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Vehicle Pollution Monitoring System using IoT

Sneha Dharnatti[1], Arfa Torgal[2], Priya Shamboji[3], Rashmi Ingalagi[4], Sushmita N. Nesarikar[5]

[1]Dept. of Computer Science and Engineering, S. G. Balekundri Institute of Technology, Belagavi, Karnataka, India.
[1]snehadharnatti@gmail.com
[2]Dept. of Computer Science and Engineering, S. G. Balekundri Institute of Technology, Belagavi, Karnataka, India.
[2]arfatorgaltorgal@gmail.com
[3]Dept. of Computer Science and Engineering, S.G. Balekundri Institute of Technology, Belagavi, Karnataka, India.
[3]priyashamboji26@gmail.com
[4]Dept. of Computer Science and Engineering, S. G. Balekundri Institute of Technology. Belagavi, Karnataka, India.
[4]rashmiingalagi9@gmail.com
[5]Assistant Professor, Dept. of Computer Science and Engineering, S.G. Balekundri Institute of Technology, Belagavi, Karnataka, India.
[5]sushmitan@sgbit.edu.com

ABSTRACT—

A complicated interaction between the natural and manmade environment leads to the deterioration of air quality in cities. There is a significant increase in the production of particulate matter and harmful gases as a result of increased urbanization and industrialization, poor emission control, and sparse usage of catalytic converters. The objective of this paper is to track automobiles that exceed a certain limit for roadside air pollution and monitor its levels. A critical issue that has persisted for a very long time is the growing number of cars. In order to solve this issue, this study suggests using the Internet of Things (IoT). Here, the system comprises a network of sensors and devices that are integrated with IoT technology to collect, transmit, and analyze data related to vehicle emissions. The sensors are capable of detecting the levels of pollutants emitted by vehicles, such as carbon dioxide. The data collected by the sensors is transmitted to a central server, which processes and analyses the data to generate insights and reports. In the event of significant pollution levels, the system can also inform authorities and drivers, enabling them to take the necessary steps to cut emissions. In general, this system has the potential to make a major contribution to lowering air pollution and raising air quality.

Keywords— Air pollution, Internet of Things, Emission Level, Carbon Dioxide

I. INTRODUCTION

Our environment continues to face serious pollution problems. Each nation on the planet has serious worries about air pollution. As massive amount of air pollution in metropolitan areas which is mostly caused by vehicle traffic needs to be observed constantly and precisely. One of the main sources of air pollution is automobiles. Asthma, eye discomfort, lung issues, and reproductive issues are some of the serious and long-term health effects of automobile air pollution. As one-fifth of all carbon monoxide, carbon dioxide and nitrous oxide emissions into the atmosphere in India are attributed to the road transport sector. To minimize pollution in metropolitan areas, it is crucial to track vehicle emissions and develop both immediate and long-term pollution reduction plans. People who reside in rapidly expanding cities are more likely to be ill.

The Indian government passed the Air (Precaution and Reduction of Air Pollution) Act in 1981, and it was modified in 1987 to address the prevention, reduction, and lowering of air pollution. The administration has currently set the most recent emission criteria for tracking air pollution, and the data gathered enables the mitigation of the negative effects on the environment. The use of taxis, buses, and 72% of carbon monoxide and nitrous oxide emissions are caused by trucks.

Even incomplete combustion in engine of the vehicle leads to emission of different gases which increases the pollution and also affects the environment. Detection and controlling of these gases is an important work so here we come up with a concept to reduce pollution produced by vehicle. As a solution to this we have proposed Vehicle pollution monitoring system using IoT to monitor and control emission level of vehicles. Vehicle pollution monitoring system using IoT is an innovative technology that allows real-time monitoring and analysis of vehicular emissions. This system uses a network of sensors and devices to capture data related to vehicle emissions such as carbon dioxide. The collected data is then transmitted to a cloud-based platform where it is analyzed and processed to provide insights into the levels of pollution in a particular area.

The amount of carbon dioxide in the smoke emitted by a vehicle as a result of fuel combustion is measured using a pollution sensor. A smoke detector is permanently mounted at the point where a vehicle's exhaust releases smoke into the air. The controller checks the maximum percentage of carbon content

in the smoke produced by cars by using the pollution sensor to detect carbon dioxide. The controller then measures the carbon percentage, and if it rises above a certain level, a system is triggered, bringing the engine to a neutral position before the data is wirelessly transmitted to the RTO office.

The IoT-based vehicle pollution monitoring system is far superior to conventional monitoring systems in many ways. It gives real-time data, allowing for the quick taking of action in the event of high pollution levels. Additionally, it offers precise and trustworthy data that may be applied to scientific investigation and decision-making.

Overall, the Vehicle pollution monitoring system using IoT is an innovative technology that has the potential to significantly improve our understanding of vehicular emissions and help us take proactive steps towards monitoring and reducing pollution levels in atmosphere.

II. LITERATURE REVIEW

In the study [1], a system uses multiple sensors including a gas sensor located at the vehicle's exhaust to measure pollution limits in real time. The information collected checks the standard limits and is sent to vehicle owner via GSM. This system is able to monitor and detect separate vehicle emission levels and informs the vehicle user if vehicle pollution level is higher than the regulatory limit.

In the study [2], the system's main concern is detecting car theft by implementing anti-system. The purpose of a vehicle tracking system is to determine the location of the vehicle. GPS and GSM modules are used in the development of a tracking system to make it simple to find the user's vehicle. The location of the car is tracked using a GPS module, which records information like latitude and longitude. These values are delivered to the user via the mobile network using a GSM modem. Both the accident and alcohol consumption are detected using several sensors. Anyone from anywhere in the world can check the sensor data via the ThingSpeak channel. In order to improve security for the car monitoring and anti-theft system, RFID technology is used. Theft is detected by the ignition key, and the vehicle can then be remotely controlled using a GSM control app.

In the study [3], a system is made up of sensors like MQ-2, MQ-7, and MQ-135 that are installed at the vehicle exhaust to track the emissions of carbon monoxide, nitrogen oxide, and hydrocarbons. The LCD is refreshed continuously with the value that the sensors have detected. The owner of the car is notified if the value surpasses the threshold limit set by the government. The transport office will be informed in full if the vehicle owner disregards the warning.

In the study [4], system consists of MQ-7 gas sensor which detects the carbon monoxide emitted by the vehicle and GSM is used to send warning message to vehicle owner if the emission level crosses the required threshold. In the event of avoidance by the vehicle owner, the emission rates are sent to pollution control board via GSM and the board may take the appropriate steps.

In the study [5], the MQ-7 gas sensor and arduino is used to create a system that can determine the amount of carbon monoxide present in the car. The GSM module will be used to transmit the sensor data to the ThingSpeak cloud over the GPRS network. With the device, an Android app can be used to remotely turn off the automobile and check the carbon monoxide levels. Additionally, the user may be alerted when carbon monoxide levels are unsafe. When the level of carbon monoxide is really harmful, the system can also provide efficient automated countermeasures.

In the study [6], the authors have designed an IoT kit using gas sensors, controller and a wi-fi module. This kit can be physically mounted in exhaust system of every vehicle. Gas sensors connects data about vehicle emission and send it to the controller which transmit the data to cloud through wi-fi module. Web server is designed which keeps the data of each vehicle emission and only vehicle authority can access the data from website. So authorities can check the data to inform the vehicle owner.

In the study [7], a system is able to identify polluting vehicles on city streets and gauge the amount of different pollutants in the air. The system comprises of a framework that has been established that uses a remote sensor network to provide a structure for gathering sensor data via IoT at any place. The proposed remote sensor framework uses wireless sensors and dynamic RFID to check for traffic contaminants.

In the study [8], to track vehicle pollution data at any time, a system combines a wireless sensor network with electrochemical hazardous gas sensors and a radio frequency identification (RFID) tagging system. The vehicle will notify the owner through LCD when the rate of gases it emits exceeds the government's threshold level.

In the study [9], sensors, arduino, RFID, and a wi-fi module make up a system. Sensors are used to measure the concentrations of smoke, nitrogen oxides, and carbon monoxide (CO). With the aid of RFID, the specific vehicle number and its concentration of pollutants are logged if it violates the Bharat Stage emission regulations, and the specific vehicle owner is notified to ensure that the vehicle is maintained properly. The car number is notified to the RTO office if the same issue occurs five times so they can take action by issuing fines.

III. METHODOLOGY

The PIC controller, WI-FI Module, and sensors are used to build this system. These functions of comparison and triggering are the key ones the PIC controller is programmed to perform. Input is provided by pollution sensors and other sources with pre-set threshold levels. The PIC controller activates and informs the relay to trip when the output of the pollution sensor exceeds the threshold value. Relay with one pole and double throw is employed. The relay is driven by the relay driver ULN 2003 IC, which also amplifies the signals. The vehicle number is sent to the appropriate agency. The RTO office notifies the person via relay 1 and buzzer. The WI-FI module is a wireless module that serves as an interface for communication purposes.

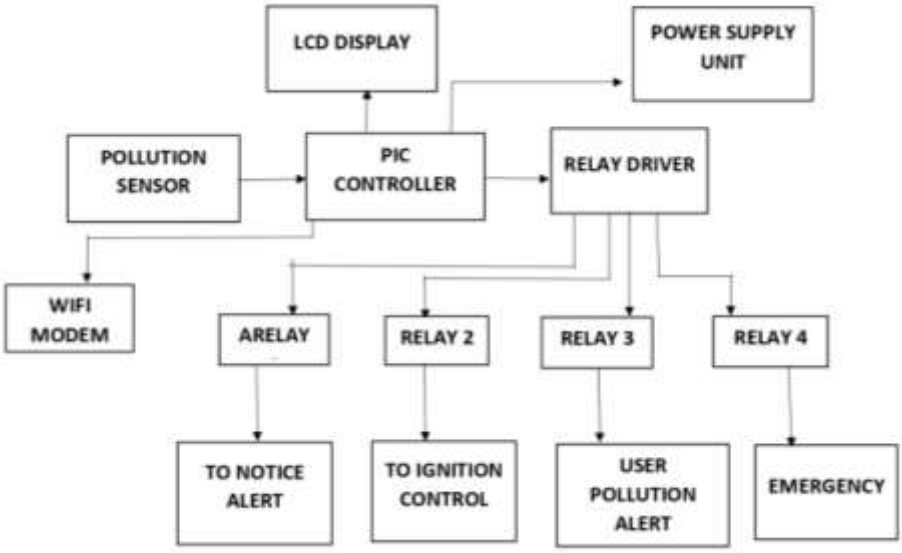

Fig. 3.1 Block Diagram

The following materials are used to construct this vehicle monitoring detecting kit:

1. POLLUTION SENSOR:

Utilizing pollution sensors, the various vehicle emissions are determined. Pollution sensors need to be calibrated and checked often in order to ensure sensor accuracy and system integrity. It is essential to install permanent sensors in locations where quick calibration is possible. Depending on the sensor, the interval between calibrations can change. Usually, the manufacturer of the sensor will recommend a time interval between calibrations. However, it is advised to perform a more thorough inspection of the sensor during the first 30 days of installation. It is possible to see how effectively the sensor is adjusting to its new surroundings throughout this period. There may be additional aspects that affect the sensor's functionality that weren't considered when the system was being designed.

2. RELAY:

An electrically controlled switch is a relay. Although there are other relays that function using alternative principles, most use an electromagnet to power their switching mechanism. Relays are used in situations when a circuit has to be controlled by a low-power signal or when multiple circuits need to be controlled by a single signal. The relays are utilized in long-distance telegraph circuits to duplicate and retransmit signals from one circuit to another. A contactor is a sort of relay that can manage the high power needed to directly operate an electric motor. Without any moving parts, solid-state relays manage power circuits by employing a semiconductor chip that is activated by light.

3. RELAY DRIVER:

The relay driver is used to drive the relay and to make the signal strong. It is an electro-magnetic switch that will be used whenever we want to use a low voltage circuit to switch a light bulb on and off which is connected to 220v mains supply. The ULN2003 IC is used as a relay driver.

4. LIGHT EMITTING DIODE (LED):

A light-emitting diode (LED) is a semiconductor-based light source. LEDs are used as indication lamps in many devices, and their popularity as illumination sources is rising. When LEDs were initially introduced as a practical electrical component in 1962, they generated dull red light, but more recent models now emit light that is bright across the visible, ultraviolet, and infrared spectrums.

Over traditional light sources, LED lights have a number of advantages, including:

- High levels of brightness and intensity
- High levels of efficiency
- Low requirements for voltage and current
- Low radiation heat
- High dependability (resistant to stress and vibration)
- Absence of UV rays
- Long source life

- Easy controllability and programmability

5. LIMIT SWITCH:

Basic switches called limit switches have been enclosed to shield them from the elements, including water, oil, and dirt. There are numerous versions available, including high-precision ones and those that are corrosion, head, or cold resistant.

An electrical circuit and a mechanical motion or position are interlocked by a mechanical limit switch. Contact arrangement is a good place to start when choosing a limit switch. The most common limit switch is a single-pole contact block with one NO and one NC set of contacts, while there are alternatives with up to four poles. Limit switches can also transfer contacts slowly over time. This kind is helpful in identifying clogs that keep the limit switch engaged for a longer period of time than expected.

One sort of "contact sensor" is a limit switch, which has normally open and normally closed contacts. When the plunger in the limit switch is depressed, the NO and NC contacts are directly connected.

IV. RESULTS

As a result, an IoT kit is created to assist in the detection, monitoring, and testing of air pollutants released by automobiles. This kit has various gas sensors that can recognize the harmful pollutants generated by moving automobiles. The cloud is used to store data gathered regarding vehicle pollution emissions. If a vehicle's emission exceed a predetermined standard threshold, a message is generated. The transportation authority, or RTO, can use this technology to identify defaulter vehicles and pursue legal action against them. By limiting the harmful air pollutant emissions from the automobiles, this aids in reducing air pollution.

V. CONCLUSION

Air pollution is a major issue right now. The primary sources of air pollution are industries and cars used in transportation. In order to protect the ecosystem from the negative effects of air pollution, it must be reduced. This system will monitor the emissions from moving vehicles that threaten our sensitive climate, calculate the quantities of hazardous gases, and notify the car owner and the relevant transportation authorities, assisting in the maintenance of the vehicle. To protect our environment, it is necessary to lessen the environmental pollution brought on by the petrol emissions from vehicle exhaust, including carbon monoxide, hydrocarbons, and nitrogen oxide. In order to prolong the life of the vehicle and lower environmental pollution, the proposed system offers the best way to keep track of the gases released from the exhaust of moving vehicles. The suggested solution is inexpensive and simple to maintain. In the future, GPS might be included to calculate the amount of gases emitted from vehicles in a specific area and to send information to the regional transport office. This particular device has a sensor that can identify the carbon dioxide parameter that contributes to vehicular pollution. The sensor in use is a MQ7, this sensor detects when the carbon dioxide level rises and sends a signal or alert to the vehicle owner. Through a GSM module, the emission levels are sent to the Pollution Control Board.

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