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Automated System for Emission Control in Vehicles Using IoT

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Abstract

Vehicles have become an essential part of everyone's life. In today's world, the demand for usage of vehicles has been increasing in this fast-paced urban life. One of the major drawbacks of vehicles is Air pollution. The abundant usage of vehicles in urban cities causes an increase in air pollution and thereby decreases the quality of air which leads to several health issues and diseases. This air pollution causes lung diseases, respiratory problems, and conditions such as asthma and chronic obstructive pulmonary disease. As urbanization and industrialization are said to be increasing and due to poor control over the gases emitted and little use of particle converters, the large amount of toxic gases are released. This paper aims at controlling and monitoring the pollutants emitted from the vehicle using a control circuit, which comprises a gas sensor, Internet of Things (IoT) system to alert the user to service the vehicle and speed control circuit if appropriate actions are not taken.

Keywords- *IoT, control circuit, vehicles, Air pollution*

1. INTRODUCTION

One of the major concerns regarding the environment is Air Pollution and emission of toxic gases from vehicles contributes a major part to this apart from industries. As the population is increasing rapidly the usage of vehicles is also increasing. The increase in the number of vehicles in cities has given rise to a significant increase in the release of various toxins into the atmosphere. Air pollution not only degrades the environment but also has severe effects on living beings. The major pollutant constituents of the emitted gas are oxides of carbon and nitrogen. Transportation is the major factor for generating carbon monoxide which contributes 72% of the total amount of pollution in the major metropolitan cities like Delhi and Mumbai. When the vehicle is not maintained properly the engine has to work harder to burn the fuel and causes more pollution. It leads to the greenhouse effect, a treat to the survival of mankind. Paying attention to heavy-duty vehicle pollution is very much essential for improving air quality and reducing global warming in overly populated countries across the world. To reduce air pollution, the amount of emission from vehicles needs to be monitored regularly and the vehicles that emit above permissible limits need to be identified. IoT plays a major role in monitoring the particular toxic gases released from vehicles and it provides the data which can be viewed with the help of the internet.

2. LITERATURE SURVEY

There have been several laws and regulations enforced by the Government to control the emission from vehicles by standardizing permissible limits [1] but has been unsuccessful in implementing. The Central Pollution Control Board (CPCB) is responsible for framing the standards to be followed and the timeline within which it has to be implemented. Few emission standards are framed by the Government of India, which are referred to as "The Bharat stage emission standards" (BSE), to limit the amount of air pollutants emitted from various types of engines such as internal combustion engine and spark ignition engine, which is widely used [2] in the majority of vehicles. The first emission

standard was introduced in 1991 in India [3] for fuel vehicles which lead to the making of the Catalytic converter fitted engine which was later firmly imposed as mandatory for vehicles that use petrol fuel. The Supreme Court of India then gave judgment that all vehicles manufactured and sold in India have to meet the BS-II norms by June 1, 2005. And in the forthcoming years [4] more stringent norms were rolled out. Bharat stage III or BS- III norms were implemented since October 2010 across the country and Bharat stage IV (BS-IV) emission norms came into effect in 2017. The BS-V fuel quality [5] and emission norms were implemented throughout India from 2019 to speed up the green initiative. From April 1st of 2020, the Central government has mandated all vehicle manufacturers of both two-wheeler and four-wheeler to manufacture and sell only BS-VI vehicles.
This paper mainly focuses on monitoring and control of emission in vehicles that are already in existence that do not come under the BS-VI norms.

3. PROPOSED SYSTEM

In this proposed system, our main aim is to control pollution as well as not cause hindrance to the day to day activities of the people, thereby overcoming the drawbacks of the existing system. The block diagram is shown in Figure 1,

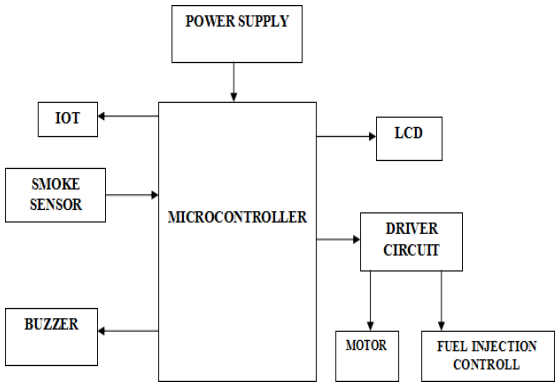

Figure 1. Block Diagram of the proposed system

The system consists of three modules or three courses of action

i. Detection and monitoring of gas

It is necessary to monitor the concentration of harmful gases such as Carbon monoxide (CO) from the smoke emitted by the vehicle. This detection of CO gas is done by a gas sensor which is fitted in the silencer chamber of the vehicle where the smoke is emitted. The operation of the sensor is to get the range of smoke emitted as input and to output the received values to the microcontroller at pre-defined time intervals. This information is sent as an electrical signal using a transducer and then converted to digital values by ADC when it reaches the microcontroller.
The sensor used in this system is the MQ9 gas sensor which is used for detecting CO gas concentration ranging from 100 – 1000 ppm. The sensitive material used in this sensor is SnO2 which has low conductivity in clean air and increases as the concentration of gas increases. This particular sensor is chosen because of its high sensitivity and response time thus measurements can be taken fast. It gives output in both analog and digital form and also has a long lifetime which makes it idle for low maintenance.

ii. Intimation and alerts using IoT

The microcontroller is programmed such that the values given by the sensor are updated in a web page created and this is done using an IoT module ESP12-R4, shown in Figure 2. When an internet connection is provided to this module it updates the web page and when the emission exceeds an average pre-defined value a buzzer indication is given which is fitted in the vehicle and also a

message alert is sent to the number registered by the owner while purchasing the vehicle. The message alert lets the person know that the vehicle needs to be serviced as the emission has increased.

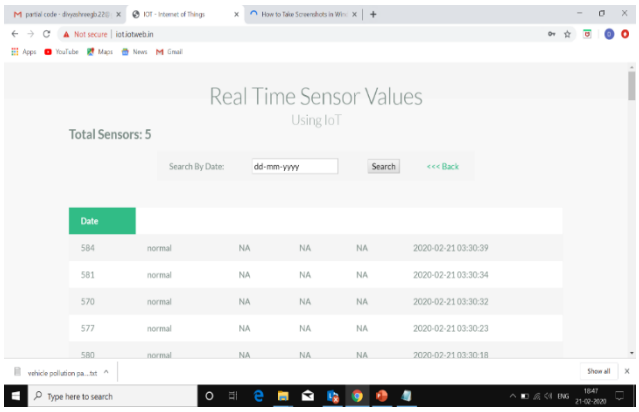

Figure 2. IoT Webpage

Internet of things is the network of physical things interfaced with software and connectivity enabling data exchange. GSM is only used to exchanged information with a cell phone but with the help of IoT module values are updated over a webpage regularly, automatic intimation and this web server can be accessed easily by the user from anywhere. This helps the owner keep a tab of the amount of emission of their vehicle and also encourages them to service the vehicle periodically.

iii. Speed Control

If no action has been taken by the owner to service the vehicle in the first level of warning then the fuel injection to the engine is controlled to reduce the speed of the vehicle automatically. This amount of fuel injected can be controlled using electronic Solenoid Valve. A solenoid valve is an electromechanically operated valve controlled by electrical signals and is used to control the flow of liquids. It acts like a tap which is rotated and adjusted to control the flow of water. Similarly, this valve is triggered by the microcontroller which sends signals when the emission of pollutants crosses the permissible limits. This solenoid valve is fitted on the fuel valve which supplies fuel to the engine is depicted in Figure 3.

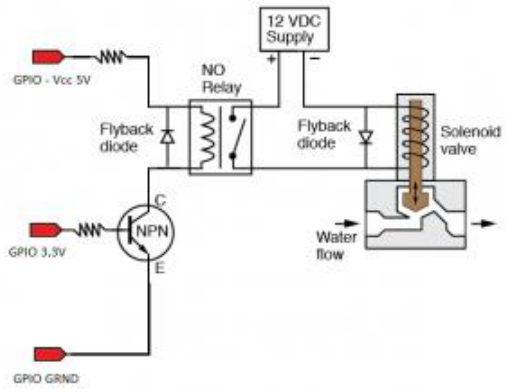

Figure 3. Circuit diagram of the wiring in solenoid valve

When triggered it partially closes the fuel valve and due to insufficient fuel supply, the speed of the vehicle is reduced to a minimum. Thus, the emission of gases is automatically reduced at low speed and the owner is forced to service the vehicle. This method of speed control is better than completely halting the vehicle as it does not pose a hindrance to the activities of the people but reduce the pollution effectively. Once the vehicle is serviced the system is reset as the emission level is back within the permissible limits

4. RESULT AND DISCUSSIONS

Thus, this project demonstrating the automatic emission control in vehicles using IoT has been designed and the working prototype has been constructed successfully yielding the expected results. The kit diagram is shown in Figure 4. It was observed that the sensor fed accurate data via IoT to the webserver to enable alerts to the user. Also, the speed control circuit worked efficiently by maintaining a minimum preset speed limit when the necessary actions are not taken by the owner. This project developed is cost-efficient and is structurally compatible with the existing vehicle without much alterations to any built-in components, making it highly feasible to be implemented in a practical environment.

The performance and robustness of each component used to build this project are tested carefully to ensure its durability during real-time implementation.

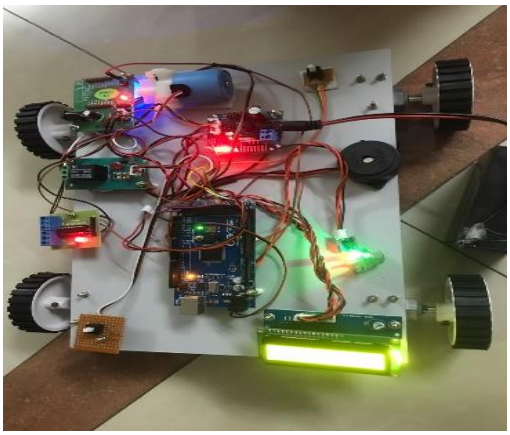

Figure 4. Kit Diagram

5. CONCLUSION

The increasing pollution of air due to emissions from vehicles and industry has been the major crisis for the past couple of decades. Even though with the advancement in technology people neglect to do the very basic thing of servicing their vehicle periodically which can drastically reduce the emission of harmful gases into the atmosphere which has adverse effects on both the environment causing ozone layer depletion as well as on living beings causing serious diseases. This paper mainly focuses on alerting the user about the breach of permissible limits and provides an alternate solution of reducing the speed of the vehicle if no action is taken despite the alerts, forcing them to service the vehicle. This method does not alter any configuration of the engine and is very effective for implementation because of its simplicity, low cost, and low maintenance.

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