Smart Vehicle System for Real-Time Monitoring, Safety Enhancement and Intelligent Transportation

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***Abstract*—Rapid urbanization and the increasing number of vehicles have created major challenges related to road safety, traffic congestion, and vehicle security. Machine learning—based smart transportation platforms have emerged as effective solutions to address these problems through real-time monitoring and intelligent data analysis. This research presents a Smart Vehicle System developed using React for the frontend and Python for the backend and machine learning implementation. The platform enables real-time vehicle tracking, driver behavior analysis, accident prediction, and intelligent decision-making using software-based technologies.**

I. INTRODUCTION

A. Introduction

Transportation systems are very important in daily life, but problems like road accidents, traffic congestion, and vehicle theft are increasing rapidly. Many accidents happen because of over-speeding, careless driving, and lack of proper monitoring. To solve these issues, the proposed Smart Vehicle System uses Machine Learning, Computer Vision, React, and Python to provide real-time vehicle tracking, driver behavior analysis, route monitoring, and safety alerts. The system helps improve road safety and transportation management through intelligent data analysis and decision-making.

Unlike traditional systems, this platform does not depend on costly 10T devices or sensors. It mainly uses software technologies, GPS tracking, cloud storage, and Al-based analysis to monitor vehicle activities and detect risky driving behavior. The React dashboard provides easy visualization, while the Python backend handles data processing and predictions. The system is affordable, scalable, and can be upgraded with advanced Al and cloud services in the future, making it an effective solution for smart and safe transportation management.

B. Scope of Project

The scope of this research covers the conceptual design and analytical evaluation of an intelligent vehicle monitoring and safety framework capable of supporting modern transportation ecosystems. The study focuses on the integration of sensing, communication, cloud analytics, and visualization technologies to enable continuous monitoring of vehicle behavior and environmental context.

The proposed framework is intended to support both individual vehicle owners and fleet operators by providing real-time monitoring, safety analytics, and remote accessibility through web-based interfaces.

The major scope boundaries of the research include:

- Real-time monitoring of vehicle motion and driving behaviour.
- Continuous tracking of vehicle location and trip history
- Detection of abnormal driving events such as harsh braking, over speeding, and long driving duration.
- Centralized storage and processing of vehicle telemetry data using cloud infrastructure.
- Dashboard-based visualization for user interaction and monitoring.

C. Objectives of the Project

1. To collect and preprocess CCTV or dashcam video data for accident analysis and model training.
2. To develop machine learning models using Python for real-time accident detection, tracking, and segmentation.

3. To predict accident duration accurately using regression-based machine learning techniques.
4. To integrate all modules into a real-time intelligent transportation system with a React frontend interface.
5. To evaluate and deploy the system for continuous traffic monitoring without using 10T devices or sensors.

II. LITERATURE REVIEW

l. Artur Grigorev, Adriana Simona Mihäitä, Khaled Saleh, and Fang Chen authored the paper Automatic Accident Detection, Segmentation and Duration Prediction Using Machine Learning. The paper presents a machine learning framework for automatic accident detection and duration prediction using traffic speed data. It analyses traffic speed changes to identify accident-related disruptions and segment affected traffic areas. Over all, the research provides an effective solution for accurate accident detection and traffic disruption duration estimation.

2. Artur Grigorev, Adriana Simona Mihäitä, Dong-Kyu Lee, and Fang Chen authored the paper Incident Duration Prediction Using a BiLevel Machine Learning Framework with Outlier Removal and Intra—Extra Joint Optimisation. The paper presents a bi-level machine learning framework for predicting traffic incident durations more accurately. The system first classifies incidents as short-term or long-term and then applies regression models for detailed duration prediction. It also removes outliers to improve model performance and reliability.

3. Redhwan Nour, Sultan H. Almotairi, and Abdulrahman Alenezi authored the paper RealTime Road Accident Detection Using YOLO and Deep Learning. The paper proposes a real-time road accident detection system using the YOLO deep learning algorithm and CCTV video streams. The model automatically detects vehicles and identifies accident events from traffic footage. The system improves detection speed and accuracy compared to traditional manual monitoring methods.

4. Mingyuan Yuan, Mohamed Abdel-Aty, and Qiang Cai authored the paper Traffic Accident Detection Using Convolutional Neural Networks and Video Surveillance. The paper presents a CNN-based accident detection system using CCTV surveillance videos to automatically identify traffic accidents and abnormal vehicle movements. The system Improves real-time detection accuracy and reduces the need for manual traffic monitoring. Experimental results showed effective detection of collision events, highlighting the importance of deep learning in intelligent transportation and road safety systems.

III. PROBLEM STATEMENT

Road accidents cause loss of life, traffic congestion, and delays in emergency response. Existing accident detection systems rely on manual reporting and CCTV monitoring, which are often slow and inaccurate. Current methods also fail to predict accident duration effectively for proper traffic management. The proposed project, Smart Vehicle System for Real-Time Monitoring, Safety Enhancement and Intelligent Transportation, uses machine learning with Python and React to detect accidents and predict incident duration from live video streams. The system works without using 10T devices or physical sensors, improving road safety and traffic monitoring.

IV. METHODOLOGY

The above diagram explains the working process of the proposed Smart Vehicle System for real-time monitoring and safety detection. The system starts by collecting data from different sources such as cameras, GPS, and ultrasonic/LiDAR sensors. The collected data is then processed using image preprocessing, feature extraction, and machine learning techniques to detect hazards like accidents, smoke, traffic issues, pedestrians, roadblocks, and other obstacles.

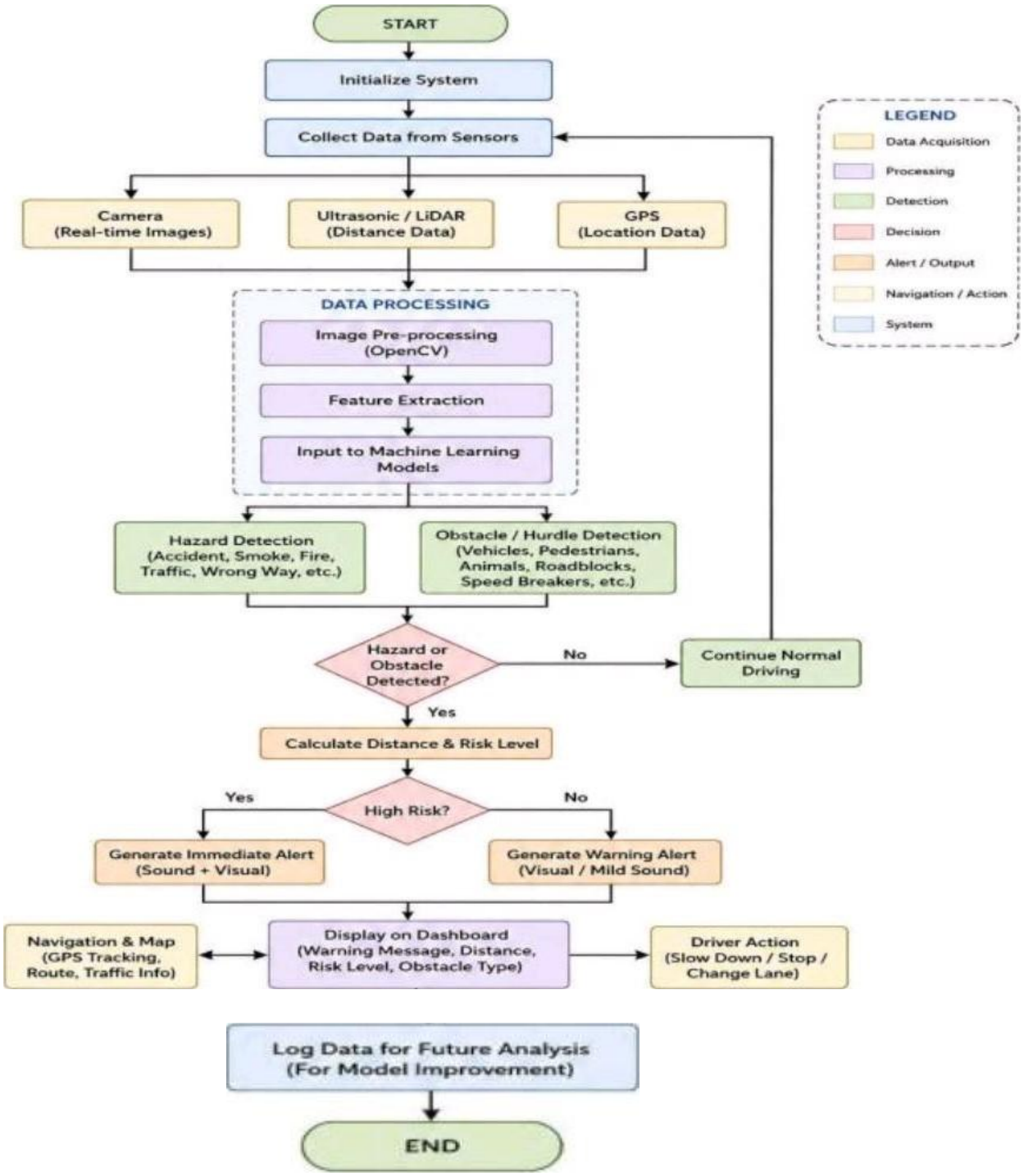

Figure l . System Flowchart

After detection, the system checks whether any hazard or obstacle is present. If no risk is detected, the vehicle continues normal driving. If a hazard is identified, the system calculates the distance and risk level. For high-risk situations, immediate alerts such as sound or visual warnings are generated to inform the driver. The system also displays warning messages, navigation details, and obstacle information on the dashboard to help the driver take safe actions like slowing down, stopping, or changing lanes. Finally, all data is stored for future analysis and model improvement.

Project Output:

i. **Smart Drive Dashboard:**

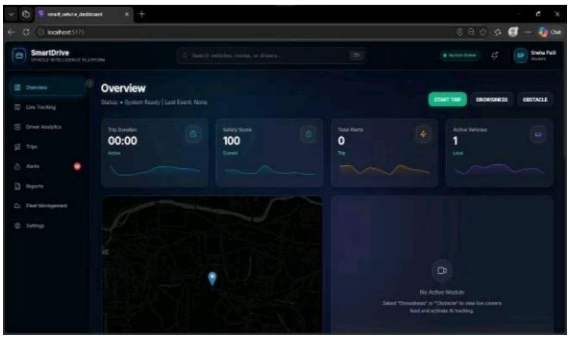

Figure 2: Smart Drive Dashboard

ii. Real Time Obstacle Detection:

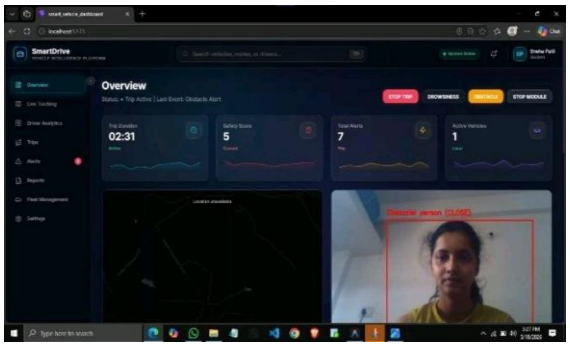

Figure 3: Real Time Obstacle Detection

iii. Real-Time Driver Drowsiness Detection:

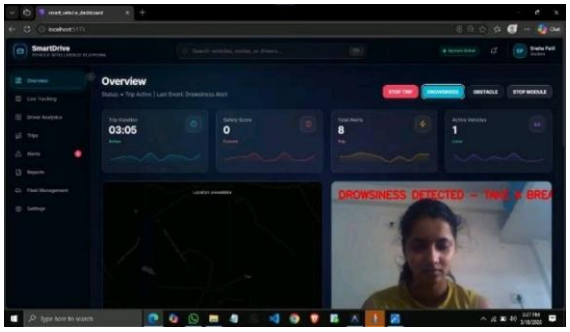

Figure 4: Real-Time Driver Drowsiness Detection

iv. **Smart Vehicle Tracking:**

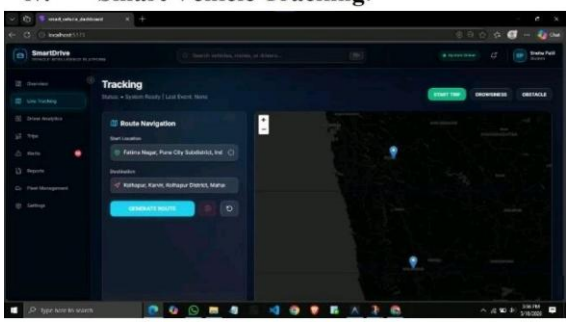

Figure 5: Smart Vehicle Tracking

v. Real-Time Vehicle Trip Records:

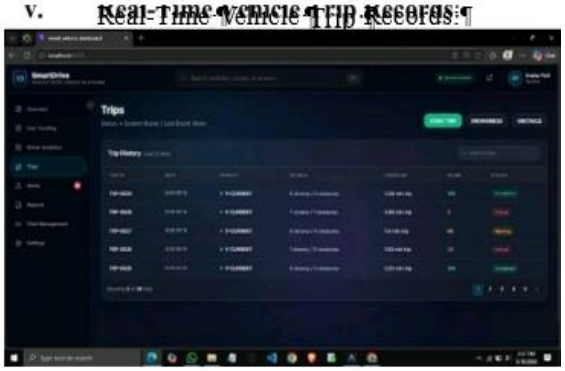

Figure 6: Real-Time Vehicle Trip Records

vi. Real-Time Vehicle Alert and Warning:

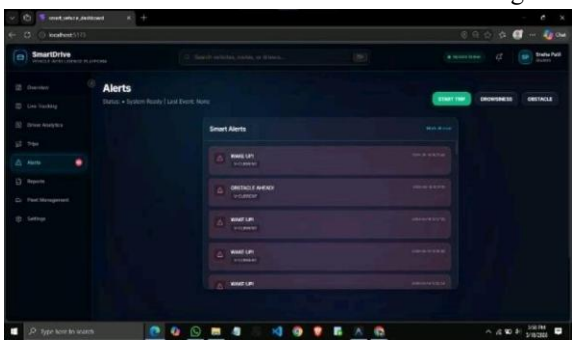

Figure 7: Real-Time Vehicle Alert and Warning

V. PUBLICATION PRINCIPLES

The publication of this research work adheres to established academic ethics and standards to guarantee the originality and credibility of the proposed web application. Every methodology, diagnostic workflow, and architectural feature detailed in this study has been carefully documented to preserve research integrity. Plagiarism is strictly avoided by ensuring all text is original and that external literature is properly credited. All sample data utilized during system testing is managed securely to uphold user privacy. This study intends to provide a meaningful contribution to the domains of Web Security and Threat Detection by offering an efficient, Python-based framework capable of mitigating modern phishing risks.

VI. CONCLUSION

This research presented a Smart Vehicle System developed using React and Python to improve vehicle safety, real-time monitoring, and intelligent transportation. The system uses Machine Learning and

Computer Vision to analyses road conditions, driver behavior, traffic patterns, and vehicle movements through video-based processing. It provides features such as real-time alerts, route optimization, driver analytics, and intelligent decision-making to improve driving safety and transportation efficiency. Unlike traditional systems, the platform does not depend on 10T devices or external sensors, making it more affordable, software-based, and easy to use in different environments. Overall, the research shows how Al technologies and modern web development can be combined to create an effective and future-ready smart transportation solution.

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