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AI-Based Driver & Vehicle Health Monitoring System

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ABSTRACT: The increasing demand for intelligent transportation systems has created a strong need for real-time driver monitoring and vehicle health analysis to improve road safety and prevent mechanical failures. This study presents an integrated AI-driven Driver and Vehicle Health Monitoring System that combines deep learning-based driver behaviour detection with sensor-driven vehicle diagnostics. A CNN model, accessed through the Robo flow API, is used to identify drowsiness, eye closure, and yawning from live camera frames, while vehicle parameters such as engine temperature, tire pressure, battery condition, transmission status, brake wear, fuel level, and ethanol concentration are continuously monitored through sensors and simulation modules. The collected data is processed using threshold-based mathematical rules and is visualized in an interactive Laravel- and MySQL-based dashboard that provides instant alerts and predictive maintenance insights. Experimental results show that the system accurately detects unsafe driver conditions and identifies early signs of vehicle issues, enabling timely intervention. Overall, the proposed system offers a comprehensive solution that enhances driving safety and supports proactive vehicle maintenance, with future potential for on-device AI processing, OBD-II integration, mobile app support, and deployment in large-scale fleet environments.

KEYWORDS: Driver Monitoring System, Vehicle Health Monitoring, Deep Learning, Convolutional Neural Network (CNN), Predictive Maintenance, Telematics, Ethanol Detection, Real-time Monitoring, Smart Vehicle Systems, Robo flow API.

I. INTRODUCTION

Road safety and vehicle reliability have become major concerns in modern transportation systems due to the increasing number of accidents caused by driver fatigue, distraction, and poor vehicle maintenance. Traditional monitoring methods often focus on either the driver or the vehicle, resulting in incomplete safety coverage and delayed responses to critical issues. With advancements in artificial intelligence, sensor technologies, and automotive telematics, there is a growing opportunity to design integrated systems that continuously assess both the driver's behaviour and the vehicle's health. Such systems can help prevent collisions, reduce breakdowns, and support timely maintenance, ultimately improving the overall driving experience.

This project introduces an AI-driven Driver and Vehicle Health Monitoring System that combines deep learning-based driver analysis with real-time vehicle telemetry. The system uses a CNN model to detect drowsiness, yawning, and eye closure from live camera frames, while various sensors and simulated data monitor vehicle parameters such as engine temperature, tire pressure, transmission condition, brake wear, battery level, and ethanol concentration. All collected data is processed through threshold-based logic and displayed on an interactive web dashboard for instant alerts and predictive maintenance insights. By integrating driver behavior analytics and vehicle diagnostics into one unified platform, this system provides a comprehensive approach to enhancing road safety, preventing failures, and supporting proactive vehicle management.

II. LITERATURE SURVEY

- Recent advancements in intelligent transportation systems and data-driven technologies have motivated the development of integrated solutions for driver safety and vehicle health monitoring. Ajayi [1] emphasizes the importance of data privacy and regulatory compliance when handling sensitive information, a crucial requirement for systems that collect driver images and telemetry data. Ahmad and Patwary [2] propose a secure and intelligent framework for vehicle health monitoring using big-data analytics, demonstrating how large-scale sensor data can enhance diagnostic accuracy. Rovito [3] provides a vulnerability-assessment framework for complex systems, highlighting the need for robust architectures capable of handling critical automotive failures. Similarly, Holm and Afridi [4] investigate the Common Vulnerability Scoring System, showing how structured risk assessment can improve system reliability.
- Research by Perić et al. [5], [6] on engine oil monitoring provides practical insights into tracking real-time engine condition and predicting maintenance needs, which aligns closely with the goals of this project. Suter [7] discusses structured qualitative data analysis and systematic design, offering methodological insights that support the development of well-organized monitoring frameworks. Li, Lv, and Wang [8] introduce deep reinforcement learning for traffic signal control, indicating the increasing role of AI in transportation systems. Yu et al. [9], [10] investigate cooperative vehicle-to-grid (V2G) networks using coalition game theory, showing how vehicles can intelligently interact in smart grid environments—a concept related to connected automotive ecosystems. Yang et al. [11] use EEG data to study driver behaviour and fatigue patterns, supporting the use of physiological and behavioural signals for detecting drowsiness. Finally, Sultana et al. [12] explore how human behaviour varies under uncertain conditions, which reinforces the importance of monitoring driver alertness and attention levels.

III. PROBLEM STATEMENT

Road accidents and unexpected vehicle failures remain major concerns in modern transportation, often caused by driver drowsiness, distraction, alcohol influence, and poor vehicle maintenance. Existing systems usually monitor either the driver or the vehicle, but not both together, resulting in incomplete safety coverage. Drivers receive little real-time feedback on their alertness level, and many vehicle issues—such as engine overheating, low tire pressure, brake wear, or declining battery health—remain undetected until they lead to breakdowns or accidents. There is a need for an integrated, intelligent system that can continuously assess driver behavior using AI-based image analysis while also evaluating real-time vehicle health using sensor data and predictive logic. The problem, therefore, is to design and implement a unified monitoring system that detects driver fatigue, yawning, and alcohol levels, monitors critical vehicle parameters, predicts maintenance requirements, and provides instant alerts to prevent unsafe driving conditions and mechanical failures.

IV. OBJECTIVES

- To develop an integrated system that monitors driver alertness using AI-based facial analysis for detecting drowsiness, eye closure, and yawning.
- To continuously track key vehicle health parameters such as engine temperature, tire pressure, battery level, brake status, and ethanol levels.
- To generate real-time alerts and warnings to prevent unsafe driving conditions and reduce the risk of vehicle failures or accidents.
- To provide an interactive dashboard that displays driver behavior, vehicle condition, and predictive maintenance insights for better decision-making.

V. PROPOSED SOLUTION

The proposed solution is an integrated Driver and Vehicle Health Monitoring System that combines AI-based driver analysis with real-time vehicle diagnostics to enhance road safety and prevent failures. The system uses a CNN-powered deep learning model to detect driver drowsiness, eye closure, and yawning from live camera input, ensuring continuous monitoring of driver alertness. At the same time, vehicle health is tracked using sensor data and telemetry, including engine temperature, battery status, tire pressure, brake condition, transmission health, and ethanol levels. These data streams are processed through rule-based logic and automatically compared with predefined safety

thresholds. The system generates instant alerts whenever abnormal driver behavior or risky vehicle conditions are detected. All information is displayed on a web-based dashboard, providing users with real-time insights and predictive maintenance suggestions. This unified approach ensures proactive prevention of accidents, timely maintenance, and an overall safer driving experience.

VI. SYSTEM DESIGN

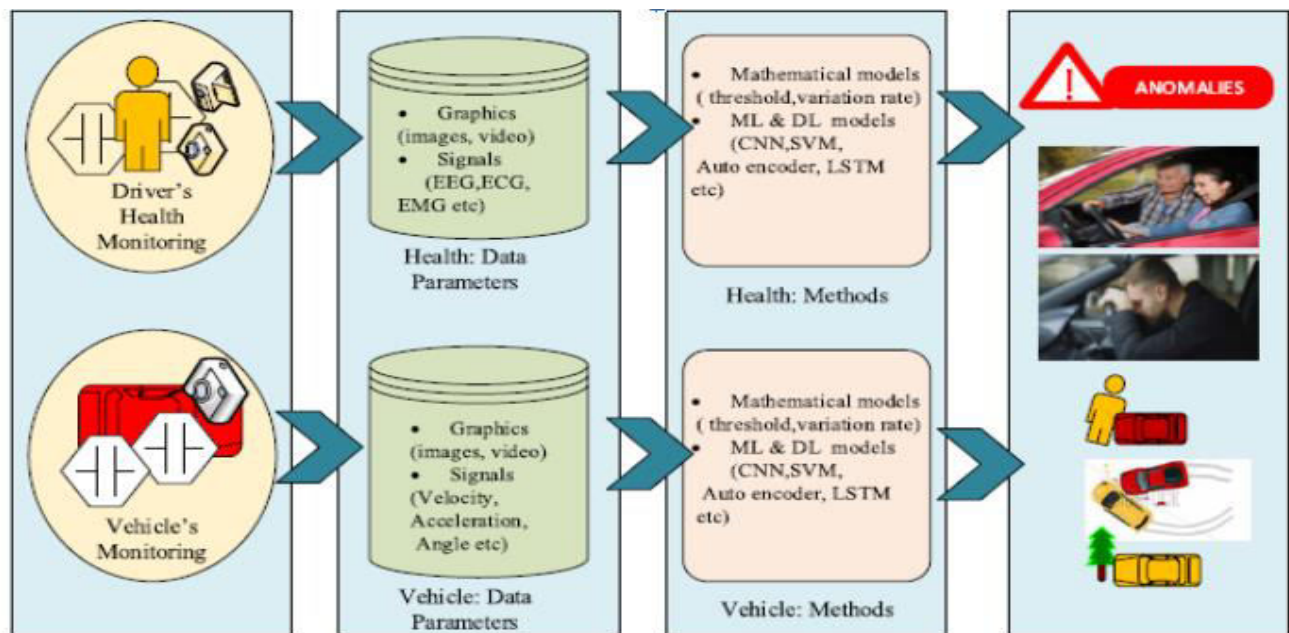


Figure1: Proposed AI-Based Driver and Vehicle Monitoring Architecture

1. SYSTEM ARCHITECTURE

The system architecture combines driver monitoring and vehicle monitoring into one smart safety system. First, data is collected from two sources: the driver's camera, which captures images or video to check for signs like eye closure, yawning, or drowsiness, and the vehicle's sensors, which provide information such as speed, acceleration, and engine condition. This data is organized into two groups—driver health data and vehicle data.

Next, the collected data is processed using mathematical rules and AI models. For driver monitoring, deep learning models like CNNs detect the driver's face and identify tiredness or unsafe behavior. For vehicle monitoring, the system checks sensor values using threshold rules and machine learning models to identify unusual patterns or faults. These methods help the system understand whether anything is wrong with the driver or the vehicle.

Finally, the system sends the results to an alert module. If any dangerous situation is detected—such as the driver feeling sleepy or the vehicle having a fault—the system immediately shows warnings and alerts. This helps prevent accidents and ensures both the driver and the vehicle remain safe.

VII. RESULTS

1. Snapshots Of The Proposed System:

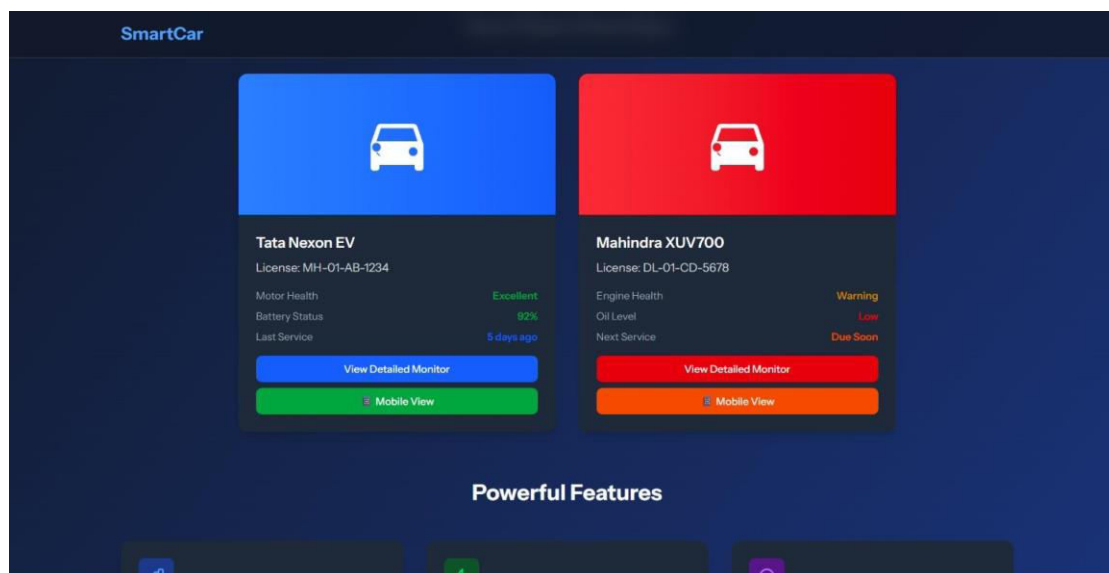


Figure 2: System Homepage – Main Interface of the SmartCar Monitoring System

The System Homepage shows all connected vehicles along with their basic health summary using color-coded indicators. It allows users to quickly identify vehicle status and navigate to detailed monitoring pages.

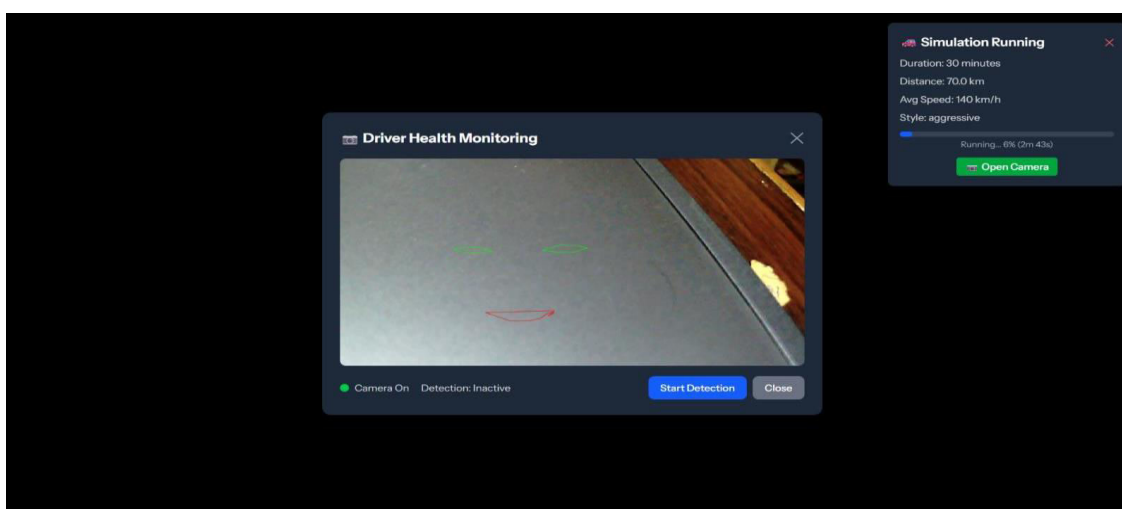


Figure 3: Driver Monitoring Window Showing Facial Landmark Detection

Shows the interface shows real-time eye and yawn detection to monitor the driver's alertness level.



Figure 4: Detailed Feedback and Semantic Analysis Output

This screen displays the detected driver health events such as yawning and eye closure, along with confidence levels. It helps identify moments of driver fatigue or distraction by showing real-time alert statuses.

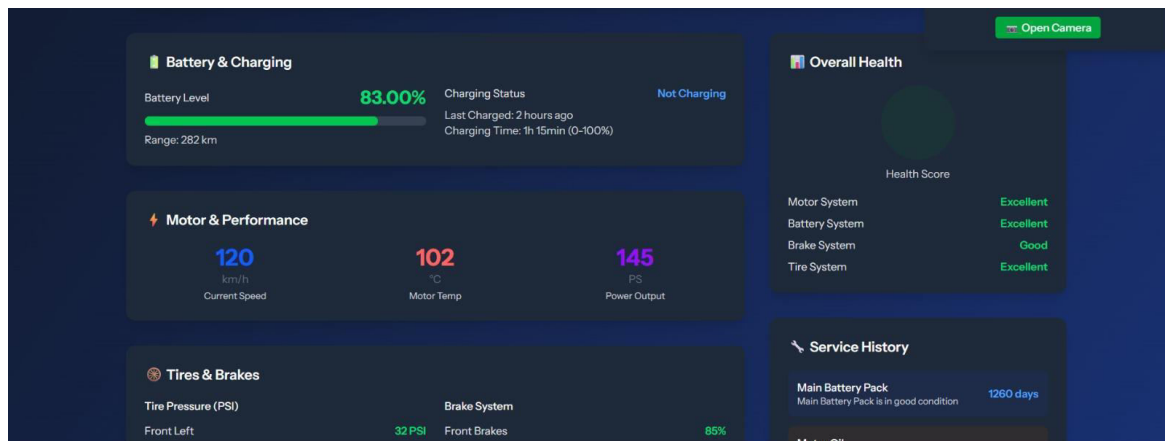


Figure 5: Real-Time Simulation of Driver and Vehicle Health

This simulation dashboard displays real-time vehicle performance metrics along with overall health status. It also supports driver monitoring, allowing the system to test and visualize both driver and vehicle conditions together.

VIII. CONCLUSION

The proposed Driver and Vehicle Health Monitoring System successfully integrates AI-based driver behaviour detection with real-time vehicle diagnostics to enhance road safety and reduce unexpected failures. By combining CNN-driven facial analysis for detecting drowsiness and distraction with continuous monitoring of critical vehicle parameters such as engine temperature, brake condition, tire pressure, and battery status, the system provides accurate, timely alerts that support preventive action. The interactive dashboard and simulation tools further help users understand current conditions and predict future maintenance needs. Overall, the system proves to be an effective and intelligent solution for improving driver awareness, optimizing vehicle performance, and supporting safer, more reliable transportation.

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