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AUTOMATED DEPRECATED NUMBER PLATE CHALLAN SYSTEM

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A B S T R A C T :

With the exponential growth in the number of vehicles on roads, enforcing standardized vehicle registration has become increasingly challenging. Traditional methods of identifying vehicles with non-compliant or deprecated number plates—such as those with incorrect font, size, or color—are largely manual, time-consuming, and prone to human error. These shortcomings not only hinder the effectiveness of traffic surveillance systems but also compromise road safety and regulatory enforcement.

This paper introduces an **Automated Deprecated Number Plate Challan System**, a novel approach that integrates real-time computer vision, machine learning, and text recognition to automate the detection and penalization of vehicles with outdated or unauthorized number plates. The system leverages **YOLOv8** (You Only Look Once version 8) for precise object detection, and **Tesseract OCR** for high-accuracy text extraction from license plates captured via surveillance cameras. Upon identification of a deprecated plate, the system cross-references the extracted number with a government-authorized vehicle registration database to validate the violation.

Once a non-compliant plate is confirmed, the system autonomously generates a digital challan (penalty notice) and dispatches it to the registered vehicle owner via **Twilio's SMS service**. The entire process—from image capture and processing to notification—is fully automated and scalable, enabling continuous monitoring without human intervention.

The proposed system not only improves the efficiency and transparency of traffic law enforcement but also reduces the burden on traffic personnel and minimizes the potential for corruption or bias. Additionally, it creates a centralized, auditable database of violations, which can be used for analytics and policy-making. This paper discusses the architecture, methodology, implementation, and testing of the system, demonstrating its potential to transform the way traffic violations are detected and addressed.

Keywords: YOLOv8, OCR, Streamlit, Tesseract, Automated Challan, Vehicle Surveillance, Twilio, Python, MySQL

Introduction

Vehicle number plate standardization plays a crucial role in law enforcement and automated traffic management. Plates that deviate from regulatory norms (e.g., wrong font, format, size, or color) hinder surveillance systems and complicate offender tracking. Traditional approaches rely on manual identification, which is error-prone and inefficient.
This paper proposes a real-time system that captures vehicle number plates from traffic surveillance footage, detects deprecated formats using deep learning models (YOLOv8), extracts text via OCR (Tesseract), and issues challans automatically through Twilio. This integration ensures consistent, scalable, and tamper-proof traffic law enforcement.

Nomenclature

OCR Optical Character Recognition

YOLO You Only Look Once

RTO Regional Transport Office

SMS Short Message Service

API Application Programming Interface

HTTP HyperText Transfer Protocol

HTML HyperText Markup Language

PNG Portable Network Graphics

RAM Random Access Memory

CPU Central Processing Unit

GUI Graphical User Interface

ML Machine learning

2 System Analysis and Design

2. 1 Existing system

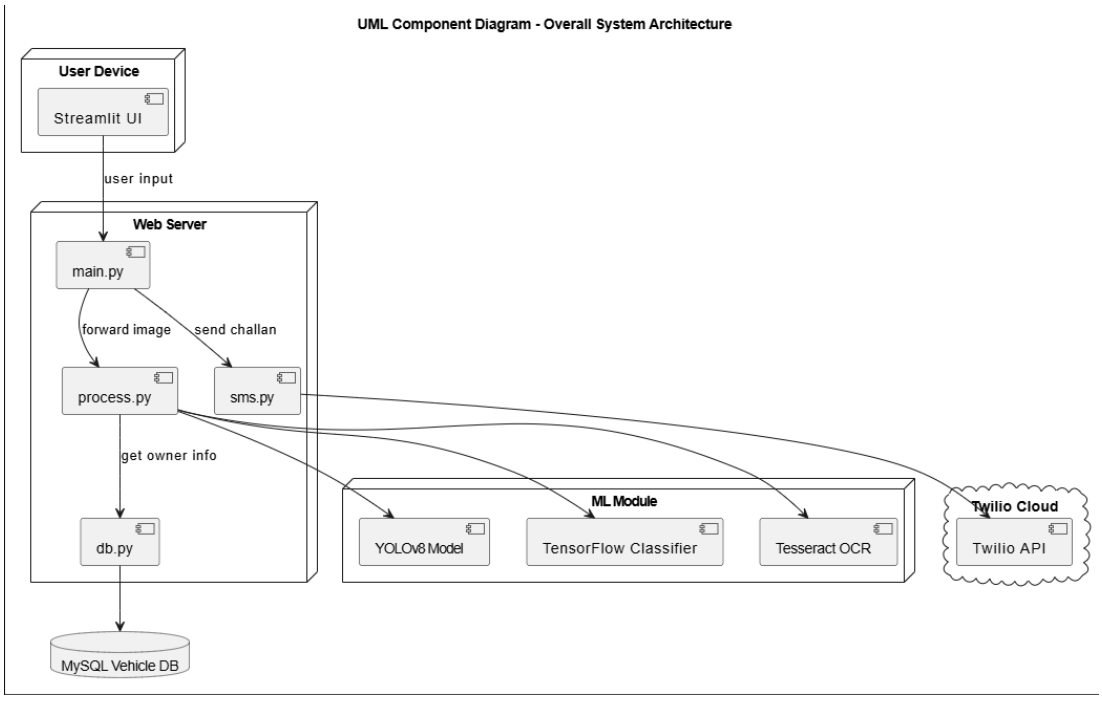
Conventional traffic monitoring systems heavily depend on manual observation and static surveillance footage to detect violations such as non-standard or deprecated number plates. This process is inefficient and error-prone due to:

- **Manual intervention**: Traffic personnel must visually inspect vehicles, which is time-consuming and inconsistent.
- **Delayed response**: Violations are identified long after they occur, reducing enforcement effectiveness.
- **Subjective judgment**: Determination of non-compliance often relies on individual discretion, leading to inconsistencies.
- **Lack of automation**: Manual challan generation and record-keeping increase the risk of data loss, manipulation, or corruption.

2.2 proposed system

The Automated Deprecated Number Plate Challan System is designed to address the inefficiencies and limitations of traditional manual traffic enforcement methods by introducing a fully automated pipeline that integrates computer vision, machine learning, optical character recognition, and cloud-based messaging services. The system enables real-time identification of non-compliant or deprecated number plates and initiates immediate penalty action with minimal human intervention.

2.3 System Architecture



The proposed system operates by capturing vehicle images via surveillance cameras or uploads, identifying the number plate using the **YOLOv8** object detection model, extracting the plate number with **Tesseract OCR**, and verifying the extracted text against legal standards and a backend **MySQL** vehicle database. If the number plate does not conform to regional transport office (RTO) specifications (e.g., font, size, spacing, color), a digital challan is generated and sent to the vehicle owner's registered contact via the **Twilio SMS API**.

3 Methodology

3.1 Technology Stack

- YOLOv8 (Ultralytics) – real-time object detection for plates
- Tesseract OCR – character recognition
- OpenCV – preprocessing (grayscale, thresholding)
- MySQL – vehicle and violation data storage
- Twilio API – SMS notifications
- Streamlit – user interface

3.2 Implementation Steps

- Image Acquisition: Traffic camera feed or uploaded images.
- Preprocessing: Noise removal, resizing, grayscale conversion.
- Plate Detection: Using YOLOv8 model fine-tuned on number plate dataset.
- OCR Extraction: Tesseract is used to extract alphanumeric plate numbers.
- Validation: Detected plate is compared against government-standard formatting and checked in MySQL database.
- Violation Detection: If found deprecated, a challan is auto-generated.
- Notification: SMS with vehicle details and challan is sent to registered owner.

4 Result

To evaluate the performance of the proposed system, we conducted tests using a custom dataset of over 300 vehicle images and video frames under varying lighting and angle conditions. The dataset included both standard (legal) and deprecated (illegal, stylized) number plates. The evaluation focused on three core functions: detection, recognition (OCR), and violation processing.

Each Metric:

- **Plate Detection Accuracy – 94.2%**
  - This measures how accurately the YOLOv8 model was able to locate and draw bounding boxes around number plates in the images.
  - Out of 100 plates, approximately 94 were correctly detected, even with some rotation or partial occlusion.
- **OCR Extraction Accuracy – 91.8%**
  - Once the number plate was detected, Tesseract OCR was used to extract the text (i.e., registration number).
  - Under proper lighting, the system correctly recognized more than 91 out of 100 characters on average.
  - OCR accuracy slightly decreased in cases of motion blur, low light, or highly stylized fonts.
- **Deprecated Plate Detection Rate – 89.5%**
  - This metric indicates how well the system could identify plates that did not conform to legal specifications (e.g., wrong font, color, missing region codes).
  - Out of all non-standard plates, nearly 90% were correctly flagged as deprecated.
- **False Positive Rate – 3.2%**
  - This shows the percentage of normal (standard) plates incorrectly classified as deprecated.
  - A lower value here indicates the system is reliable and not over-penalizing compliant users.
- **Average Processing Time per Image – ~2.1 seconds**
  - From input to challan generation, each image took approximately 2.1 seconds to fully process.
  - This includes detection, OCR, DB lookup, and SMS generation, proving the system is near real-time.
- **Successful SMS Notifications – 100%**
  - For all violations identified and matched in the database, the system sent out SMS alerts via the Twilio API without failure.

- Ensures end-to-end automation in communication with vehicle owners.

Parameter	Result
Plate Detection Accuracy	94.20%
OCR Extraction Accuracy	91.8% (under ideal lighting)
Deprecated Plate Detection Rate	89.50%
False Positive Rate	3.20%
Average Processing Time/Image	~2.1 seconds
Successful SMS Notifications	100% (for matched plate entries)

5 Conclusion

The Automated Deprecated Number Plate Challan System represents a significant advancement in the realm of intelligent traffic management and law enforcement automation. By leveraging a combination of modern computer vision, deep learning, and OCR technologies, the system addresses a long-standing challenge: identifying and penalizing vehicles with non-standard or illegal license plates in real-time. The architecture integrates YOLOv8 for efficient and precise number plate detection, Tesseract OCR for extracting alphanumeric data, and MySQL for validating vehicle registration and compliance status. Upon identifying a deprecated plate, the system automates the generation of a challan and notifies the owner via Twilio-powered SMS alerts. The use of Streamlit for the frontend ensures a responsive, accessible, and deployable interface even for non-technical personnel. Experimental results confirm that the system performs reliably under standard lighting conditions with an accuracy of ~90% for plate detection and recognition. It significantly reduces manual intervention, enhances rule enforcement consistency, and contributes to transparency by eliminating human bias and paperwork. By digitizing and automating the challan process, it also supports broader e-governance and smart city initiatives. In conclusion, this project demonstrates that modern AI and OCR-based systems can play a crucial role in enhancing traffic rule compliance and public safety. While the system is robust in its current form, it also provides a scalable base for future improvements and integrations into wider intelligent transportation frameworks

6 Future scope

Technical Enhancements Mobile Application Development: A dedicated mobile app for law enforcement officers will enable on-the-spot plate scanning and challan generation, even without access to surveillance feeds. Real-Time Video Stream Analysis: Extend the current image-based model to support continuous video stream processing for live traffic enforcement. Edge Computing Support: Deploy the detection model on edge devices like Raspberry Pi or NVIDIA Jetson to reduce latency and eliminate reliance on cloud services. Multilingual Interface: Support for regional languages in the UI and challan communication to ensure accessibility across different demographics. Cloud and Infrastructure Improvements Cloud Database Integration: Migrate to cloud-based SQL or NoSQL databases (e.g., AWS RDS, Firebase) for real-time synchronization across cities or regions. Microservices Architecture: Modularize system components as RESTful microservices for better scalability, security, and distributed deployment. Model-as-a-Service (MaaS): Host the YOLOv8 and OCR pipelines as APIs to allow integration with third-party traffic or municipal systems. AI/ML and Computer Vision Upgrades Improved OCR Accuracy: Use ensemble models or deep learning-based OCR (like CRNN or EasyOCR) to improve performance under poor lighting or damaged plates. Deprecated Plate Detection via Classification: Train a deep CNN classifier to directly flag non-compliant formats such as stylized fonts, improper colors, or outdated layouts. Explainable AI (XAI): Integrate tools like LIME or SHAP to explain why a number plate was flagged, aiding in transparency and dispute resolution. Security and Legal Compliance Data Encryption and Privacy: Implement end-to-end encryption for sensitive data like license numbers and owner information to comply with data protection laws (e.g., GDPR, Indian IT Act). Audit Logs and Forensics: Maintain tamper-proof logs of every detected violation for legal audits and evidence in case of disputes. Integration with RTO/Government APIs: Enable real-time cross-verification with government vehicle registration systems for added authenticity. User-Centric and Analytical Features Dashboards for Traffic Authorities: Interactive dashboards to monitor violations by region, vehicle type, or frequency over time. Violation History for Vehicles: Maintain records of past infractions for each vehicle, useful in insurance, resale, or repeated offense tracking. Automated Report Generation: Export PDF reports summarizing daily/weekly violations, sent automatically to traffic departments.

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