

An Intelligent YOLOv8-Based Deep Learning Framework for Real-Time Vehicle Registration Plate Recognition, Automated Access Control, and Security Alert Management

Nagarjuna G R ¹, Nagendrababu N C ², Prasanna Kumar N ³

¹ Assistant Professor Department of CSE (AI & ML), SJC Institute of Technology, Karnataka, India

² Assistant Professor Department of CSE (AI & ML), SJC Institute of Technology, Karnataka, India

³ Department of CSE (AI & ML), SJC Institute of Technology, Karnataka, India

*Corresponding Author Email nag.ngr@gmail.com, nagendrababu.nc@gmail.com, prasanna.n5559@gmail.com

Abstract

Automated Vehicle Registration Plate Recognition (AVRPR) has become an essential technology for smart transportation systems, access control, and security surveillance applications. Traditional vehicle monitoring approaches often rely on manual verification processes that are time-consuming, error-prone, and inefficient in high-traffic environments. This paper presents a sophisticated deep learning framework that integrates YOLOv8 object detection and EasyOCR text recognition for real-time vehicle identification, automated access control, and security alert management. The proposed system records real-time video feeds from security cameras and performs vehicle detection using the YOLOv8 architecture. Detected license plate regions are processed through image enhancement techniques before being recognized using EasyOCR. The extracted vehicle registration numbers are validated against a whitelist database to determine authorization status. A Flask-based web dashboard provides continuous monitoring, while instant notifications are delivered through Telegram-based alert services whenever unauthorized vehicles are detected. Experimental evaluation demonstrates reliable detection performance, accurate license plate recognition, and real-time monitoring capabilities with processing speeds suitable for practical deployment. The proposed framework offers an efficient, scalable, and cost-effective solution for smart campuses, residential communities, industrial facilities, and transportation infrastructures requiring intelligent security management.

Keywords- Automatic Number Plate Recognition, YOLOv8, EasyOCR, Deep Learning, Computer Vision, Vehicle Detection, Optical Character Recognition, Real-Time Surveillance, Access Control, Security Alert Management, Intelligent Transportation Systems, Artificial Intelligence.

1. Introduction

The rapid growth of urban transportation systems and increasing security concerns have created a significant demand for intelligent vehicle monitoring solutions. Conventional vehicle access management systems primarily depend on human operators for vehicle verification and record maintenance, resulting in operational inefficiencies and delayed response times. Recent developments in artificial intelligence, deep learning, and computer vision have enabled the automation of vehicle identification processes through advanced image analysis techniques.

Automated Vehicle Registration Plate Recognition system have become an essential component of modern surveillance infrastructure. These systems are extensively utilized in various areas such as parking management, toll collection, smart campuses, industrial security, residential communities, and intelligent transportation systems. Despite substantial progress in ANPR technology, challenges remain in achieving reliable recognition under

varying illumination conditions, complex backgrounds, and real-time processing requirements.

This work proposes an integrated deep learning framework utilizing YOLOv8 and EasyOCR to provide accurate Detection of vehicles and recognition of license plates, authorization verification, and automated security alert generation within a unified platform.

2. Related Work

Early ANPR systems relied on Conventional image processing methods, including edge detection, morphological operations, and template matching, have shown satisfactory results in controlled settings. However, their effectiveness tends to diminish considerably when applied to real-world scenarios.

Machine learning-based approaches introduced Support Vector Machines (SVMs), Artificial Neural Networks (ANNs), and Random Forest classifiers enhance plate detection and character recognition.

However, these methods often required extensive feature engineering and lacked robustness.

Recent deep learning approaches employ Convolutional Neural Networks (CNNs), YOLO-based object detectors, and OCR frameworks to achieve superior performance. YOLOv8 has demonstrated remarkable accuracy and inference speed in object detection tasks, while EasyOCR provides flexible multilingual text recognition capabilities. Nevertheless, Numerous current systems concentrate solely on license plate recognition, lacking integration of authorization verification, access management, and real-time security alerts.

The suggested framework tackles these shortcomings. through a comprehensive surveillance and access control architecture.

3. Materials and Methods

The proposed system uses a CCTV or IP camera to capture live video of vehicles. The video frames undergo processing with OpenCV, while the YOLOv8 model is employed for vehicle detection. The area of the license plate is then extracted, followed by the identification of the vehicle number is read using EasyOCR. The recognized number is checked with a whitelist database to identify whether the vehicle's status is either authorized or unauthorized. All details regarding the vehicle are stored in a database and presented via a Flask web dashboard. If an unauthorized vehicle is detected, an instant alert is sent through Telegram for security monitoring.

3.1 System Architecture

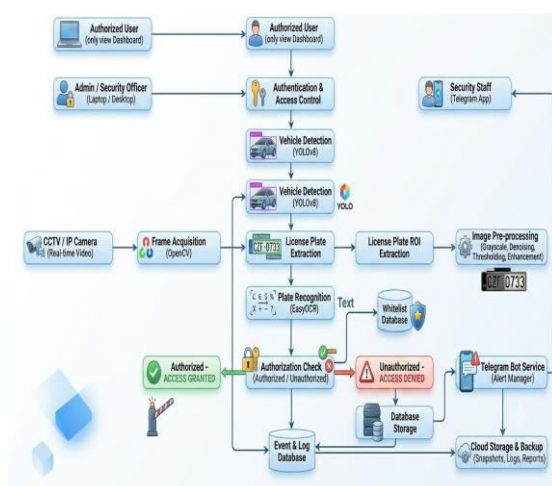


Figure 3.1: proposed framework

3.2 Video Acquisition

Live video feeds are sourced from CCTV or IP cameras. OpenCV is utilized to capture and preprocess video frames for further analysis.

3.3 Vehicle Detection Using YOLOv8

YOLOv8 is employed for real-time vehicle detection. The model identifies vehicles such as cars, motorcycles, buses, and trucks from incoming video frames. Its single-stage detection architecture enables high-speed inference while maintaining strong detection accuracy.

3.4 License Plate Recognition

Detected vehicle regions are cropped and subjected to image enhancement procedures including grayscale conversion, noise reduction, and contrast optimization. EasyOCR extracts the alphanumeric information from the license plate region.

3.5 Authorization Verification

Recognized vehicle numbers are compared with records stored in a secure whitelist database. Vehicles are classified as authorized or unauthorized based on matching results.

3.6 Alert Generation and Monitoring

Unauthorized vehicle entries trigger automatic Telegram notifications. Simultaneously, all vehicle information is stored in a SQL database and visualized through a Flask-based dashboard.

4. Results and Discussion

The suggested system underwent assessment using real-time video feeds and recorded surveillance datasets. Experimental observations indicate that YOLOv8 successfully detected vehicles under varying environmental conditions. EasyOCR achieved reliable character extraction after image preprocessing.

The integrated framework demonstrated the following capabilities:

- Real-time vehicle detection and recognition
- Automated authorization verification
- Continuous entry-exit tracking
- Instant unauthorized vehicle alerting
- Secure database storage and retrieval

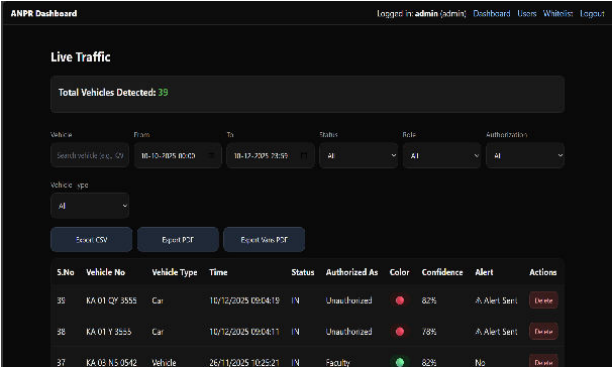


Figure 4.1: Live ANPR Monitoring Dashboard

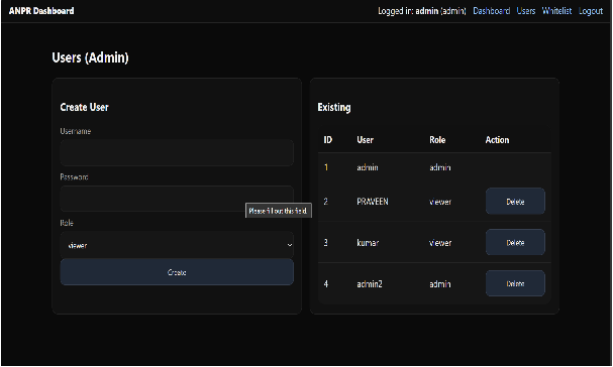


Figure 4.2: User Management Interface (Admin Panel)

The dashboard enabled administrators to monitor vehicle activity with minimal latency. Experimental testing achieved processing speeds ranging between 12 and 18 FPS on standard CPU hardware, demonstrating suitability for practical deployments.

Compared with conventional monitoring approaches, The suggested system greatly minimizes the need for manual effort. while improving operational efficiency and security responsiveness.

5. Conclusion

This paper presented an advanced deep learning framework designed for real-time vehicle number plate recognition, automated access control, and security alert management. The integration The combination of YOLOv8 for vehicle detection and EasyOCR for text recognition has facilitated precise and effective vehicle identification. The proposed system successfully combined surveillance, authorization verification, record management, and instant alert generation within a unified architecture. Experimental results confirmed the effectiveness of the framework for practical security applications. Future work will focus on edge-AI deployment, transformer-based OCR models, multi-camera integration, predictive vehicle analytics, and AI-agent-assisted security decision support systems.

References

[1] J. Redmon, A. Farhadi, "YOLO: Real-Time Object Detection," IEEE Conference on Computer Vision and Pattern Recognition, 2016.

[2] G. Jocher et al., "YOLOv8 Documentation and Implementation Guide," Ultralytics, 2024.

[3] J. M. S. V. Ravi Kumar, B. Sujatha, N. Leelavathi, "Automatic Vehicle Number Recognition System Using Machine Learning," International Journal of Computer Applications, 2020.

[4] T. P. Anish, P. M. Joe Prathap, "Automated Vehicle Number Recognition Scheme Using Neural Networks," International Journal of Engineering Research and Technology, 2015.

[5] A. Rosebrock, OpenCV with Python Blueprints, Packt Publishing, 2016.

[6] A. Grinberg, Flask Web Development, O'Reilly Media, 2018.

[7] R. Szeliski, Computer Vision: Algorithms and Applications, Springer, 2011.

[8] EasyOCR Documentation, GitHub Repository, JaidedAI, 2025.

[9] S. Du, M. Ibrahim, M. Shehata, and W. Badawy, "Automatic License Plate Recognition (ALPR): A State-of-the-Art Review," IEEE Transactions on Circuits and Systems for Video Technology, vol. 23, no. 2, pp. 311–325, 2013.

[10] H. Li, P. Wang, and C. Shen, "Toward End-to-End Car License Plate Detection and Recognition with Deep Neural Networks," IEEE Transactions on Intelligent Transportation Systems, vol. 20, no. 3, pp. 1126–1136, 2019.

[11] Z. Zheng, P. Wang, W. Liu, J. Li, R. Ye, and D. Ren, "Distance-IoU Loss: Faster and Better Learning for Bounding Box Regression," Proceedings of AAAI Conference on Artificial Intelligence, 2020.

[12] G. Jocher, A. Chaurasia, and J. Qiu, "YOLO by Ultralytics: YOLOv8 Documentation," Ultralytics, 2024.

[13] A. Bochkovskiy, C. Y. Wang, and H. Y. M. Liao, "YOLOv4: Optimal Speed and Accuracy of Object Detection," arXiv preprint arXiv:2004.10934, 2020.

[14] K. Simonyan and A. Zisserman, "Very Deep Convolutional Networks for Large-Scale Image Recognition," International Conference on Learning Representations (ICLR), 2015.

[15] A. Krizhevsky, I. Sutskever, and G. E. Hinton, "ImageNet Classification with Deep Convolutional Neural Networks," Advances in Neural Information Processing Systems, vol. 25, pp. 1097–1105, 2012.