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YOLO-Based Traffic Surveillance System for Violation Detection and E-Challan Issuance

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ABSTRACT: Traffic violations, including over-speeding, helmet and seat belt non-compliance, mobile usage, red light jumping, and lane violations, pose serious risks to road safety. In India, the Motor Vehicles Act, 1988, mandates strict traffic regulations, but violations persist due to inefficient enforcement and lack of real-time monitoring. The current system relies on manual surveillance and post-event CCTV reviews, leading to delays, human errors, and inconsistent enforcement. Additionally, manual e-challan processing is time-consuming, making it difficult to track offenders efficiently. These challenges highlight the need for an automated system to enhance traffic rule enforcement and road safety. This project proposes an AI-powered automated traffic rule violation detection system integrating YOLOv8 for real-time object detection, Optical Flow Based Speed Estimation for over-speeding detection, and EasyOCR for Automatic Number Plate Recognition (ANPR). YOLOv8 is used to identify violations such as no helmet, no seat belt, mobile phone usage, triple riding, red light jumping, and lane violations. Optical flow techniques estimate vehicle speed to detect over-speeding offenses, while EasyOCR extracts vehicle registration numbers from detected number plates. Once a violation is detected, the system automatically generates an e-challan by fetching vehicle owner details from the RTO database and sending notifications via SMS and email. By leveraging computer vision, deep learning, and AI driven automation, the proposed system ensures realtime detection, efficient processing, and automated fine generation, reducing human intervention and enhancing road safety. This solution contributes to smart city initiatives by enabling a more reliable, scalable, and data-driven approach to traffic law enforcement.

I. INTRODUCTION

OVERVIEW: Traffic violations are one of the leading causes of road accidents, injuries, and fatalities, posing a serious threat to public safety. Reckless driving behaviors such as over-speeding, lane indiscipline, red light jumping, and distracted driving due to mobile phone usage significantly contribute to road mishaps. The absence of strict and real-time enforcement further worsens the situation, allowing offenders to evade penalties and continue violating traffic rules. Studies have shown that countries with robust traffic law enforcement systems experience significantly lower accident rates, highlighting the need for an efficient and automated system to monitor and penalize violators effectively. In India, road safety regulations are governed by the Motor Vehicles Act, which mandates strict adherence to traffic laws to ensure safer roads. One of the critical provisions includes compulsory helmet usage for two-wheeler riders, which significantly reduces head injury risks during accidents. Similarly, seat belt enforcement for all four-wheeler occupants is mandatory to minimize fatal injuries in case of sudden collisions. The law also defines specific speed limits based on the type of vehicle and road conditions, preventing high-speed crashes and improving overall traffic safety. Lane discipline is another crucial rule that ensures smooth vehicular 1 movement and prevents sudden lane-





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changing maneuvers that can lead to accidents. Additionally, the use of mobile phones while driving is strictly prohibited as it diverts the driver's attention and increases reaction time, leading to dangerous situations on the road. Despite the presence of these stringent laws, enforcement remains a major challenge due to limited surveillance, reliance on manual monitoring by traffic police, and inefficiencies in the penalty issuance process. Many violations go undetected, and even when caught, delays in fine collection and weak legal follow ups reduce the effectiveness of the deterrent measures.

II. LITERATURE SURVEY

Prior studies have explored various Albased traffic surveillance and violation detection: Detection of Two-Wheeler Traffic Rule Violation Using Deep Learning – This paper explores computer vision techniques for detecting violations in two-wheeler traffic. Two-Wheeler Vehicle Traffic Violations Detection and Automated Ticketing for Indian Road Scenario – Discusses AI-based techniques for detecting violations like helmet-less riding, phone usage, and illegal parking, with automated ticketing. A Video-Based Traffic Violation Detection System – Focuses on video-based monitoring for traffic violations. Traffic Surveillance & AI: Studies on AI-driven traffic monitoring systems, including computer vision techniques for detecting violations, such as signal jumping or overspeeding. E- Challan Systems: Papers discussing digital challan issuance and its integration with smart city frameworks. Smart Traffic Management: Work on AI-powered traffic control systems that optimize road safety and efficiency.

III. METHODOLOGY

Traditional traffic enforcement methods primarily depend on traffic police and CCTV footage review to identify violations. This manual approach leads to delays in detecting and processing violations, often resulting in human errors and inconsistent enforcement. Due to the limited number of personnel and resources, many infractions go unnoticed, further contributing to traffic indiscipline. Additionally, delayed penalty processing reduces the effectiveness of deterrence, as violators are not held accountable in a timely manner. Speed enforcement is another major challenge. Existing speed detection methods often lack real-time accuracy, making it difficult to impose speed limits effectively. Inaccurate speed estimations lead to disputes and reduced compliance with traffic laws. Moreover, the effectiveness of Automatic Number Plate Recognition (ANPR) is compromised by poor lighting conditions, occlusions, and variations in number plate formats, making it difficult to identify vehicles accurately. The manual issuance of fines further exacerbates the problem. The slow processing of penalties creates backlogs and reduces the deterrent effect of traffic law enforcement. As a result, there is an urgent need for an automated, real-time traffic violation detection system that ensures efficiency, accuracy, and timely enforcement of penalties. This project aims to develop an AI-powered traffic violation detection system that automates the identification of rule-breaking behavior, including overspeeding, red light jumping, lane violations, and helmet or seat belt non-compliance. By utilizing YOLOv8 for object detection, Optical Flow for speed estimation, and EasyOCR for number plate recognition, the system will provide real-time violation detection and automated e-challan generation. This will enhance traffic law enforcement, improve road safety, and ensure effective penalty processing.







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IV. EXPERIMENTAL RESULT

The project is a smart, AI-based system designed to detect and report traffic violations using real time video processing and automatic number plate recognition (ANPR). The system leverages YOLOv8 for object detection and EasyOCR for license plate recognition, ensuring accurate identification of violations. This test report summarizes the software testing process, including objectives, scope, environment, test results, and conclusions.

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V. OBSERVATION

The testing phase successfully validated all the core functionalities of the project. The system effectively detects traffic violations, recognizes number plates with high accuracy, and automates fine generation. It ensures secure user management, payment processing, and dispute handling. Performance and security tests confirm system stability under various conditions. No critical bugs were found, and the application is ready for deployment with optimal performance and reliability.

VI. CONCLUSION

In conclusion, the project is an AI-powered, real-time traffic monitoring system designed to enhance law enforcement and improve road safety. Developed using Python, Flask, MySQL, TensorFlow, OpenCV, EasyOCR, and YOLOv8, the system efficiently detects traffic violations, extracts vehicle number plate details, and automates e-challan processing. The End User Dashboard provides role-specific functionalities for admins, traffic police, and vehicle owners, enabling seamless violation management, e-challan issuance, fine payments, and real-time notifications. The Violation Detection Module, powered by YOLOv8, accurately identifies traffic offenses such as signal jumping, overspeeding, and lane violations. The Number Plate Recognition System, utilizing EasyOCR and ANPR, ensures precise text extraction for vehicle identification. The E-Challan System automates fine generation and notification dispatch via SMS and email, ensuring transparency and efficiency in violation handling. Additionally, the system offers detailed analytics and reporting tools, empowering traffic authorities with data-driven insights for policy making and enforcement strategies. By integrating machine learning, OCR, and cloud-based services, this project modernizes traditional traffic monitoring, enhances compliance, and contributes to safer roads. The Traffic Violation Finder Web App stands as a scalable, intelligent, and reliable solution for smart traffic management, revolutionizing law enforcement with AI driven automation.

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