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Vehicular Emission Monitoring and Alerting System Using IOT

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Abstract *- Automobile emission is the major contributor to pollution. Authorities which monitor emission standards are Road and Transportation Office (RTO) and Central Pollution Control Board (CPCB). Vehicle emits various gases which mixes with atmospheric air decreasing air quality that leads to severe health diseases. Emission of gases such as carbon monoxide, hydrocarbon, nitrogen oxide causes air to be polluted leading to global warming also. The problem arises when the rate of emission of gases of vehicles crosses the standardized values. As a solution to vehicular pollution problems, we have designed a system which monitors vehicular emission. For that we have used IoT technique. This system monitors the individual vehicle emission level in real-time process by collecting data from various MQ sensors which is placed at the exhaust of the vehicle. The data collected verifies the standard limits and this information is then to cloud using Internet of Things (IoT) for further process. Vehicle owner gets text message alert if the vehicle exceeds the standard limit. To analyse the data and to verify the emission level of vehicle with the standard limit, the coding has been done in Node-MCU Microcontroller. This system helps in reduction of vehicle emission in the atmosphere.*

Keywords *- Road and Transportation Office, Central Pollution Control Board, MQ Sensor, Internet of Things, Node-MCU, Cloud.*

I. INTRODUCTION

In this age of rapid industrialisation, one of the biggest problems being faced by us is the issue of clean air. The number of vehicles is increasing day by day. pollution due to vehicles is a major source of air pollution due to the high number of vehicles that are present on the roads today. Various gases emitted by vehicles are becoming environmental threat and threat to human's health in urban centers. To control vehicle emission Government of India had made many regulations to reduce environmental pollution, but most of them turn to be unsuccessful. These include the improvement in the fuel quality, enforcement of vehicle emission standards, improved road, and traffic management, etc. Emission of harmful gases is due to incomplete combustion in the engine of a vehicle which leads to increase in the amount pollution and continuously affecting the environment. The major pollutants emitted through vehicle are carbon monoxide (CO), hydrocarbons (HC), oxides of nitrogen (NOx) and sulphur dioxide (SO2). pollution due to gases emitted by vehicles is increasing at a tremendous rate due to growing urbanisation in India. As urbanisation is increasing the vehicles number is also increasing continuously. To inspect all those vehicles, we require a lot of man force. To monitor all the vehicles easily, we develop a system called Vehicular Emission Monitoring and Alerting system using IOT. Internet Of Things i.e., IOT performs an important role in this system. MQ sensors

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monitors emission level of gases and with help of IOT the value is updated to the cloud, this makes for vehicle owner and transport workplace to monitor vehicle easily.

II. LITERATURE SURVEY

In the proposed system [1], a smart monitoring system is used for monitoring the emissions from the vehicles. Two sensors are used to collect the data from the exhaust of the vehicles. The sensors are connected to the input pin of Arduino and the values are sensed. A threshold is set in the Arduino. If the sensed data goes above the threshold, a warning message is given to the owner using GSM. Two or more warning messages are given with some delays. If the owner reluctant to correct it, or to decrease the pollution from the vehicle, the data are transferred to the authority through GSM. The data are stored in a cloud by ThingSpeak for future analysis. By using this system, the owner can analyze the emission level of his vehicle. Authorities can take appropriate actions accordingly. In this proposed system [2], the RFID reader, LCD, wireless gas sensors are integrated along with microcontroller. This entire system is placed in either of the road. Whenever the vehicles equipped with RFID tags passed through the sensor node, RFID reader presents in the monitoring system detects the vehicles and the sensors measures quality of the air produced by that vehicle. This sensed data is continuously sent to the microcontroller for verification of the pollution level by the vehicle. The levels of the pollutants of the air produced by the vehicle is verified by microcontroller. If the pollutants levels are beyond the threshold levels, then the warning message is sent to the vehicle owner. This data is also displayed on the Liquid Crystal Display (LCD). The information such as the levels of CO2 and Sox gases, RFID of the vehicle, vehicular number and time and date of vehicle are also sent to the server of the authorized agencies. The authors of this system [3] monitors the emission of gases like carbon dioxide, carbon monoxide, hydrocarbons using MQ sensors. If the number 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. In the proposed paper [4], review of the existing methods of Air Quality Monitoring systems using WSN is done along with their comparisons. Based upon the carriers of the sensor nodes, they classified the present air pollution monitoring systems broadly into three categories 1.Static Sensor Network (SSN) where Low-cost sensors are deployed on fixed structures like traffic lights, streetlights, walls, etc. 2.Community Sensor Network (CSN) where Low-cost portable sensors are used, and these nodes are carried by the public or the professional users usually environmental volunteers who are concerned about the quality of air.

3.Vehicle Sensor Network (VSN) where Low-cost portable sensors are used for acquiring the air pollution data in Vehicle Sensor Network (VSN) systems, typically carried by the public transportations like buses, trains, taxis. This paper [5] is to develop a compact system to detect the pollutants in the vehicle which could be assembled in the vehicle itself. This idea employs an MQ-7 sensor and DHT-11 which is economical and capable of detecting Carbon Monoxide gas and temperature and humidity emitted from the exhaust gases of the vehicle. An initial warning is given to the driver regarding the amount of CO gas if it exceeds the threshold value with the help of LCD display. System also sends message to the user when module is connected to internet and later the same information is transferred to the Police Control Room in case of negligence. For this purpose, Arduino Controller is used which is incorporated in the vehicle. It also creates database and for this purpose it uses MySQL server. In this system [6] mq2, mq7, mq135 sensors placed at the vehicle exhaust monitor the hydrocarbon, carbon monoxide and nitrogen oxide value emitted from the exhaust. The analog value received from the sensors is processed by the controller with wifi connection to the internet. The data obtained from the sensors is continuously updated to LCD and cloud. When the value obtained from the sensor reaches the threshold limit, the controller will alert to

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the user through LCD and database of the vehicle owner. IoT helps the system to update the value to the cloud. The Node MCU connected helps to update the value obtained from the sensors to cloud when wifi is connected to the internet. The value is continuously updated to vehicle owners cloud storage. when the value exceeds the threshold limit set by the government, it will indicate it to the vehicle owner. The entire details will be shared with the transport office, when the vehicle owner ignores the alert. This system [7] is based on Raspberry Pi and Arduino. Here Gas sensors value are send to the raspberry Pi board using serial communication on python. Arduino Uno is continuously sending sensor data to the python script and python is comparing the values. If value exceeds set range or threshold value, the python script will mail to the given mail address from vehicle's mail address in the python script. The SMTP library is used to send a mail to RTO and along with mail raspberry Pi will send GPS location in latitude and longitude format to given mail address with attachment which includes vehicle and owner's details. At first the warning is given to owner to solve vehicle problem, if owner will not solve problem, then RTO can block the vehicles using relay which is connected between vehicle battery supply and machine engine and starter. Here LCD IS used to show the vehicle machine temperature which sensed using LM35 temperature sensor. In this system [8], The active RFID and the active RFID tag are designed for the collection of the data emitted from the vehicle exhaust system. RFID reader will receive emissions data when the vehicles, which are installed RFID tag, drive into inspect range. Once the RFID reader receives the data from the tags, 3G data transmission is used for transmission of data which is the most cost-effective way for data transmission. It can steadily transmit the data to the control system. Collected data will send from ADC to ARM Microcontroller and then to RFID tag to Cloud Data Base Centre through GPRS and Cloud Web Server it may located in remote place. The connection with Cloud Web Server is established by GPRS through Dongle. The system [9] is intended for automatic recording of moving vehicle parameters and storing readings from the sensors into an embedded memory with a possibility of their further computer processing by means of specially developed software. Monitoring system collects and records the data like exhaust gas temperature at three points of vehicle exhaust system, ambient temperature, gas flow velocity in exhaust pipe, vehicle speed, wind velocity relative to driving direction, vehicle-tilt angle relative to horizontal axis, engine revolutions, vehicle coordinates with attachment to real terrain map, electric current, voltage and power of thermoelectric generator. In operation, current data from the sensors are reflected on a built-in display screen of recording device. Based on the processed data, the tabulated and graphical time dependences of moving vehicle parameters are obtained. firstly, the sensed data is given to the microcontroller vis ADC. After that the data is transmitted by Bluetooth transmitter and received by Bluetooth receiver of the recording device.

III. PROPOSED SYSTEM

This system is used to monitor the various emissions like hydrocarbons, carbon monoxide, nitrogen oxide by the vehicles. mq2, mq7, mq135 and lm35 sensors placed at the vehicle to detect the emission by the vehicles. The values from the sensors are in the analog form. These values are used by the controller with the internet via Wi-Fi. The value obtained from the sensors is simultaneously updated on cloud. In case if the value obtained from the sensor is greater than the threshold limit or value, the controller will alert the user that your vehicle is emitting gases in more amount. IoT helps the system to alter the value to the cloud. The various sensors are connected first to the multiplexer and then to the Node MCU because Node MCU has only one analog channel. At that moment it will update value of emission on our cloud storage with the Wi-Fi having internet connectivity. The value is interminably updated on the cloud storage of the user that is owner of the vehicle. If the value of the

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emission becomes more than the threshold limit by the respective Authority, then it will inform both vehicle owner as well as the respective authority like transport office or government.

INPUT SIDE • MQ sensors • LM35 temperature sensor

PROCESSING SIDE • Multiplexer • Node MCU OUTPUT SIDE • 16 X 2 LCD • GSM Module • Cloud

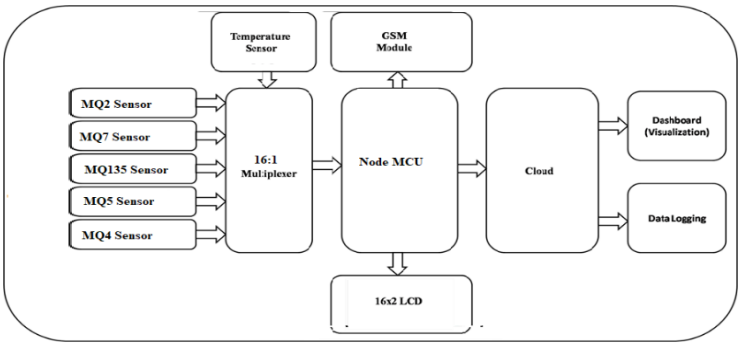

Figure 1: Block diagram of system

A. Input Side

Sensors-The main purpose of sensors is to collect data from the surrounding environment. Various Sensors or the IOT system, form the front end. These are connected directly or indirectly to IOT networks after signal conversion and processing.

MQ Sensors used are: -

1. MQ2 Sensor - Hydrocarbon monitoring.
2. MQ7 Sensor - Carbon monoxide monitoring.
3. MQ135 Sensor - Nitrogen oxide monitoring.
4. MQ5 Sensor - for smoke detection.
5. MQ4 Sensor – for CNG monitoring.

LM35 that is temperature sensor is used to observe the temperature of the system.

B. Processing Side

The data from the sensors are collected by the processor i.e Node MCU with the help of Multiplexer(16:1).This data is transmitted serially to the controller by using the select lines. Node MCU performs the Encryption and Decryption of the data. This data is sent by the Node MCU to the Cloud for further computation purpose. If the data from the sensors exceeds the threshold value the processors sends the alert message to the user via GSM module. Also, it updates the values form the data received on the cloud whenever it is connect to the internet/network.

C. Output side

This part includes LCD module, GSM module and Cloud. All these modules are used to show the results after processing of data by the controller. This output side is also called as user end as it is the interfacing side for the user. The alert message is given to a user with the help of this Output side part.

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• LCD module – LCD is used for showing the alert signal including all gases values & temperature values.

• GSM module - If the analog signal cross the threshold value then alert signal (Message)gives to the vehicle driver using GSM.

• CLOUD - Cloud acts as a bridge in the form of a mediator or communication facilitator when it comes to IOT. The sensor values which are taken by microcontroller are stored in the cloud. The cloud monitors all the data and also helps in visualizing the data for the user. Data bucket and dashboard is used in this system. Data Bucket is the basic containers that holds systems data. Data bucket contains each value that is updated on the Cloud Storage. Data buckets organize systems data and control access to that data. A Data dashboard is the window which keeps the information management that visually tracks, analyzes and displays key performance indicators, metrics, and key data points to monitor the values and behaviour of the sensors. The user can access and visualize the data in form of graphs, tables, charts, etc, and it is easily accessible. This is the whole architecture of the proposed system.

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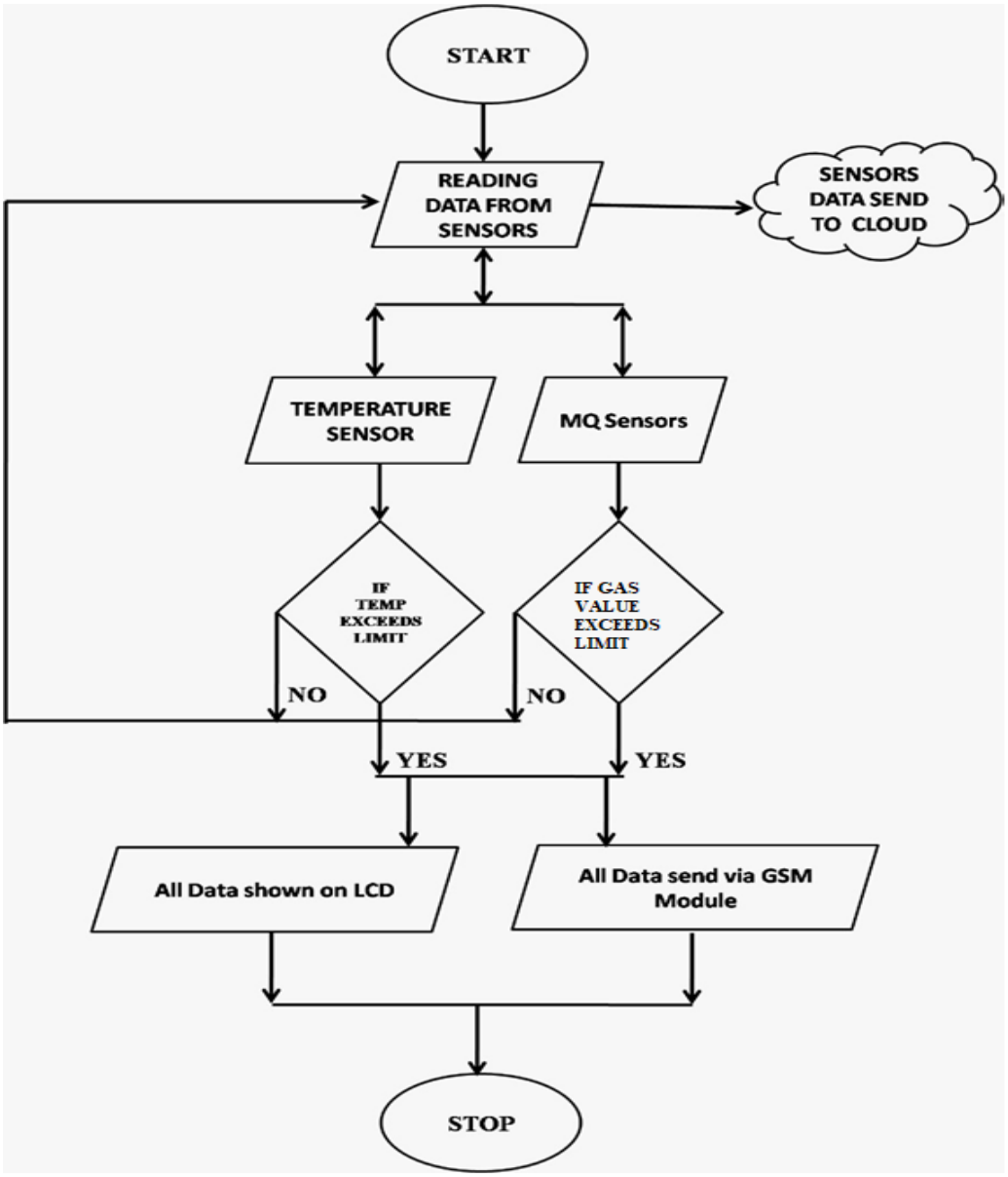

Figure 2: flowchart of the system

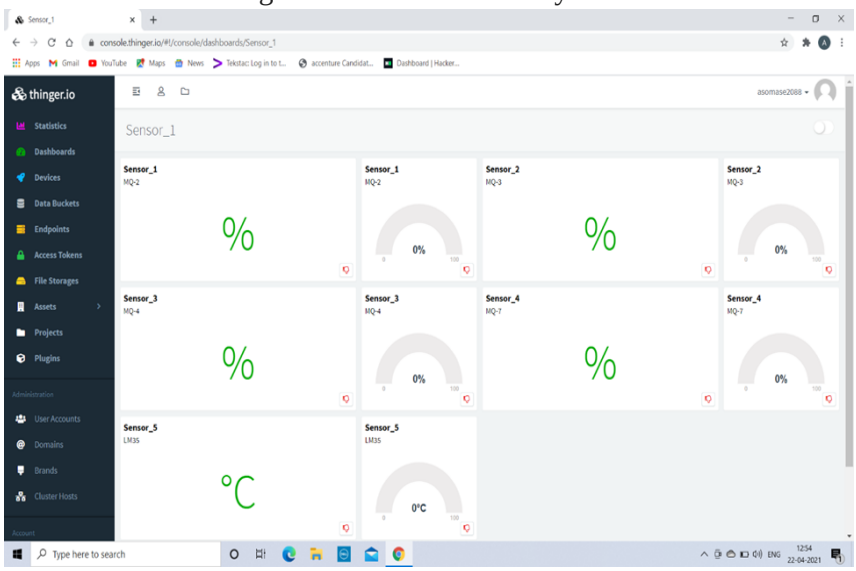

Figure 3: dashboard of the system

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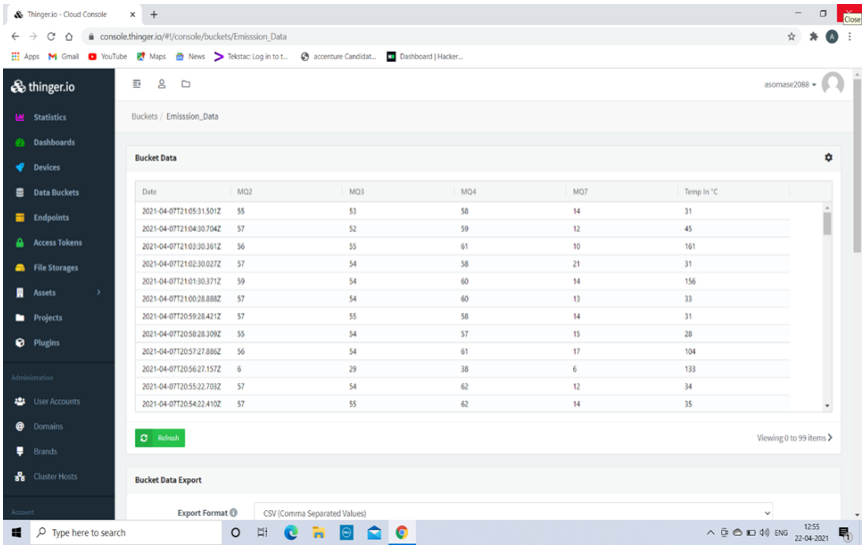

Figure 4: Data logging (Data Bucket)

Figure 3 is the image of Dashboard which shows the values of different gas sensors to the user and Figure 4 is the image of Data logging(Data Bucket) which continuously stores the data sensed by different sensors whenever the system is connected to the internet. This data in data logging is used by the authorities like RTO or CPCB for detection of emission of gases by exhaust system of the vehicle.

IV.CONCLUSION

This paper granting the design and development of IoT based vehicular emission monitoring and alerting system to prevent the environment from harmful gases. This smarts the designed smart inventive and system keeps the eye on the various pollutants such as various harmful gases emitted by the vehicles and also convey it to the owner of the vehicle so that he can repair the vehicle. This system also sends the pollutant values to the cloud for future analysis. The transport authorities or the environment conservation department can be able to study the data and identifies the vehicles that are emitting the pollution causing gases in the atmosphere. The cost of the system is vey low, easy to operate and is easily inserted in any vehicle. The developed system provides better accuracy with low cost than the previous systems.

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