Review on IoT Based Vehicle Safety and Monitoring System

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Abstract — With increased traffic and stringent regulations, it has never been more crucial to keep a vehicle safe and in optimal condition. Drivetech is an IoT-based system designed to be of help in monitoring the vehicle in real-time for its driver and the fleet managers. It provides insights into the most vital parameters like location, temperature, and emissions so that one can ensure the vehicle stays safe and efficient. The system accumulates data from the vehicle, processes it, and sends that information over to the cloud where a simple mobile or web dashboard gives the user access to it. Whether it's tracking the location of the vehicle, receiving alerts for an over-heated vehicle, or monitoring emissions, Drivetech offers a real, easy-to-use solution. It even allows users to start or stop the vehicle remotely, giving them even more control. Drivetech was very practical and cost-effective, ideal in helping to make the management of vehicle safety easy and accessible to all.

Keywords: Internet of Things (IoT), Vehicle Safety, Emission Monitoring, Fleet Management, Real-Time Data Monitoring, Remote Control System, Cloud Integration, Environmental Compliance, Smart Vehicles, Vehicle Efficiency

I. INTRODUCTION

Along with the increasing number of vehicles on roads and stricter environmental regulations, the demand for vehicle safety and efficiency is growing. Thus, Drivetech has been designed as an IoT-based system, providing real-time monitoring of all the fundamental parameters about a vehicle in terms of location, temperature, and emissions. It employs Raspberry Pi as the central controller and Firebase for cloud storage, hence making it an advanced solution to manage vehicle safety, emissions control, and efficiency. Since it collects real-time data of the vehicle sensors, pre-processes it with the help of the central controller, and stores it in the cloud, the user can monitor the vehicle conditions or control the vehicles directly over a mobile or web interface. The system is built with a vision to offer a powerful tool to not only the individual drivers but also fleet managers so that they can proactively deal with overheating or emissions violations, thereby enhancing safety and efficiency.

II. LITERATURE SURVEY / RELATED WORK

Kumar, A., et al. focused on real-time vehicle emission monitoring using IoT-based sensors and cloud integration [1]. Their system collected data on emissions and transmitted it to a cloud platform, where alerts were generated if threshold levels were exceeded.

Pandithurai, S., et al. extended this idea by integrating temperature sensors with the emission tracking system. Their system provided comprehensive vehicle diagnostics to detect overheating and emissions violations in real time [2].

Mozhi Devan, P., et al. proposed an alerting system for emission monitoring using IoT devices to notify users when emissions exceeded predefined limits. This method streamlined the notification process and allowed authorities to take timely action [3].

Wang, R., et al. integrated cognitive IoT technology, enabling the system to make intelligent decisions based on sensor data, including monitoring CO2 levels and temperature changes to optimize vehicle performance [4].

Abera, E.S., et al. introduced a framework combining emission monitoring with GPS tracking, allowing users to track both the location and performance of the vehicle in real-time [5].

El-Medany, W., et al. developed a cost-effective system using GPS/GPRS for tracking vehicles and monitoring their emissions, alerting users when they exceed environmental standards [6].

III. EXISTING SYSTEM

In such traditional automobile monitoring system, capabilities of real-time data processing generally aren't developed, and diagnostics usually are through human intervention. Such systems generally don't collect data on emissions and temperature or store them in a manner not readily retrievable and analysed. Thus, users find it hard to predict and prevent problems like engine overheating or excessive emissions. Another thing is that most of them do not integrate remote control functionalities; thus it is not possible to have any corrective action in time.

IV. PROPOSED METHODOLOGY

This system takes Raspberry Pi as a central control unit, and Firebase is used as the cloud storage source in order to bridge those gaps. The methodology includes:

1) Data Collection: Sensors mounted on the vehicle monitor the following parameters: the temperature of the engine, location, and emissions, which comprise the levels of carbon dioxide and carbon monoxide. Data will be collected in real time and transmitted to the Raspberry Pi, serving as a local controller.
2) Data Transmissions: The Raspberry Pi does the processing of data and gives connectivity via Wi-Fi so that the data is sent towards Firebase, thus keeping data in the cloud and providing safety measures.
3) Alerts and Notifications: When the system finds values that are deviating from normal ranges-for example, high engine temperature or excessive emissions over the permissible limit-it will give instantaneous alerts to the user in the form of SMS or a mobile app.
4) Remote Control: With Drivetech, users can also remotely control their vehicle, meaning they can start or stop it as often as needed, thereby enhancing safety and convenience as well.

V. SYSTEM ARCHITECTURE

The architecture of the Drivetech system integrates multiple components to ensure seamless communication between the vehicle's sensors, the Raspberry Pi controller, and the Firebase cloud platform. The system architecture is divided into several layers:

1) Sensor Layer: This layer includes various sensors installed in the vehicle to monitor key parameters such as:
   - MQ-135 Gas Sensor: For detecting emissions like CO2, CO, and NOx.
   - Temperature Sensor: To monitor the engine's temperature and ensure it operates within safe limits.
   - GPS Module: For real-time tracking of the vehicle's location.
2) Processing Layer (Raspberry Pi): The Raspberry Pi serves as the central controller in this architecture. It is responsible for collecting data from the sensors, pre-processing it, and ensuring that only relevant data is transmitted to the cloud. The Raspberry Pi:
   - Interfaces with the vehicle's sensors via GPIO pins.
   - Utilizes Python scripts to process the raw sensor data.
   - Transmits the processed data to Firebase using a Wi-Fi module.
3) Communication Layer: Communication between the Raspberry Pi and the cloud is facilitated through Wi-Fi. The processed data is sent to the Firebase cloud in real-time, ensuring that users can access the latest vehicle information at any moment.
4) Cloud Layer (Firebase): Firebase is used as the cloud storage platform, offering secure and scalable data management. It stores real-time vehicle data, including emissions levels, engine temperature, and location coordinates. Firebase also provides:
   - Real-time database synchronization, ensuring that users have immediate access to up-to-date data.
   - Cloud Functions that trigger automatic alerts and notifications based on predefined thresholds.
5) User Interface Layer (Mobile/Web Dashboard): The front-end of Drivetech consists of a mobile application for individual drivers and a web interface for fleet managers. This layer enables users to:
   - Receive alerts when emissions or temperature exceed safe levels.
   - Use the remote control feature to stop or start the vehicle as needed.
6) Alert and Notification System: Drivetech's alert system is integrated with Firebase's cloud messaging service, which sends notifications to the users when any parameter, such as emissions or temperature, exceeds predefined limits.

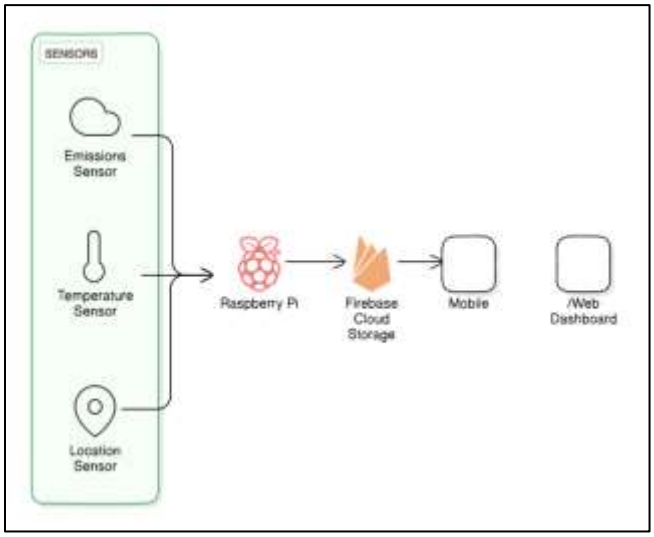

Fig. 1: System Architecture

VI. APPLICATION

As such, Drivetech offers the end users interactive interfaces, using mobile and web applications that provide real-time information regarding the performance of their vehicles by the owners and fleet managers. Through such applications, the mobile and web apps also enable the users to:

- They monitor the location, exhaust emission, and temperature of their cars.
- It receives real-time alerts whenever any parameter crosses the set threshold.
- Remote control will be allowed where they can stop or even crank the engine in case of an emergency from their base. That is one system that fleet managers especially like to use for the efficient and safety management of more than one vehicle.

Fig. 2: Key Features

VII. CONCLUSION

There has been an enormous demand for safer, efficient, and environmentally friendly vehicles, which brought forth innovative technologies such as Drivetech. It's based on IoT that provides the real-time monitoring of key parameters of a vehicle: the engine's temperature, location, and emissions to ensure all the requirements of safety as well as environmental regulations are met. Through cloud integration, the system

affords the capability to allow for remote control and a very friendly dashboard which makes it possible for individual drivers and fleet managers to make decisions that improve vehicle safety and efficiency in operations.

Among the features of Drivetech include proactive alerts for overheating and emissions, remote vehicle control, and full cloud-based data storage. Apart from its effectiveness in enhancing safety in vehicles, this system also provides the added advantage of contributing to the reduction in environmental impact since it ensures that emissions are within acceptable limits. The system is further extendable and cost-effective, thus making it widely applicable for both an individual driver and large fleet operators.

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