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License Number Plate Recognition and Challan Generation Website Using Real-Time Camera and OCR

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Abstract: License Number Plate Recognition (LNPR) is a computer vision-based technique designed to automatically identify vehicle registration numbers from images or video frames. This technology is increasingly used in traffic monitoring, toll collection, and law enforcement for enhancing road safety and operational efficiency. The primary objective of this research is to develop an LNPR system capable of recognizing license plates in real time using image processing and Optical Character Recognition (OCR). The proposed system involves several stages, including image acquisition through a real-time camera, license plate localization, character segmentation, and text recognition. Techniques such as grayscale conversion, noise reduction, edge detection, and contour analysis are utilized to enhance the accuracy of detection. OCR is then applied to extract alphanumeric characters from the identified license plate region. The system is tested under different lighting and environmental conditions to evaluate its robustness. Results indicate that the system achieves a high level of accuracy in controlled scenarios, demonstrating its potential for integration into smart traffic systems and automated vehicle monitoring solutions.

Keywords*: License Plate Recognition (LPR), Number Plate Detection, Optical Character Recognition (OCR), Image Processing, Vehicle Identification, Intelligent Transportation Systems, Real-Time Surveillance, Computer Vision, Pattern Recognition, Traffic Monitoring.*

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I. INTRODUCTION

In recent years, the demand for intelligent and automated traffic management systems has significantly increased with the rapid growth of urbanization and vehicular traffic. License Number Plate Recognition (LNPR) has emerged as a crucial component of these systems, enabling the automatic identification of vehicles by extracting and recognizing their registration numbers from images or video streams. This technology has wide-ranging applications, including automated toll collection, traffic law enforcement, vehicle tracking, access control in parking lots, and detection of stolen vehicles.

The core idea behind LNPR systems lies in the integration of computer vision, image processing, and optical character recognition (OCR) techniques. These systems typically involve several stages: capturing the image of a vehicle, detecting and isolating the license plate region, segmenting the characters, and recognizing them using OCR. The effectiveness of such systems depends on their ability to handle various challenges, including variations in lighting conditions, camera angles, plate orientations, fonts, background noise, and motion blur.

In countries like India, where number plate designs can vary significantly and may not always adhere to standard formats, developing a robust and accurate LNPR system becomes even more complex. Therefore, there is a growing interest in leveraging machine learning and deep learning techniques to improve the accuracy and reliability of license plate detection and recognition.

This research aims to design and implement a real-time LNPR system using image processing techniques and OCR. The system is tested under different environmental conditions to evaluate its performance and reliability. By automating the process of vehicle identification, the proposed solution contributes to the development of smart transportation infrastructure and enhances the efficiency of traffic regulation systems.

II. LITERATURE REVIEW

License Number Plate Recognition (LNPR) has been an area of active research due to its critical role in intelligent transportation systems. Numerous studies have contributed to the advancement of LNPR technologies by exploring different methods of image processing, character recognition, and system optimization to improve the accuracy and reliability of such systems.

Early LNPR systems were largely based on traditional image processing methods, which included grayscale conversion, edge detection, and morphological filtering. These methods were used to locate the license plate region and extract the characters for recognition. While effective in controlled environments, these approaches often failed under varying lighting conditions, complex backgrounds, and inconsistent plate formats.

To address these challenges, researchers began integrating Optical Character Recognition (OCR) algorithms into LNPR systems. OCR facilitated the automatic reading of text from segmented license plate regions. Template matching and feature extraction techniques improved the character recognition process, although performance still suffered when plates were damaged, dirty, or poorly lit.

III. METHODOLOGY

➢ *System Architecture*

The proposed system consists of six core modules:

- Camera Interface: Captures live video or still frames of passing vehicles.
- Image Processing Unit: Converts images to grayscale, applies filters, and extracts edges to identify license plate regions.
- Segmentation Engine: Isolates individual characters from the license plate.
- OCR Module: Extracts alphanumeric characters using the Tesseract OCR engine.
- Database Layer: Stores and retrieves vehicle records, including ownership and history.
- Challan Generator: Automatically issues fines based on violations detected and logs them in the database.

➢ *Tools and Technology Stack*

- Frontend: React.js
- Backend: Django REST Framework
- Database: PostgreSQL
- OCR Engine: Tesseract
- Computer Vision: OpenCV with Python

IV. SYSTEM DESIGN

➢ *Image Processing*

Captured images undergo grayscale transformation to minimize processing complexity...

➢ *Character Recognition*

The processed image is segmented into individual characters using contours...

➢ *Challan Generation*

A multi-step process follows character recognition:

- Plate number is matched with the vehicle registry.
- Violation conditions (e.g., signal jump, overspeeding) are verified.

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- If any rule is broken, a challan is automatically generated.
- Challan details are stored and accessible via a secured web portal for further action.

V. RESULTS AND ANALYSIS

➢ *Recognition Accuracy*

Tests conducted under controlled conditions yielded an average character recognition accuracy of 89–92%...

➢ *Performance*

On an average mid-tier machine, license plate recognition and challan generation took 2–3 seconds from image capture to database update...

➢ *Web Interface*

The web dashboard offers functionalities including user login, challan record search, filtering by violation type, and summary views...

VI. CONCLUSION

This research presents the development of a License Number Plate Recognition (LNPR) system designed to detect and recognize vehicle registration numbers using image processing and Optical Character Recognition (OCR) techniques. The proposed system effectively captures vehicle images, locates the license plate region, segments the characters, and recognizes them with high accuracy under controlled conditions. Through various preprocessing steps, including grayscale conversion, noise reduction, and edge detection, the system achieves reliable results in identifying license plates.

The successful implementation of this LNPR system demonstrates its potential in automating vehicle monitoring tasks such as traffic rule enforcement, toll collection, parking management, and access control. Furthermore, by tailoring the system for regional license plate variations, such as those commonly found in India, it shows strong adaptability to real-world scenarios.

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