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Automated Control System for Air Pollution Detection in Vehicles

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Abstract:

Vehicles have become an integral part of every one's life. Situations and circumstances demand the usage of vehicles in this fast paced urban life. The large majority of today's cars and trucks travel by using internal combustion engines that burn gasoline or other fossil fuels. The process of burning gasoline to power cars and trucks contributes to air pollution by releasing a variety of emissions into the atmosphere. Emissions that are released directly into the atmosphere from the tailpipes of cars and trucks are the primary source of vehicular pollution. When the pollution emission level shoots beyond the already set threshold level, there will be a buzzer in the vehicle to indicate that the limit has been reached and the vehicle will stop after a certain period of time, a caution time given for the driver to park his/her vehicle. During this time period, the GPS starts locating the nearest service stations. After the timer runs out, the fuel supplied to the engine will be cut-off and the vehicle has to be towed to the mechanic or to the nearest service station. These systems have both track and record and allow reports automatically in the form of SMS messages to the authorities along with vehicle details along with localization technique using both GPS and GSM-SMS communication modules. The existent system also provides with an automatic turned off the ignition control using relay to reduce the pollution emissions. The synchronization and execution of the entire process is monitored and controlled by a microcontroller.

Key words:

GPS receiver, GSM modem, LCD, ignition control, buzzer alarm, temperature sensor, pollution CO sensor, DC motor.

I. INTRODUCTION:

Primary pollution from motor vehicles is pollution that is emitted directly into the atmosphere, whereas secondary pollution results from chemical reactions between pollutants after they have been released into the air. Despite decades of efforts to control air pollution, at least 92 million Americans still live in areas with chronic smog problems. U.S. Environmental Protection Agency (EPA) predicts that by 2010, even with the benefit of current and anticipated pollution control programs, more than 93 million people will live in areas that violate health standards for ozone (urban smog), and more than 55 million Americans will suffer from unhealthy levels of fine-particle pollution, which is especially harmful to children and senior citizens.While new cars and light trucks emit about 90 percent fewer pollutants than they did three decades ago, total annual vehicle-miles driven have increased by more than 140 percent since 1970 and are expected to increase another 25 percent by 2010. The emission reductions from individual vehicles have not adequately kept pace with the increase in miles driven and the market trend toward more-polluting light trucks, a category that includes sports utility vehicles (SUVs). As a result, cars and light trucks are still the largest single source of air pollution in most urban areas, accounting for one quarter of emissions of smog-forming pollutants nationwide.The following are the major pollutants associated with motor vehicles:

• Ozone (O_3). The primary ingredient in urban smog, ozone is created when hydrocarbons and nitrogen oxides (NO_x)—both of which are chemicals released by automobile fuel combustion—react with sunlight. Though beneficial in the upper atmosphere, at the ground level ozone can irritate the respiratory system, causing coughing, choking, and reduced lung capacity.

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• Particulate matter (PM). These particles of soot, metals, and pollen give smog its murky color. Among vehicular pollution, fine particles (those less than one-tenth the diameter of a human hair) pose the most serious threat to human health by penetrating deep into lungs. In addition to direct emissions of fine particles, automobiles release nitrogen oxides, hydrocarbons, and sulfur dioxide, which generate additional fine particles as secondary pollution.

• Nitrogen oxides (NO x). These vehicular pollutants can cause lung irritation and weaken the body's defenses against respiratory infections such as pneumonia and influenza. In addition, they assist in the formation of ozone and particulate matter. In many cities, NO x pollution accounts for one-third of the fine particulate pollution in the air.

Figure-1: Image of the Air pollution due to vehicles

(i)Carbon monoxide (CO). This odorless, colorless gas is formed by the combustion of fossil fuels such as gasoline. Cars and trucks are the source of nearly two-thirds of this pollutant. When inhaled, CO blocks the transport of oxygen to the brain, heart, and other vital organs in the human body. Newborn children and people with chronic illnesses are especially susceptible to the effects of CO.
(ii)Sulfur dioxide (SO 2). Motor vehicles create this pollutant by burning sulfur containing fuels, especially diesel. It can react in the atmosphere to form fine particles and can pose a health risk to young children and asthmatics.
(iii)Hazardous air pollutants (toxics). These chemical compounds, which are emitted by cars, trucks, refineries, gas pumps, and related sources, have been linked to birth defects, cancer, and other serious illnesses. The EPA estimates that

II. RELATED WORK:

The beginning of the 21st century was the time when importance for Environmental awareness was instigated. One of the major concerns regarding the environment is air pollution. Air pollution contributes to the green houses gases, which causes the green house effect, whose side effects are now well known to all of us after the findings about the hole in the ozone layer. Air pollution is not only harmful to the environment but, also to all other living beings on earth. Air pollutants that are inhaled have serious impact on human health affecting the lungs and the respiratory system; they are also taken up by the blood and pumped all round the body.

These pollutants are also deposited on soil, plants, and in the water, further Contributing to human exposure and also affecting the sea life. Vehicles are one of the major contributors to air pollution apart from industries. The main pollutants from vehicles are the oxides of carbon and nitrogen, which can be easily detected these days with the help of semi conductor gas sensors. Therefore, in this paper an idea is suggested, which would be very helpful in reducing the amount of pollution from vehicles.

the air toxics emitted from cars and trucks account for half of all cancers caused by air pollutionVehicular Emissions That Contribute to Global Warming are Carbon monoxide, ozone, particulate matter, and the other forms of pollution listed above can cause smog and other air quality concerns, but there are vehicular emissions that contribute to a completely different pollution issue: global warming. Individuals can make a difference in the effort to reduce pollution from cars and trucks like burning less fuel, switching to cleaner fuels, using technologies that reduce or eliminate emissions, and reducing the number of vehicle-miles traveled. The following are several ways people can reduce the harmful environmental impact of air pollution through vehicles.

• Driving as little as possible is the best way to reduce the harmful environmental impact of transportation needs. Carpooling, mass transit, biking, and walking are ways to limit the number of miles we drive. Choosing a place to live that reduces the need to drive is another way.

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• Driving moderately and avoiding high-speed driving and frequent stopping and starting can reduce both fuel use and pollutant emissions.

• Simple vehicle maintenance—such as regular oil changes, air-filter changes, and spark plug replacements—can lengthen the life of your car as well as improve fuel economy and minimize emissions.

• Keeping tires properly inflated saves fuel by reducing the amount of drag a car's engine must overcome.

• During start-up, a car's engine burns extra gasoline. However, letting an engine idle for more than a minute burns more fuel than turning off the engine and restarting it.

• During warm periods with strong sunlight, parking in the shade keeps a car cooler and can minimize the evaporation of fuel.

Pollution control is a term used in environmental management. It means the control of emissions and effluents into air, water or soil. Without pollution control, the waste products from consumption, heating, agriculture, mining, manufacturing, transportation and other human activities, whether they accumulate or disperse, will degrade the environment. In the hierarchy of controls, pollution prevention and waste minimization are more desirable than pollution control. In the field of land development, low impact development is a similar technique for the prevention of urban runoff.

Figure-2: Image of the pollution check from vehicles

Federal and California regulations require the use of technologies that have dramatically reduced the amount of smog-forming pollution and carbon monoxide coming from a vehicle's tailpipe.

For gasoline vehicles, "threeway" catalysts, precise engine and fuel controls, and evaporative emission controls have been quite successful. More advanced versions of these technologies are in some cars and can reduce smog-forming emissions from new vehicles by a factor of ten. For diesel vehicles, "two-way" catalysts and engine controls have been able to reduce hydrocarbon and carbon monoxide emissions, but nitrogen oxide and toxic particulate-matter emissions remain very high. More advanced diesel-control technologies are under development, but it is unlikely that they will be able to clean up diesel to the degree already achieved in the cleanest gasoline vehicles. Added concerns surround the difference between new vehicle emissions and the emissions of a car or truck over a lifetime of actual use. Vehicles with good emission-control technology that is not properly maintained can become "gross polluters" that are responsible for a significant amount of existing air-quality problems. New technologies have also been developed to identify emission-equipment control failures, and can be used to help reduce the "gross polluter" problem.

When considering vehicles information security system, developers need to take into account not only the vehicle itself, but also equipments that can be attached to and removed from the vehicle, modules that communicate with the vehicle, and the services provided through those modules, and then advance consideration. So, in this guide, "automotive systems" is defined as a system that consists of "vehicles" supplied by vehicle manufacturers, "add-on equipments" such as ETC (Electronic Toll Collection System) in-vehicle equipment and car navigation, and "peripheral services" such as ETC and telematics. Many types of vehicle tracking devices exist. Typically they are classified as "passive" and "active". "Passive" devices store trigger event such as key on/off, door open/closed and GPS location, speed, heading. Once the vehicle returns to a predefined point, the device is removed and the data downloaded to a computer for evaluation. Passive systems has auto download type that transfer data via wireless download. "Active" devices also store the same information but usually transmit the data in near-real-time via cellular or satellite networks to a computer or data center for evaluation. Many modern vehicle tracking systems combine both active and passive tracking abilities: when a cellular network is available and a tracking device is connected it transmits data

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II. PROPOSED METHODOLOGY:

In this paper we are presented a system that can be interconnected with the car alarm system and alert the owner when the pollution emission crosses beyond the threshold limit the parameters along with GPS coordinates will be sent to RTO authorities in the form of SMS using GSM technology. When the pollution emission level shoots beyond the already set threshold level, there will be a buzzer in the vehicle to indicate that the limit has been reached and the vehicle will stop after a certain period of time. The system aims at designing an intelligent vehicle state estimation system regarding engine temperature and vehicle pollution. The system also has a relay to control the ignition of the vehicle. The alerts server; when a network is not available the device stores data in internal memory and will transmit stored data to the server later when the network becomes available again.

In the Proposed system we used (i) GPS tracking device: The device fits into the vehicle and captures the GPS location information apart from other vehicle information at regular intervals to a central server. Capability of these devices actually decides the final capability of the whole tracking system. (ii) GPS tracking server: The tracking server has three responsibilities: receiving data from the GPS based tracking unit, also securely storing it, and also the system serves this information on demand to the user. (iii) User interface: The user interfacing system determines how one will be able to access the current information, view vehicle related data, and elicit all the important details from it.regarding abnormal parameters are given through buzzer and on LCD display.

Features of the Proposed model:
1.Continuous monitoring of Engine temperature.

2.Continuous monitoring of vehicle pollution.

3.Alerts regarding abnormal parameters through buzzer.

4.Ignition controlling through relay operation.

5.SMS to RTO authorities regarding abnormal parameters.

6.LCD based visual alerts display.

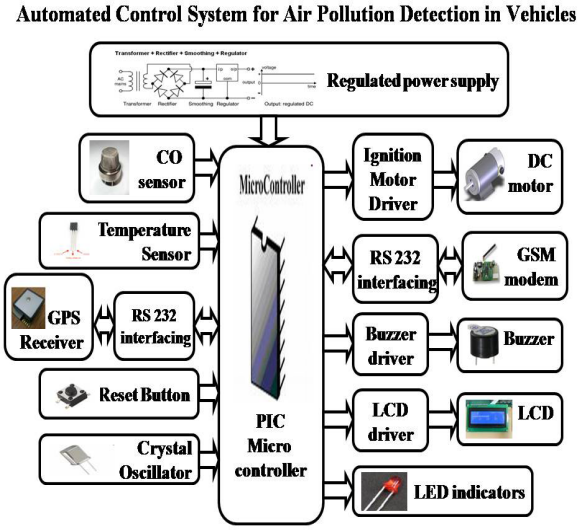

Figure- 3.Block diagram of the proposed model

The presented application is a low cost solution for automobile position and status, very useful in case of car theft situations also, for monitoring adolescent drivers by their parents as well as in car tracking system applications. The present system uses an onboard minicomputer named as PIC microcontroller which consists of number of input and output ports. The input and output port of the micro controller are interfaced with different input and output modules depending on the requirements. The proposed solution can be used in other types of application, where the information needed is requested rarely and at irregular period of time (when requested).

III. HARDWARE DESIGN OF PORTABLE DEVICE :

An embedded system is a combination of software and hardware to perform a dedicated task. Some of the main devices used in embedded products are Microprocessors and Microcontrollers. Microprocessors are commonly referred to as general purpose processors as they simply The main controlling device of the whole system is a microcontroller. The input modules interfaced to the microcontroller are

1. Pollution sensor for detection of pollution level,
2. Temperature sensor for engine over heat detection,
3. GPS to provide the Location information using latitude and longitude details

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The output modules interfaced with the microcontroller

1.Visual alerts display on to the LCD module
2.Audible alerts when the pollution emission crosses beyond the preset limit using Buzzer alarm
3.GSM modem using which the SMS messages can be sent to the pollution control authorities along with location of the vehicle for further actions.

The PIC Microcontroller continuously monitors the pollution and engine temperature levels along with GPS location coordinates. It automatically sends the information of abnormal parameters to predefined numbers (RTO authorities). The System provides both visual and audible alerts. The Microcontroller is loaded with a program written in embedded 'C' language to perform the task.

accept the inputs, process it and give the output. In contrast, a microcontroller not only accepts the data as inputs but also manipulates it, interfaces the data with various devices, controls the data and thus finally gives the result. The portable Electronic security mobile device consists of GPS receiver module, GSM modem, sensors like pollution, temperature, alerts through LCD display module, buzzer alarm interfaced with PIC16-F877A micro-controller. The microcontroller collects the data of location using GPS module and sends as input to the microcontroller (16F877A).

a. Microcontroller:

The microcontroller used in the proposed system is PIC which stands for Peripheral Interface Controller given by Microchip Technology to identify its single-chip microcontrollers. PIC microcontrollers are very successful in 8-bit microcontrollers. It acts as heart of the project. This onboard computer can efficiently communicate with the output and input modules which are being used. The controller contains some internal memory to store the program code. This memory is also used to dump some set of assembly instructions into the controller and these help for the functioning of the controller. The crystal oscillator speed that can be connected to the PIC microcontroller ranges from up to 20Mhz. Using the CCS C compiler usually 20Mhz oscillator will be used. The cost of the microcontroller is also very cheaper.

The 20 MHz crystal oscillator should be connected with about 22pF capacitor. There are 5 input/output ports on PIC microcontroller namely port A port B port C port D and port E. Every single port has different based functionality. Most of them can be used as general I/O ports. The microcontroller uses Harvard architecture which separates both Program and Variable (data) memory interface. This facilitates fetching of an instruction and the operation on data/accessing of variables simultaneously.

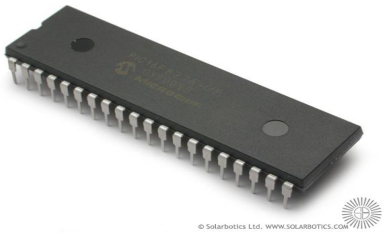

Figure- 4.PIC Microcontroller

b. Temperature Sensor:

The LM35 sensor series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. To detect the heat produced during fire occurrence, engine over heat of vehicles, we make use of it. The temperature sensors contain a sensing element enclosed in housings of plastic or metal. With the help of conditioning circuits, the sensor will reflect the change of temperature.

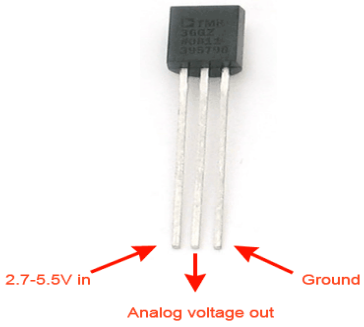

Figure- 5.LM35 Temperature sensor

c. Pollution sensor:

Sensitive material of MQ-2 smoke or pollution sensor is SnO2, which with lower conductivity in clean air. When the target combustible smoke exist, the sensor's conductivity is higher along with the smoke concentration rising.

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MQ-2 sensor has high sensitive to LPG, Propane and Hydrogen, also could be used to Methane and other combustible steam, it is with low cost and suitable for different application. This semiconductor pollution or gas sensor detects the presence of combustible gas and smoke at concentrations from 300 to 10,000 ppm. This flammable gas and smoke sensor detects the concentrations of combustible gas in the air and outputs its reading as an analog voltage. The sensor can measure concentrations of flammable gas of 300 to 10,000 ppm. The sensor can operate at temperatures from -20 to 50°C and consumes less than 150 mA at 5 V.

Figure- 6.Polltuion sensor

d. GPS receiver:

The GPS stands for Global Positioning System (GPS), which provides unequalled accuracy and flexibility of positioning for navigation, surveying and GIS data capture. The GPS NAVSTAR (Navigation Satellite timing and Ranging Global Positioning System) is a satellite-based navigation, timing and positioning system. The GPS provides continuous three-dimensional positioning 24 hrs a day throughout the world. The technology seems to be beneficiary to the GPS user community in terms of obtaining accurate data up to about100 meters for navigation, meter-level for mapping. GPS navigation in helicopters, in vehicles, or in a ship can provide an easy means of navigation with substantial savings.

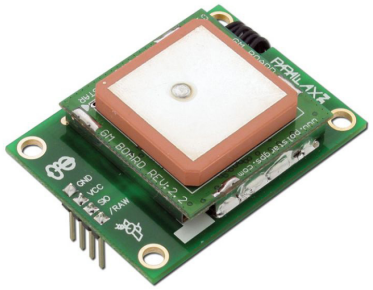

Figure- 7.GPS Receiver

watches, since they require very little amount of electricity consumption.

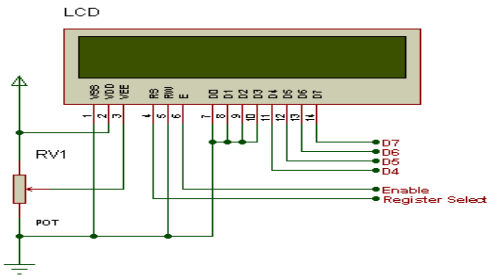

Fig.5. LCD module

f. Buzzer:

The paper related to pollution control uses a buzzer module for audible alerts when the pollution emission level shoots beyond the already set threshold level. The buzzer or beeper is an audio based signaling device. It is mainly designed as mechanical, electromechanical, or piezoelectric. There are many typical uses of buzzers and beepers which include alarm devices, timers and also based on confirmation of user inputs such as a mouse click or keystroke.

Fig.6. Buzzer

f. GSM modem:

GSM, which stands for Global System for Mobile communications, which is widely used as cell phone technology. Cell phones use a cell phone service carrier's GSM network by searching for cell phone towers in the nearby area. SIM300 GSM modem works for supply voltages from 3.4V to 4.5V. GSM modem specifically used for SMS via GSM/GPRS at Point to point MO and MT.

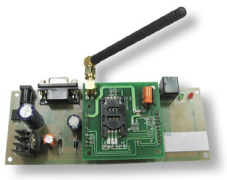

Fig.6. Buzzer

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g. Ignition system:

The Microcontroller checks the data with the program embedded in it and performs appropriate actions on the vehicle ignition to control pollution. We are using a DC motor as a vehicle ignition system. A DC motor uses electrical energy to produce mechanical energy, very typically through the interaction of magnetic fields and current-carrying conductors. The input of a DC motor is current/voltage and its output is torque (speed).

Fig.7. DC motor

IV CONCLUSION:

The existing "Automated control system for air pollution detection in vehicles" is an Integrating feature of all the hardware components been used and developed in it. The Presence of each and every module has been reasoned out and placed very carefully.

Hence the contributing to the best working unit for a tracking of vehicle and for pollution control along with security system has been designed perfectly. Secondly, using highly advanced IC's like GPS module, GSM technology with the help of growing technology, the project has been successfully implemented with a unique idea.

Thus the project has been successfully designed and tested. This system also enables to monitor the accident situations and it can immediately alert the police/ ambulance service with the location of accident. This project can be extended using high efficiency GPS receiver and a GSM module.

The GSM module gives the intimation of the person with this system through SMS services to the predefined authority's phone numbers.

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