Car Diagnostic Management with Cloud Connectivity and Local Storage

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Abstract - **This project presents a Car Diagnostic Management System with Cloud Connectivity and**
Local Storage, aimed at ensuring efficient vehicle health monitoring. The system collects real-time data such as engine temperature, RPM, speed, battery, fuel level, throttle, and intake air in car using onboard sensors and the OBD-II interface. Diagnostic checks are performed to identify issues in the engine, transmission, electrical, and emission systems.

The diagnostic data is stored locally on SD cards or internal memory when offline and uploaded to the cloud when internet connectivity is available. Cloud storage enables secure long-term record keeping and allows remote access via a mobile application or web dashboard. The system also maintains a history of previous reports, sends alerts and notifications, and supports predictive maintenance through data analysis. By integrating real-time monitoring, dual storage, and remote accessibility, the system reduces maintenance costs, enhances car safety, and extends vehicle lifespan.

Index Terms - **Fleet management, Vehicle health monitoring, Predictive maintenance analyses, Sensor networks, On-board diagnostics (OBD-II).**

INTRODUCTION

In developing nation like India, evolution of modern vehicles from purely mechanical systems to sophisticated, sensor-rich and software-driven machines has significantly increased their complexity. The increase in number of vehicles, has also increase the need of efficient vehicle maintenance and fault detection systems. Many vehicle owners in semi-rural and rural areas, often face challenges identifying and resolving car-related issues due to the lack of advanced diagnostic tools and limited access to professional service centers. In result, minor faults that go undetected can lead to major breakdowns, higher maintenance costs, and safety risks.

The traditional methods of vehicle maintenance rely on heavily on manual inspection and periodic servicing, which is not always possible and accurate to detect real time faults in vehicle's performance. Moreover, these methods don't store or analyse past diagnostic data which could help in detecting and predicting future issues. To overcome such limitation, integration of cloud computing and local data storage offers solution for intelligent vehicle management.

While driving manual inspection is required, if data is collected and analysis in proper way, it can be a hidden treasure for an individual's, companies and for real-time monitoring in fleet management. By utilizing cloud connectivity, vehicle data such as engine temperature, RPM, speed, battery, fuel level, throttle, and intake air simultaneously, local storage within car's onboard system ensures that critical data remains accessible even in absence of an internet connection.

Thus, this project focuses on designing a Car diagnostic management system with cloud connectivity and local storage, enables continuous vehicle health monitoring early fault detection and efficient maintenance scheduling. This system aims to assist both vehicle owners and service canters in improving reliability, reducing repair costs and enhancing road safety through smart diagnostic technology.

I. PROBLEM STATEMENT

In modern car diagnostic systems, we often face limitations in effectively managing vehicle health data. Most of the existing systems either focus solely on **local storage**, restricting access to diagnostic data within the vehicle, or rely completely on **cloudbased monitoring**, which demands in constant internet connectivity. This creates several issues for vehicle owner and technicians specially located with areas like poor network coverage.

In local diagnostic system the diagnostic data can't be accessed remotely, making it difficult for service canters and owners to vehicle performance in real time. On other hand cloud system fails to function efficiently if system goes offline, it leads incomplete or delay in synchronization also, it creates absence for integrated history of data tracking that prevents users from analyzing continuous vehicle performance.

In result these limitations contribute in late fault detections that may increase repair cost price and also lead vehicle life span. To overcome such problem hybrid system that diagnoses system by combing cloud connectivity and local storage.

II. DESIGN & SIMULATING MODEL

The main purpose is to design a system that helps in continuous monitoring data of a vehicle using various sensors, display, controller etc. *Figure.1* represents the representation of model.
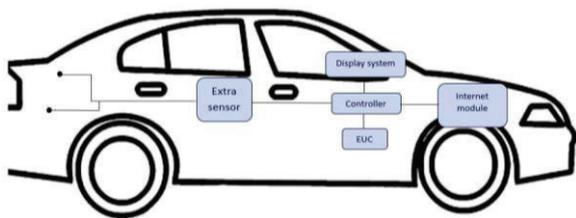

Figure 1. Representation of system diagram

The main requirement of model to work is controller which will act as base for network to which multiple sensors will be attached that will sense the various parameter of subsystem. Further display will be needed for illustrate the collected data from sensors attached so that it can display its output and show result for what system is monitoring.

In last a software will be needed for simulation to simulate and develop model. In software coding platform that controls, monitors and stores data for required purpose. Also, a debugging system and troubleshooting tools to avoid errors and faulty occurrences in the system.
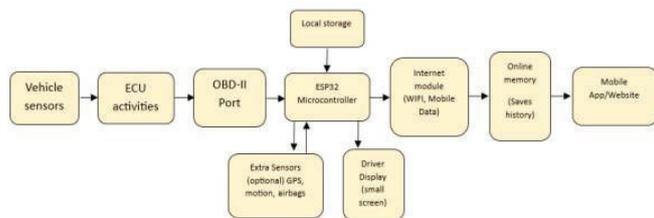

Figure 2. System block diagram

Figure ll. shows step by step function for the system. Vehicle sensors continuously monitor's various car parameters which can be engine temperature, fuel level, battery voltage, and many others, which provide real-time signals to the ESP32 for diagnostic and monitoring purposes, detecting abnormalities early to prevent damage. **ECU Activities (Engine Control Unit)** is the vehicle's internal computer that controls important systems like engine performance and emission, generates diagnostic trouble codes (DTCs) that can be read through the **OBD-II** interface, used to identify faults and errors in the car's systems by reading data/parameters from the car's Engine Control Unit such as speed, fuel level, RPM, and error codes. Further **Local**

Storage store vehicle health reports and diagnostic data locally in case there is no internet connection, which ensures that data is not lost and can be synchronized later to the cloud otherwise data is save to cloud storage or in an online database through **Internet Module (Wi-Fi / Mobile Data)** connected to the internet using Wi-Fi or mobile hotspot making remote monitoring and history tracking possible through a mobile app or website. The **Mobile App / Website** acts as the user interface for the system providing displays all the car health parameters, error codes, and maintenance alerts in real also view history, reset error codes, or schedule maintenance reminders. A **mini display inside the car** that shows live diagnostic data such as temperature, fuel level, or fault alerts. It helps the driver monitor vehicle health without using the mobile app.

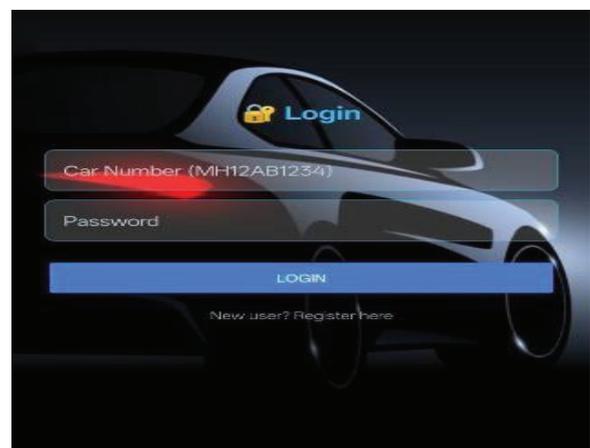*Figure 3. Representation for registering app*

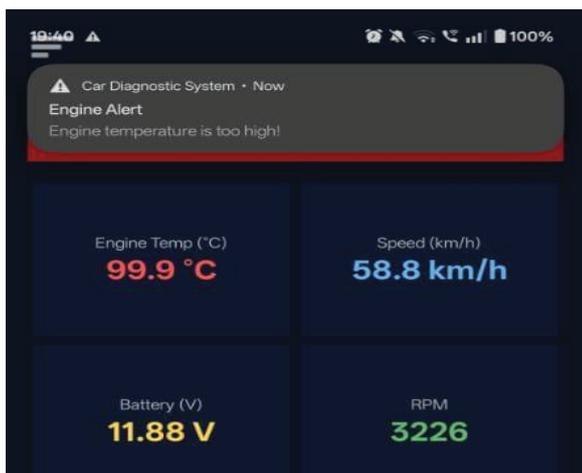*Figure 4. Representation for login into app*

Figure 5. Representation for app's notification
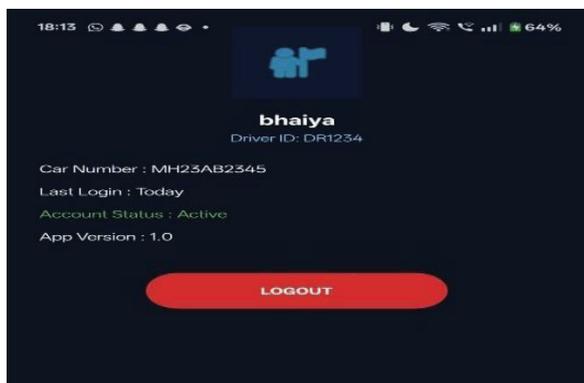

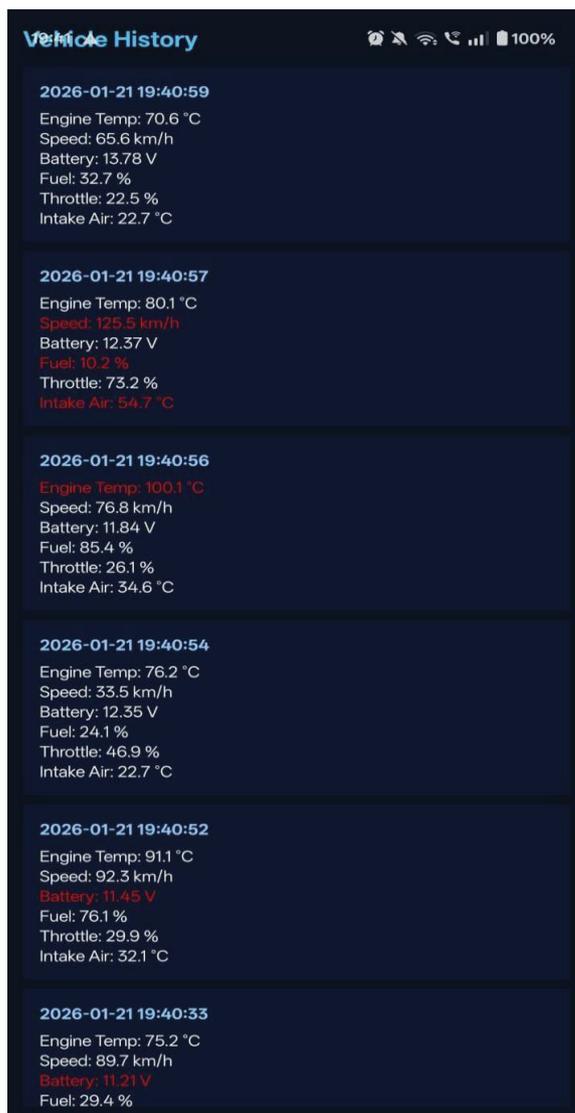*Figure 6. Representation for app's logout*

Figure 7. Representation for car's data app's history

III. RESULT

Figure 8. Representation shows results for various parameters

This section will compile the results of the experiment and simulation of the prototype and model –The OBD model currently performs functions such as checking engine temperature, RPM, speed, battery, fuel level, throttle, and intake air in vehicle (car). As a result, we get a forecast of events in the near future, in-short we get more accurate the result of the operation being function which is been collected to observed by creating graph so that it is more-easy for owners and company to per detect any malfunctioning to avoid any accident or failure in future, to get service on time, vehicle functioning, reduce repair cost and to improve life span of vehicle (car).

PARAMETERS & TIME	1:30:01 PM	1:30:02 PM	1:30:03 PM	1:30:04 PM	1:30:05 PM	1:30:06 PM
Engine temperature	87.2 C°	87.2 C°	87.2 C°	87.5 C°	87.2 C°	87.2 C°
Intake temperature	30 C°	30 C°	45 C°	50 C°	50 C°	50 C°
RPM	3000	3000	2569	2259	2259	2259
Speed	0 km/h	0 km/h	0 km/h	0 km/h	0 km/h	0 km/h
Fuel	59%	59%	86%	92%	93.3%	93.3%
Throttle	88.3%	88.1%	83.5%	77%	77.1%	77.2%
Battery	11.4V	11.88V	12.43V	12.76V	13.00V	13.47V

Table I. Shows data for result of various parameters

System is created in such a way that vehicle (car) is monitored remotely and receive real time maintenance recommendation without physical inspection, and data is collected and stored in both the way online and offline by using could computing and local storage, that helps to cover complete data of a vehicle.

V. CONCLUSION

In results we can conclude the aim of developing cheap and effective vehicle health monitoring system was fulfilled, using which the monitoring of vehicle conditions is made easy for the owner. This system serves a method for data acquisition to get information of variety of subsystems in vehicle (car).

The integration of cloud computing and local storage in car diagnostic management systems signifies a major step forward in modern automotive technology. Such systems enable continuous monitoring of vehicle parameters and facilitate the transmission of diagnostic data to cloud platforms for remote access and analysis, while local storage ensures uninterrupted data logging during network outages or in remote areas. hybrid architecture improves vehicle reliability by supporting both online and offline diagnostic operations, ensuring that no critical information is lost and that vehicle health data remains accessible at all times. The application extends across personal vehicles, fleet logistics, public transportation, and even smart city integration, making them foundational to the next generation of intelligent, connected transportation systems. For future it could be noted that the

collected information could be shared with the corresponding service providers or owner themselves while using fleet system which will allow them to discern and warn the user and recommend them to servicing of vehicle, which is a form of remote monitoring that can be done by original manufacturers and servicing personnel just by sharing the information logged on platform with them.

The collected information will also serve its purpose for use in developing improved versions of the vehicle improving the research and development field.

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