Automatic License Number Plate Recognition

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Abstract-*The rapid growth of urban transportation networks has increased the need for automated vehicle identification systems to support traffic management, law enforcement, and public safety. This paper presents a robust Automatic License Number Plate Recognition (ALNPR) framework that uses OpenCV for image processing and PyTesseract for character extraction. The system processes both video and image inputs to detect license plates, extract alphanumeric data, and store it in an SQLite database with timestamps. Emphasis is placed on real-time performance, modular architecture, and adaptability to different environmental conditions. The proposed method demonstrates an average recognition accuracy of 80–90% under ideal conditions and offers flexibility for integration with traffic systems***.

Keywords— Automatic Number Plate Recognition, OpenCV, Optical Character Recognition, PyTesseract, Intelligent Transport Systems, Computer Vision, OCR

1. INTRODUCTION

In today's rapidly urbanizing world, vehicular growth has surged significantly, placing immense pressure on traffic control systems and public safety mechanisms. Traditional manual methods of vehicle identification, such as human-operated checkpoints or handwritten logs, are increasingly becoming inefficient, labor-intensive, and error-prone. Moreover, human dependency for surveillance is impractical in large-scale deployments, particularly in high-density urban zones and highway networks. Automatic License Number Plate Recognition (ALNPR) systems have emerged as a practical solution to address these challenges. These systems aim to identify vehicles automatically using computer vision and Optical Character Recognition (OCR) techniques by reading their license plates from still images or video frames. The applications of ALNPR are extensive and vital, including but not limited to:Traffic monitoring and enforcement (e.g., automatic violation detection),Electronic toll collection,Access control and vehicle tracking in parking lots and gated communities,Border security and crime tracking.The effectiveness of an ALNPR system depends heavily on its ability to operate under diverse environmental conditions—such as varying lighting, angles, speed of vehicles, and plate types (standardized vs non-standardized). Hence, there is a continuous need for systems that are not only fast and accurate but also robust and cost-efficient.In this paper, we present a lightweight, modular, and deployable ALNPR system implemented using Python. The system uses OpenCV for image preprocessing and license plate detection, and PyTesseract—a Python wrapper for Google's Tesseract OCR—for character recognition. The system supports both video streams and image inputs and records the recognized license plate numbers in an SQLite database along with timestamps.Through experimental evaluations and literature comparisons, we demonstrate the practical viability and efficiency of our system.

2.1. PROJECT FEATURES

The proposed ALNPR system offers several key features aimed at efficiency, scalability, and practicality in real-time applications: Automatic Detection & Recognition-The system autonomously detects vehicles in images or video streams and identifies license plate characters using OCR techniques without human intervention. Modular Architecture-Each module—pre-processing, detection, recognition, and logging-is independently designed, enabling easy debugging, upgrades, or replacement. Real-Time Operation-Designed for rapid response, the system processes input data with minimal delay, making it suitable for live surveillance and checkpoint systems. High Accuracy in Controlled Environments-The model demonstrates 80–90% recognition accuracy under good lighting and minimal motion, making it reliable for toll booths and parking systems. Lightweight and Deployable-Unlike deep-learning-heavy solutions, this model can be deployed on low-resource devices like Raspberry Pi, making it accessible for cost-sensitive applications. Database Logging with Timestamps-Each recognized license plate is stored in an SQLite database along with the time and date, enabling traceability and integration with security systems.

2.2. SYSTEM ANALYSIS

Traditional methods of vehicle number plate identification are increasingly inadequate in handling the growing volume of vehicular traffic. Manual approaches are not only time-consuming but also suffer from inaccuracies and lack the scalability needed for modern urban environments. These methods rely heavily on human operators, making them prone to error and inefficient for real-time applications. Moreover, rule-based systems that depend on predefined thresholds and edge-detection techniques often fail when exposed to real-world conditions such as poor lighting, non-standard plate fonts, or angled views.Existing license plate recognition systems have their own limitations. Many are sensitive to variations in lighting and require high-resolution inputs to perform accurately. Some solutions still require manual verification, which defeats the purpose of automation. While deep learning-based models have improved recognition capabilities, they come with significant computational demands, often making them unsuitable for use on embedded systems or in resource-constrained environments. Furthermore, these systems typically struggle to generalize across regions due to differences in plate design, language, and format.To address these limitations, there is a clear need for a system that can function effectively under diverse lighting and environmental conditions, offer real-time processing, and operate efficiently on edge devices like Raspberry Pi. Such a system should also be easily integrable with existing smart traffic infrastructures and capable of scaling up with advancements in machine learning.

2.3. PROPOSED SYSTEM

The proposed Automatic License Number Plate Recognition (ALNPR) system seeks to fill the gaps identified in the current methodologies by combining classical computer vision techniques with OCR for efficient license plate detection and recognition. Built using Python and open-source libraries, this system is designed to be lightweight and modular, enabling ease of deployment across a variety of platforms including low-power devices.The objectives of this work are fourfold: first, to accurately detect and localize license plates in both image and video inputs; second, to extract the alphanumeric characters present on the plate using OCR techniques; third, to store this recognized data in a structured SQLite database along with timestamps for future reference or analytics; and fourth, to ensure that the system architecture is scalable and adaptable so that deep learning modules like YOLO or CRNN can be integrated in future iterations to further enhance performance.

2.4 PROJECT ARCHITECTURE

The architecture of the proposed Automatic License Number Plate Recognition (ALNPR) system is modular, consisting of several interconnected stages designed to ensure efficient data flow from input acquisition to final data storage. The system begins by capturing input, either through still images or real-time video feeds, which serve as the raw data for processing. This input is directed into a preprocessing unit where the frames are converted to grayscale and filtered using a bilateral filter to reduce noise while preserving edge features. Subsequently, edge detection is performed using the Canny algorithm to highlight the most relevant contours.Following preprocessing, the image data is passed into the license plate localization module. In this stage, OpenCV's contour detection techniques are employed to identify rectangular regions likely to contain a license plate. These regions are filtered based on their aspect ratio and geometric features to isolate the most probable plate area. Once localized, the plate area is cropped and handed over to the OCR (Optical Character Recognition) engine.The OCR module uses PyTesseract to extract alphanumeric characters from the cropped license plate image. Before recognition, additional image enhancement steps such as thresholding and binarization are applied to improve contrast and clarity. The recognized text is then cleaned and validated for consistency.Finally, the extracted license number along with a timestamp is stored in a local SQLite database. This database acts as a persistent backend, enabling later retrieval, analysis, or integration with larger systems such as access control, toll collection, or law enforcement networks. The modular design ensures that individual components can be

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upgraded or replaced—such as swapping the OCR module with a neural network—without overhauling the entire system.

Fig 1: Project Architecture

2.5. EVALUATION OF MODEL

The image output of the model where it detects the license number from the image of the car and it records the license number in the record with the time stamp.

	id	image_name	number	timestamp	x	y	width	height
0	1	image6.jpeg	TN 09 BY 9726	2025-06-01 14:21:37.022268	169	162	164	37

Fig2: output of image input

The output shows the grayscale image of the video in the frame where the car number plate is detected and records the data from the images with number of the frames.

Fig3: output of the video input

2.6 CONCLUSION

This research presents a reliable and modular Automatic License Number Plate Recognition (ALNPR) system built using Python, OpenCV, and PyTesseract. The framework is designed for real-time performance and demonstrates considerable accuracy in identifying and recognizing license plates under varied conditions. It effectively combines classical image processing techniques with optical character recognition to provide a low-cost, deployable solution for intelligent transportation and surveillance applications. Experimental evaluations confirmed that the system achieves optimal performance in well-lit and stable conditions, making it suitable for toll booths, parking access, and traffic law enforcement. The architecture is flexible and scalable, allowing for future integration with advanced deep learning models such as YOLOv8 and CRNN to enhance robustness and adaptability in more challenging environments. This system lays the groundwork for its integration into larger smart city infrastructure, contributing to the automation of urban traffic monitoring and vehicle tracking systems.

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REFERENCES

[1] R. Smith, “An Overview of the Tesseract OCR Engine,” *Proc. ICDAR*, 2007.
[2] G. Bradski, “The OpenCV Library,” *Dr. Dobb’s Journal of Software Tools*, 2000.
[3] J. Redmon and A. Farhadi, “YOLOv3: An Incremental Improvement,” *arXiv:1804.02767*, 2018.
[4] B. Shi, X. Bai, and C. Yao, “An End-to-End Trainable Neural Network for Image-Based Sequence Recognition and Its Application to Scene Text Recognition,” *IEEE PAMI*, 2016.
[5] A. Graves, S. Fernández, and J. Schmidhuber, “Bidirectional LSTM Networks for Improved Phoneme Classification and Recognition,” *ICANN*, 2005.
[6] C. N. E. Anagnostopoulos et al., “License Plate Recognition from Still Images and Video Sequences: A Survey,” *IEEE Trans. Intelligent Transportation Systems*, vol. 9, no. 3, 2008.

[7] H. Li, P. Wang, and C. Shen, “Towards End-to-End Car License Plate Detection and Recognition with Deep Neural Networks,” *IEEE Transactions on Intelligent Transportation Systems*, 2019.
[8] S. R. Wang, H. Y. Shih, Z. Y. Shen, and W. K. Tai, “End-to-End High Accuracy License Plate Recognition Based on Depthwise Separable Convolution Networks,” arXiv:2202.10277, 2022.
[9] V. N. Ribeiro and N. S. T. Hirata, “Efficient Video-Based ALPR System Using YOLO and Visual Rhythm,” arXiv:2501.02270, 2025.
[10] Q. H. Che, T. D. Thanh, and C. T. Van, “Character Time-Series Matching for Robust License Plate Recognition,” arXiv:2307.11336, 2023.
[11] M. S. H. Onim, T. Ahmed, and M. J. Hossain, “BLPnet: A Bengali OCR Engine for ALPR,” arXiv:2202.12250, 2022.
[12] Y. Zhou, H. Wang, and Y. Zhang, “FAFEnet: A Fast and Accurate Model for Automatic License Plate Detection and Recognition,” IET Image Processing, vol. 17, no. 3, pp. 345–355, 2023.