

VEHICLE NUMBER PLATE DETECTION USING DEEP LEARNING

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ABSTRACT

Automatic Number Plate Recognition (ANPR) systems play a significant role in traffic monitoring, surveillance, and security applications. This paper presents a deep learning-based system for vehicle number plate detection using the YOLO model, integrated with Optical Character Recognition (OCR) for extracting alphanumeric information.

The system processes input images to detect vehicle number plates and generates bounding boxes with confidence scores. The detected regions are further processed using OCR to recognize the vehicle registration number. In addition, a database-driven verification module is implemented to compare the extracted number plate with stored records to identify unauthorized or suspicious vehicles.

The proposed system demonstrates effective performance in detecting and recognizing number plates under standard conditions, providing a reliable and scalable solution for real-world applications.

Keywords:

YOLO, OCR, ANPR, Vehicle Detection, Deep Learning

INTRODUCTION

The rapid growth in the number of vehicles has increased the demand for efficient traffic monitoring and security systems. Traditional methods of manually identifying vehicle number plates are time-consuming, labor-intensive, and prone to human error. This has led to the development of automated systems that can accurately detect and recognize vehicle registration numbers.

Automatic Number Plate Recognition (ANPR) systems use computer vision and machine learning techniques to identify number plates from images or video streams. With advancements in deep learning, object detection models such as YOLO (You Only Look Once) have significantly improved the speed and accuracy of detection tasks. These models enable real-time identification of objects, making them suitable for applications in traffic management and surveillance.

In addition to detection, extracting meaningful information from number plates is an essential step. Optical Character Recognition (OCR) is used to convert the detected number plate image into readable text. However, detection and recognition alone are not sufficient for practical applications. There is a need for systems that can verify vehicle information to enhance security and monitoring capabilities.

This paper presents an integrated system for automatic vehicle number plate detection and verification using YOLO and OCR. The system detects number plates from input images, extracts the alphanumeric characters, and compares them with a stored database to identify unauthorized or suspicious vehicles.

OBJECTIVES

The main objectives of the study are;

- To detect vehicle number plates using the YOLO model
- To extract alphanumeric characters using OCR
- To verify vehicle details using a database system
- To develop an automated and efficient ANPR system

METHODOLOGY**4.1 Dataset Preparation**

The dataset used for training the model is collected from multiple sources, including publicly available datasets from platforms such as Roboflow, Kaggle, and other open-source repositories. The dataset consists of vehicle images with annotated number plates under varying conditions such as different lighting, angles, and backgrounds.

The use of multiple datasets improves the robustness and generalization capability of the model.

4.2 Number Plate Detection Using YOLO

The YOLO (You Only Look Once) model is used for detecting number plates in images. YOLO is a real-time object detection algorithm that identifies objects and generates bounding boxes with confidence scores.

The model is trained using labeled datasets and is capable of detecting number plates efficiently in input images.

4.3 Optical Character Recognition (OCR)

After detection, the number plate region is cropped and passed to an OCR engine. Preprocessing techniques such as grayscale conversion and thresholding are applied to enhance image quality.

The OCR system extracts alphanumeric characters from the number plate, converting image data into readable text.

4.4 Database Verification Module

The extracted number plate text is compared with a predefined database containing vehicle records. This module helps in identifying unauthorized, stolen, or suspicious vehicles.

The verification process enhances the practical applicability of the system in real-world security and surveillance scenarios.

The proposed system follows a sequential pipeline consisting of detection, recognition, and verification stages.

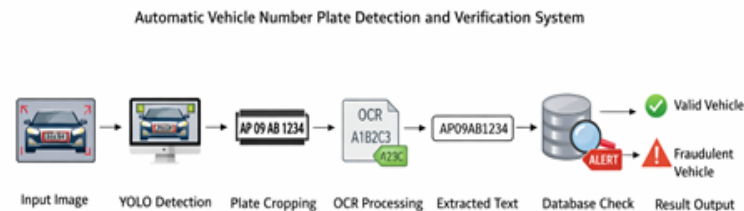


Fig 1: System Workflow

Workflow:

The workflow of the proposed model is illustrated in Fig 1.

1. Input image is provided
2. YOLO model detects number plate
3. Bounding box is generated
4. Detected region is cropped
5. OCR extracts text
6. Extracted text is compared with database
7. Result is displayed

This architecture ensures seamless integration of all modules for automated vehicle identification.

RESULTS AND DISCUSSION

The system successfully detects vehicle number plates and generates bounding boxes with confidence scores. OCR effectively extracts text from clearly visible number plates, and the database verification module correctly identifies matching records.



The inclusion of datasets from multiple sources improves the model's ability to detect number plates across different environments. The system performs reliably under standard conditions, although variations in lighting and viewing angles may influence accuracy.

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The system demonstrates consistent performance for standard test inputs and validates the effectiveness of the proposed approach.

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CONCLUSION

The proposed system presents an effective solution for automatic vehicle number plate detection and verification using deep learning and image processing techniques. By integrating YOLO for accurate number plate detection and OCR for text extraction, the system achieves reliable recognition of vehicle registration numbers.

Furthermore, the inclusion of a database verification module enhances the practical applicability of the system by enabling identification of valid and potentially fraudulent vehicles. The overall approach reduces manual effort, improves accuracy, and supports real-time monitoring in traffic management and security applications.

The system demonstrates satisfactory performance under varying conditions and can be effectively utilized in real-world scenarios such as surveillance, toll collection, and law enforcement.

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