



Intelligent Traffic Violation Detection and Criminal Tracking

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Abstract

Traffic congestion and increasing instances of traffic violations have become serious challenges for urban infrastructure and public safety. Traditional traffic management methods heavily rely on manual processes, which are often inefficient and unable to keep up with the growing number of vehicles. The need for automation and intelligent decision making in traffic enforcement is evident. This project, *Intelligent Traffic Violation Detection and Criminal Tracking*, aims to address these challenges by developing an AI-driven multilayered system. By integrating deep learning, computer vision, and cloud computing, the system will automate the detection of traffic violations and enable real-time tracking of criminal or wanted vehicles. Leveraging video surveillance and license plate recognition technologies, the system will provide accurate, scalable, and fast traffic violation verification while enhancing the capability to track offenders. Additionally, the project incorporates AWS cloud services to ensure efficient data processing and real-time alert delivery to law enforcement agencies. The proposed system will significantly reduce manual intervention, lower false positive rates, and improve the speed and accuracy of traffic law enforcement. Through this work, our goal is to contribute to safer roads, more efficient traffic management, and improved public trust in automated traffic enforcement technologies.

Keywords: Traffic Violation Detection, Intelligent Traffic Management, Deep Learning, Computer Vision, License Plate Recognition (LPR), Real-Time Tracking, Cloud Computing (or AWS), Traffic Enforcement, AI-Driven System.

1. Introduction

The rapid urbanization and expansion of modern cities like Bengaluru have led to an exponential increase in the number of vehicles on the roads. With this growth, traffic violations such as red-light running, lane encroachment, speeding, and driving without a helmet have also surged, creating severe public safety concerns. Traffic departments face mounting challenges in enforcing traffic laws due to the sheer volume of violations occurring daily. Bengaluru's traffic management system utilizes an AI-driven violation detection platform called ITEMS to automate violation detection through deep learning and computer vision. While this system marks a significant advancement, it still requires substantial manual oversight to validate detected violations and minimize false positives. This manual validation slows down the enforcement process and limits the

system's scalability. Furthermore, there is an unmet need to leverage the existing surveillance infrastructure for real-time tracking of criminal or wanted vehicles. Currently, there is no integrated system to cross-reference vehicle data against crime databases in real time. Our project, *Intelligent Traffic Violation Detection and Tracking*, proposes a solution that addresses these limitations. By introducing an intelligent secondary validation layer and integrating a criminal vehicle identification module, our system enhances both the accuracy of traffic enforcement and the ability of law enforcement to act on critical intelligence.

1.1.Objectives

The key objectives of the Intelligent Traffic Violation Detection and Tracking project are:

1.1.1. Automate Secondary Validation:



Implement an AI-based secondary validation layer to reduce the reliance on manual verification of traffic violations, thereby improving efficiency and accuracy.

1.1.2. Real-Time Vehicle Identification

Intelligent Traffic Violation Detection & Criminal Tracking Develop a robust license plate recognition system to identify vehicles in real time and cross-reference license plates with law enforcement databases to detect criminal or wanted vehicles.

1.1.3. Cloud-Based Scalability

Utilize cloud services such as AWS Lambda, S3, EC2, and DynamoDB to build a scalable system capable of processing video feeds from multiple surveillance points across the city.

1.1.4. Support Law Enforcement

Provide traffic authorities and law enforcement agencies with real-time alerts and actionable intelligence to enable rapid response and improve public safety.

1.1.5. Adaptability to Smart Cities

Design a modular and flexible system that can be easily integrated into existing smart city infrastructure and expanded to support additional functionalities such as predictive analytic and proactive traffic management.

1.2. Purpose, Scope, and Applicability

1.2.1. Purpose

The purpose of this project is to create a next generation traffic violation detection and tracking system that significantly enhances the capabilities of current AI-based traffic enforcement platforms. By addressing key limitations such as high false positive rates and lack of real-time criminal vehicle tracking, the proposed system aims to provide an intelligent, efficient, and scalable solution. This system will not only improve the operational efficiency of traffic departments but also support broader public safety initiatives by enabling real time monitoring of vehicles flagged by law enforcement agencies. The integration of machine learning and cloud computing ensures that the system remains adaptable to future technological advancements and evolving urban transportation needs.

1.2.2. Scope

The scope of the project encompasses the following functionalities:

- Real-time detection of traffic violations such as red-light running, lane violations, helmet rule violations, and more, using computer vision and deep learning models.
- Accurate extraction and recognition of vehicle license plates under varying environmental conditions.
- Intelligent filtering of detected violations to reduce false positives and improve data quality.
- Real-time cross-referencing of recognized license plates against law enforcement databases to identify and alert about criminal or wanted vehicles.
- Deployment of the system on a cloud infrastructure to support scalability, fault tolerance, and seamless integration with city-wide surveillance networks.
- Development of a secure web-based dashboard for traffic authorities to monitor violations and receive real-time alerts.

1.2.3. Applicability

The proposed system has broad applicability across multiple domains:

- Urban Traffic Management: Provides traffic departments with an intelligent, automated tool for enforcing traffic laws and improving road safety.
- Law Enforcement: Enables police and crime control units to track criminal or wanted vehicles in real time, facilitating faster response and crime prevention.
- Content Streaming Platforms: To automate tagging of ad segments within user-generated or commercial content.
- Smart City Initiatives: Supports integration with broader smart city projects focused on intelligent transportation systems, public safety, and civic administration.
- Scalable to Multiple Regions: The system's cloud-based architecture ensures that it can be scaled across different cities, states, and even

countries, adapting to various regulatory and infrastructural environments.

- Research and Development: To offers a platform for future research into predictive traffic management, behavior analysis, and intelligent transport systems.

2. Results and Discussion

2.1. Results

The proposed system is an intelligent, AI-powered solution designed to automate traffic law enforcement through real-time surveillance. It is expected to accurately detect common traffic violations like helmet-less riding and red light jumping with over 90% accuracy, significantly reducing false positives with a secondary AI validation layer. A core feature is its robust Automatic License Plate Recognition (ALPR), which can read Indian license plates with 85-95% accuracy even in challenging conditions. This enables the system to cross-reference plates with a criminal database and generate instant alerts for blacklisted vehicles in under five seconds. Built on a scalable cloud architecture, the system aims to improve law enforcement efficiency by reducing manual monitoring and enabling faster, more effective responses to enhance road safety.

2.2. Discussion

The proposed system aims to deliver an intelligent, real-time, and scalable solution to detect, validate, and track traffic violations while also identifying criminal or blacklisted vehicles from surveillance footage. The following outcomes are expected upon successful implementation:

2.2.1. Accurate Traffic Violation Detection

- Real-time identification of common traffic violations such as:
 - ✓ Helmet-less riding
 - ✓ Red light jumping
 - ✓ Stop-line crossing
 - ✓ Lane indiscipline
- Detection accuracy of over 90%, with low false positive rates due to the inclusion of a secondary AI-based validation layer.

2.2.2. Robust License Plate Recognition (ALPR)

- The proposed system incorporates an

advanced Automatic License Plate Recognition (ALPR) module that utilizes deep learning models in combination with Optical Character Recognition (OCR) techniques to accurately detect and digitize Indian vehicle license plates. This module plays a critical role in identifying vehicles involved in traffic violations or flagged for criminal activity.

- The system is designed to achieve a license plate recognition accuracy in the range of 85–95%, which makes it highly reliable for real-world applications. To ensure robustness, the model is trained on diverse datasets that simulate real traffic conditions including day/night variations, different angles, and weather effects.

- ✓ Low lighting
- ✓ Plate occlusion
- ✓ Blurred frames



Figure 1 No Helmet Deduction

The figure 1 No helmet detection is shown. This image illustrates a key functionality of the proposed system: helmet violation detection using real-time object recognition. The model has successfully detected the bike, identified the rider without a helmet, and localized the license plate with high confidence scores. This showcases the effectiveness of the AI model in enforcing traffic rules through automated surveillance. Such detections help generate violation alerts without manual intervention.



This capability supports the project's objective of reducing human workload while improving road safety compliance.

2.2.3. Real-Time Criminal Vehicle Alerts

- The license plate data will be cross-referenced with a pre-uploaded criminal/wanted vehicle database.
- If a match is detected, the system will:
 - ✓ Instantly generate an alert
 - ✓ Send vehicle details, location, and timestamp to the Traffic Control Room interface.
- The expected response time from detection to alert is under 5 seconds.

2.2.4. Automated Secondary Validation

- A machine learning classifier will act as a second layer to confirm violations flagged by the initial detection system.
- Expected to reduce false positives by at least 30-40%, thereby minimizing manual verification by officers.

2.2.5. Cloud-Based, Scalable Deployment

- The system will be deployable via AWS services (Lambda, S3, Rekognition, DynamoDB), making it:
 - ✓ Easily scalable across various intersections and cities.
 - ✓ Capable of handling multiple parallel video feeds with minimal latency.
- Supports distributed and edge-based deployments for future expansion.

2.2.6. Improved Traffic Law Enforcement Efficiency

The final system will:

- Reduce the dependency on manual monitoring.
- Enable faster decision-making for law enforcement.
- Contribute to enhanced public safety and deterrence of repeat offenses.

Conclusion

The increasing complexity of urban traffic systems demands intelligent and automated solutions for effective enforcement and public safety. This project proposes an enhanced traffic violation detection and

vehicle tracking system that integrates deep learning, computer vision, and cloud-based infrastructure to address the current limitations of existing systems like ITEMS. By adding a secondary AI-based validation layer, the system significantly reduces the rate of false positives, thereby minimizing the need for manual intervention. The incorporation of Automatic License Plate Recognition (ALPR) and a secure criminal vehicle database enables real-time identification and alerting of wanted vehicles, providing a proactive tool for law enforcement agencies. Through the use of scalable cloud services like AWS Lambda, S3, and DynamoDB, the solution is not only efficient but also deployable at city-wide or even state-wide levels. The expected outcomes of improved accuracy, real-time response, and intelligent alerting will collectively contribute to safer roads, more efficient traffic management, and better law enforcement capabilities. In conclusion, this project represents a significant step toward realizing smarter, safer, and more automated urban transport systems through the power of artificial intelligence and modern computing infrastructure.

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The literature survey conducted for this project involved a comprehensive review of various research papers, technical implementations, and case studies related to modern traffic surveillance technologies. These works span across domains such as traffic rule violation detection, vehicle tracking and re-identification, automatic license plate recognition (ALPR), and intelligent transport systems (ITS) deployed in smart city environments. The aim of this review was to understand the current advancements, methodologies, and technologies being used in the field, while also identifying limitations and opportunities for improvement. The surveyed literature collectively highlights the growing reliance on deep learning, computer vision, and cloud/edge-based infrastructure to automate and enhance traffic law enforcement and public safety. These studies also provide insights into the challenges of real-time processing, false positives in violation detection, and the difficulty of handling complex urban traffic scenes, especially under low light or occluded conditions. The findings from the literature form a strong foundational base for the proposed system and directly influence the selection of technologies and techniques used in this project.

Journal reference style

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