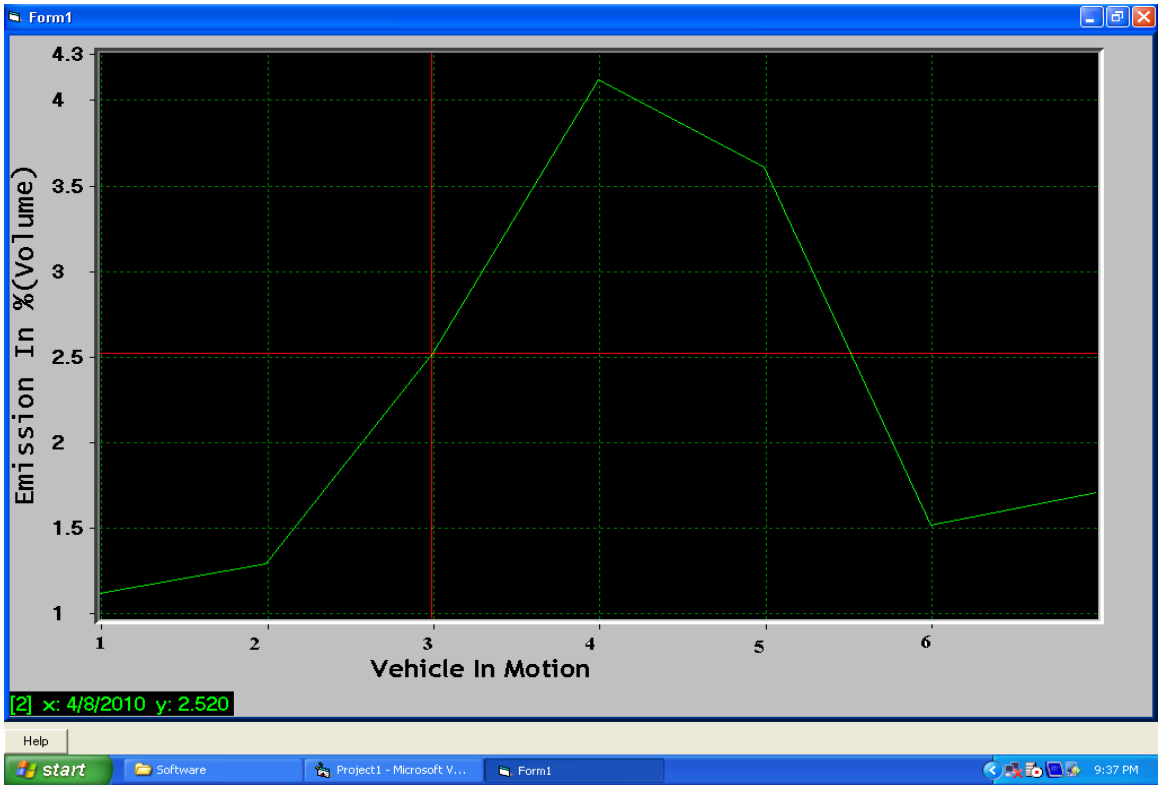


Figure 12:- Model graph

2.9 MERITS AND DEMERITS OF EMWS SYSTEM

Considering all the factors mentioned above, we designed the system which provides certain advantages which will definitely help in protecting the environment. Some of the positive aspects are shown below

1. Accuracy can be maintained since the whole system is interfaced with microcontroller
2. Malpractice is completely eradicated.
3. Easy to view the emission rates due to the presence of LCD display

4. Warning light helps in rectifying the vehicle conditions regarding emissions
5. It is an inbuilt system so none can replace it other than the manufacturers.

The main negative aspect of the system it is expensive since there is perfect blend of mechanical and electronics concept, but when comparing the positive aspects the cost seems to be quiet worthless

2.10 FUTURE IMPLEMENTATION

This system will seems to be more effective when interfaced with the Electronic Control Module (ECM).It can be interfaced when there is a provision provided for it in the ECM. Here we are using CO sensor alone, it can be made more efficient when using sensors for sensing Hydrocarbons, NOx, Sox and CO2 for diesel vehicles. The above system is based on time interval. We can also do it on the basis of air fuel mixture through oxygen sensor. For that we have to interface the system sensor module with the oxygen sensor in the vehicle. The sensing is based on the output of oxygen sensor in mV. By predicting the mV of the sensor for particular emission rate sensing can be done. Thus it can be made as a universal safety kit for providing green earth.

3. CONCLUSION

The main objective of this project is to bring awareness among the public regarding emissions. Considering the environment safety factor we innovate this system successfully. The EMWS system is one of the most essential system which must be provided for each vehicle. This system will monitor the emission rates and it also provides warning signals when the emission rates exceed the safe limit. Hence the driver can take necessary action regarding the vehicles performance. Thus EMWS system will definitely help in reducing the emission rates in the city vehicles and helps in keeping the city clean. If the EMWS system is implemented in all the vehicles, we can easily achieve green earth in the future.

REFERENCES AND NOTES

1. www.dieselnet.com

2. www.environmentgreen.com

3. www.ene.gov.on.ca

4. www.unfccc.int/kyoto-protocol

5. www.ghgprotocol.org

6. www.epa.gov

7. www.cpcb.in

8. Engine Emissions-Pollutant Formation and Advances in Control Technology by B.P.Pundir-Narosa publishing house

9. Automotive Mechanics-William H C rouse, Donald L Anglin McGraw & hill

10. Standardization for Automotive Exhaust Pollution: Some Issues in Indian Prospective by Dr D Mohan, Dr A K Agrawal, Dr R S Singh Vol 86,March 2006

11. Emissions from India's Transport Sector:Statewise synthesis T V Ramachandra, Shwetmala-Atmospheric Environment(2009)

12. Transport and Urban Air Pollution in India-Madhav G Badami-Environment Management Vol 36 No 2

Authors Biography

Yadagiri Rao Rangineni is a research Scholar at the Department of Computer Science and Engineering, CMJ University, Shillong, Meghalaya, India. He is also working as an Associate Professor in Department of Physics at RVR Institute of Engineering & Technology, Ibrahimpatnam, RRDistrict, Hyderabad, AP, India. He did his M.Sc (Physics) from Osmania University, Hyderabad, India and M.Tech (CSE) from Jawaharlal Nehru Technological University Hyderabad, Hyderabad. He has 10 years of Teaching, 4 years of research and industrial experience in various organizations in India. His major research area is Global Warming, Thermionic emissions, Solid State Physics, Image Processing and Embedded Systems. He has guided 9 M.Tech theses and 38 B.Tech theses.

E-mail: ryrao08@gmail.com Contact No: +91-9849987442

N Mahammed Abu Bassim is working as an Assistant Professor in Department of Mechanical Engineering at RVR Institute of Engineering & Technology, Ibrahimpatnam, RRDistrict, Hyderabad, AP, India. He did his B.Tech (Mechanical) from Anna University, Chennai, India. His major areas of interest are Applied Mechanics, Embedded Systems, Mechatronics, Robotics and Hydraulics. He has guided 18 B.Tech and pursing M.Tech degree.

E-mail: basim89@gmail.com Contact No: +91-9502906576