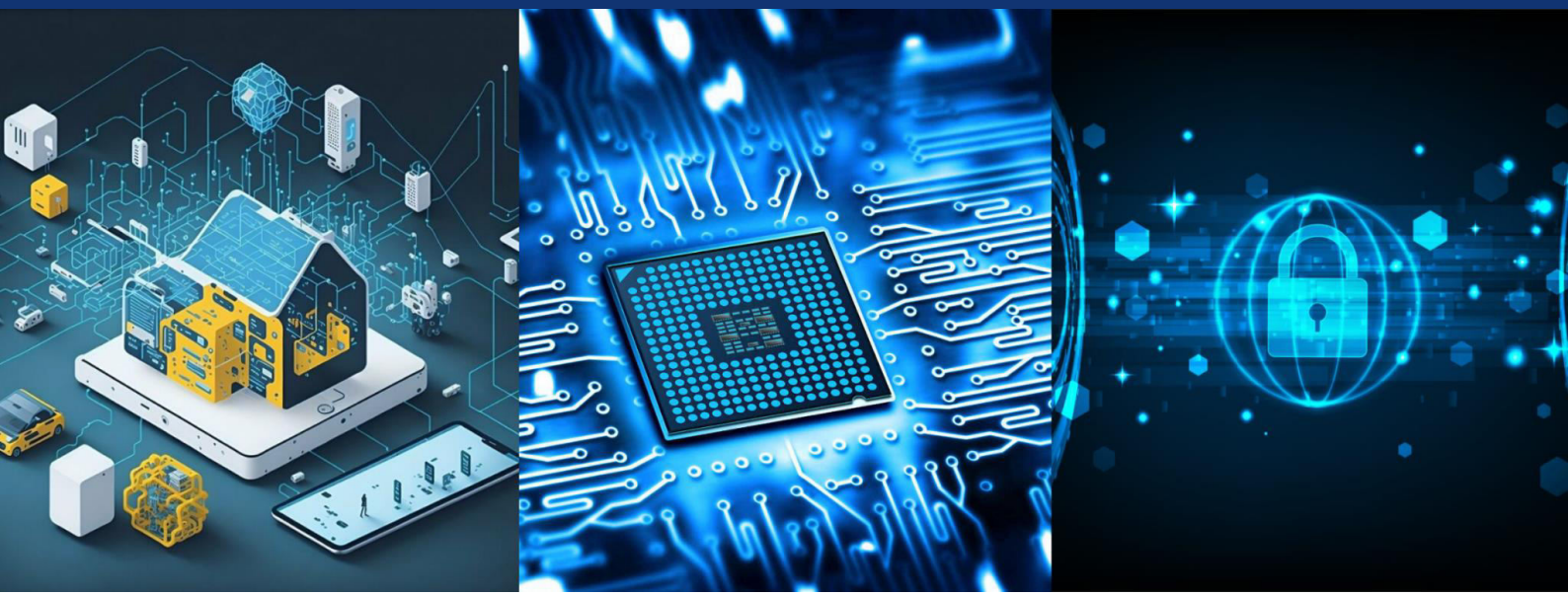
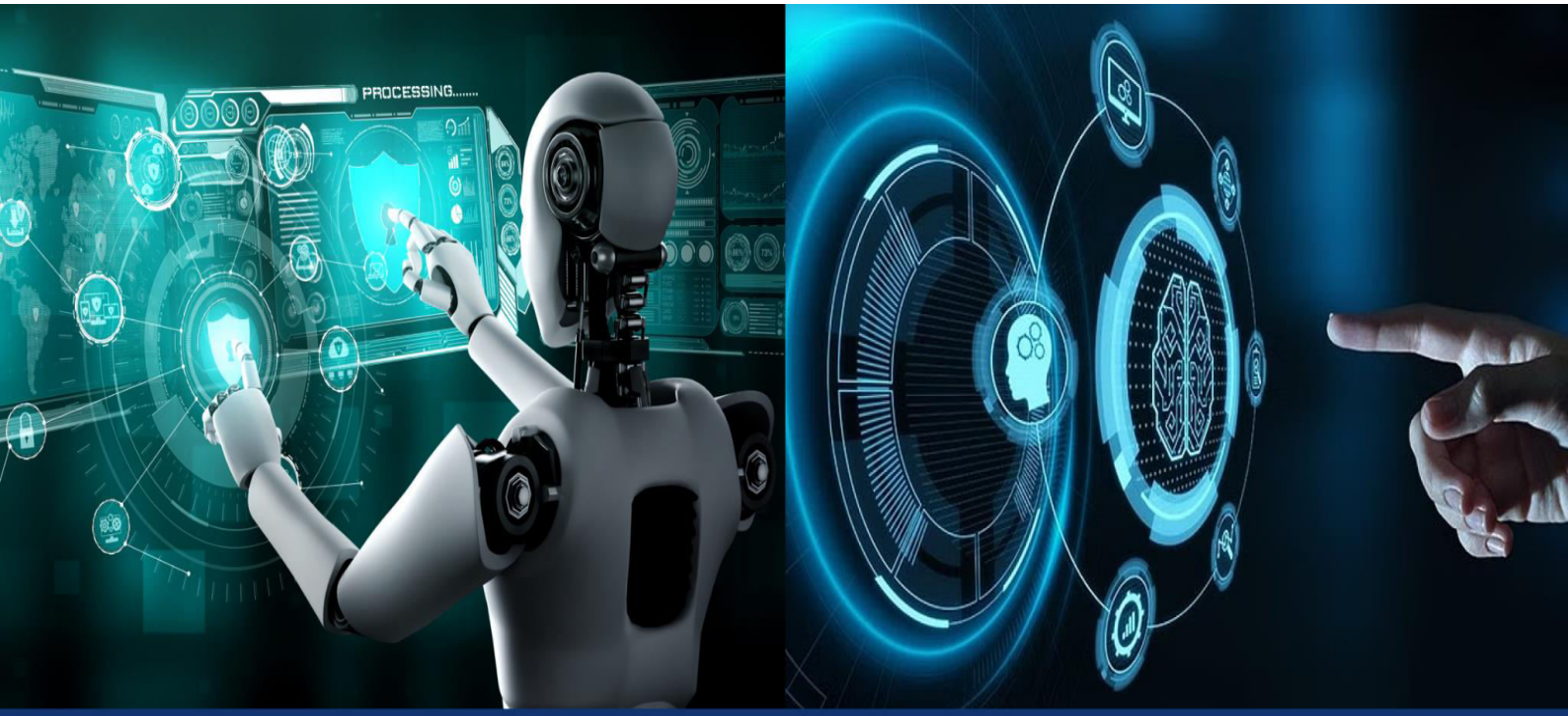
ISSN(O): 2320-9801
ISSN(P): 2320-9798



International Journal of Innovative Research in Computer and Communication Engineering

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 9.927 **Volume 14, Issue 5, May 2026**

© 2026 IJIRCCE | Volume 14, Issue 5, May 2026 DOI: 10.15680/IJIRCCE.2026.1405037

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 9.927| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Automatic Number Plate Recognition System for Real-Time Vehicle Entry and Exit Logging Using YOLO and EasyOCR

A. Rishvan[1], P. Vincent[1], S. Esakki Saran[1], R. Narmatha[2]

Department of Artificial Intelligence and Data Science, Christ the King Engineering College, Coimbatore, Tamil Nadu, India[1]

Assistant Professor, Department of Artificial Intelligence and Data Science, Christ the King Engineering College, Coimbatore, Tamil Nadu, India[2]

ABSTRACT: Vehicle monitoring and access control systems are critical for security, traffic control, and vehicle movement records in residential complexes, offices, campuses, commercial buildings, and restricted zones. As vehicle usage increases, manual entry and exit logging becomes error-prone, slow, and difficult to manage. This paper presents an Automatic Number Plate Recognition (ANPR) System designed to automate vehicle number plate detection, OCR-based text extraction, and digital entry/exit event logging. The system employs a YOLO-based object detection model for number plate localization and EasyOCR for character recognition. A Python Flask web application provides a responsive, browser-based user interface for uploading images or video inputs. Detected plates and event records are stored in an Excel database using OpenPyXL. Experimental evaluation across multiple test scenarios demonstrates a detection and recognition accuracy of 90–95% under standard conditions, with a custom-trained YOLO model achieving approximately 93.5% accuracy. Compared to manual logging, the ANPR system reduces average processing time from 5–10 seconds to under 2 seconds per vehicle and significantly reduces human error. The proposed system provides a scalable, intelligent, and efficient solution for smart vehicle surveillance and access control.

KEYWORDS: Automatic Number Plate Recognition (ANPR), YOLO, EasyOCR, Computer Vision, Deep Learning, Vehicle Monitoring, Access Control, Flask, OpenPyXL.

I. INTRODUCTION

Vehicle identification and access control have become essential components of modern smart infrastructure. Residential complexes, corporate campuses, educational institutions, industrial facilities, and commercial establishments all require reliable mechanisms for tracking vehicle entry and exit. Traditional manual logging — where security personnel note vehicle registration numbers in physical logbooks — is fundamentally limited by human fatigue, concurrent vehicle movement, and the sheer volume of records required in high-traffic scenarios.

Studies and practical observations confirm that manual systems frequently produce duplicate entries, illegible records, and delayed verification. These shortcomings reduce the effectiveness of security protocols and create data integrity challenges. The emergence of Artificial Intelligence (AI) and Computer Vision (CV) technologies has opened new opportunities for automating such processes. Modern deep learning systems can analyze visual data in real time, detect number plates with high precision, and extract alphanumeric characters using Optical Character Recognition (OCR), eliminating the bottlenecks associated with manual recording.

The Automatic Number Plate Recognition (ANPR) system developed in this work addresses these challenges by integrating YOLO-based object detection, EasyOCR-based character recognition, and automatic entry/exit classification within a web-based application. The system aims to provide consistent, fast, and reliable vehicle monitoring without dependence on human observation.

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 9.927| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

1.1 Problem Statement

The core limitations of existing manual and semi-automated vehicle logging practices motivate this work:

- Manual data entry is slow, error-prone, and unsuitable for high-traffic environments.
- Inefficient monitoring leads to queuing delays at entry and exit points.
- Traditional systems lack real-time automation and continuous monitoring support.

1.2 Objectives

- Design an automated system for number plate detection from images and video using Computer Vision.
- Accurately extract alphanumeric plate text using EasyOCR.
- Classify vehicle movement as Entry or Exit and record events automatically.
- Provide a responsive web-based interface for upload, processing, and result visualization.

II. LITERATURE REVIEW

Automatic Number Plate Recognition (ANPR) has been an active area of research since the early 2000s, evolving from classical image processing approaches to sophisticated deep learning architectures. This section surveys key contributions and contextualizes the proposed system within the broader state of the art.

2.1 Classical and Image-Processing Approaches

Du et al. (2013) provided a comprehensive review of ALPR systems, categorizing methods by plate detection, character segmentation, and recognition stages. Early approaches relied on Sobel or Canny edge detection, morphological operations, and template matching for character recognition. While effective under controlled conditions, these methods degraded significantly with lighting variation, plate tilt, and background clutter. Anagnostopoulos et al. (2006) proposed a two-stage algorithm combining vertical edge detection with neural network-based character recognition, achieving competitive accuracy on constrained datasets.

2.2 Deep Learning and YOLO-Based Methods

The introduction of the YOLO (You Only Look Once) framework by Redmon et al. (2016) marked a turning point for real-time object detection. By framing detection as a single regression problem over grid cells, YOLO achieves both high speed and competitive accuracy, making it well-suited to vehicle monitoring applications. Shashidhar et al. (2021) demonstrated the application of YOLOv3 in license plate detection combined with OCR, reporting strong performance in multi-vehicle scenarios. Chen (2019) proposed a sliding-window variant of Darknet-YOLO specifically optimized for license plate regions, further improving localization accuracy.

Recent work has extended these foundations. Satya et al. (2025) proposed an optimized YOLOv8 pipeline for challenging ANPR conditions, while Buleu et al. (2025) combined YOLOv12 with PaddleOCR for enhanced recognition accuracy. Menezes et al. (2025) introduced aspect-ratio-based plate splitting with TrOCR, addressing the challenge of elongated and non-standard plates.

2.3 OCR Integration and Character Recognition

OCR-based character extraction remains a key challenge in ANPR. Xie et al. (2018) proposed a multi-directional CNN-based approach for plates with non-standard orientations, reporting improved accuracy on rotated samples. Abdullah et al. (2018) developed a three-stage YOLO network specifically for Bangla license plate recognition, demonstrating adaptability of detection architectures to diverse script systems. EasyOCR, the OCR engine used in this work, provides pre-trained models for multiple scripts and languages, making it a practical and accurate choice for Indian number plate formats.

2.4 Research Gap and Motivation

While existing systems demonstrate strong performance in isolated laboratory conditions or with specialized hardware, there is limited focus on lightweight, web-deployable ANPR solutions suitable for small-to-medium scale deployments such as campus parking, office complexes, and residential gate management. Most academic implementations also rely on cloud databases or specialized backend infrastructure. This work addresses the gap by providing an accessible, browser-based system with Excel-based storage that requires no specialized infrastructure, while maintaining competitive recognition accuracy through custom YOLO model training.

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 9.927| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Table 1: Comparison of Related ANPR Approaches

Author / Year	Technique	Application	Accuracy	Deployment
Shashidhar et al. (2021)	YOLOv3 + OCR	Multi-vehicle detection	~90%	Offline
Chen (2019)	Darknet-YOLO Sliding Window	License plate localization	~91%	Desktop
Satya et al. (2025)	Optimized YOLOv8	Challenging conditions	~94%	Cloud
Menezes et al. (2025)	YOLOv8 + TrOCR	Non-standard plates	~95%	API
Proposed System	Custom YOLO + EasyOCR	Entry/Exit logging, Web UI	~93.5%	Web App

III. SYSTEM DESIGN AND ARCHITECTURE

3.1 Overall System Architecture

The proposed ANPR system is organized as a modular, five-stage processing pipeline. Each stage is independently designed to ensure maintainability and future extensibility. The pipeline is exposed through a Python Flask web application, allowing users to interact with the system through a standard web browser without additional software installation.

The pipeline stages are: (1) Input Acquisition, (2) Image Preprocessing, (3) Number Plate Detection via YOLO, (4) OCR-based Character Recognition via EasyOCR, and (5) Entry/Exit Decision and Data Logging. The system additionally maintains a persistent Excel database for structured record storage and retrieval.

3.2 Hardware Requirements

Component	Specification
Processor	Intel Core i5 / AMD Ryzen 5 or higher
RAM	Minimum 8 GB (16 GB recommended for real-time video)
Storage	Minimum 256 GB SSD
GPU (Optional)	NVIDIA CUDA-compatible GPU for accelerated inference
Camera / Input	USB or IP camera, CCTV, or image/video file upload

3.3 Software Requirements

Software / Library	Purpose
Python 3.9+	Core programming language
OpenCV	Image preprocessing and frame extraction
YOLO (custom-trained)	Real-time number plate detection
EasyOCR	Alphanumeric character extraction
Flask	Web application backend
OpenPyXL	Excel-based vehicle record management

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 9.927| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Software / Library	Purpose
NumPy / Pandas	Data processing and manipulation

3.4 System Modules

Module 1 – User Interface and Input System: A lightweight HTML/CSS/JavaScript frontend served via Flask provides upload functionality for images and video files. The interface displays processed results in real time, including detected plate text, event type, and confidence score.

Module 2 – Number Plate Detection: A custom-trained YOLO model processes each input frame. The model outputs bounding box coordinates for detected plate regions. The detected region is cropped and forwarded to the OCR module. YOLO was chosen for its single-pass inference architecture, enabling near real-time throughput.

Module 3 – OCR and Text Cleaning: EasyOCR processes the cropped plate region and returns candidate character sequences. Post-processing normalizes case, removes invalid characters, and validates against expected Indian registration number formats (e.g., TN01AB1234).

Module 4 – Entry/Exit Decision Logic: The recognized plate is queried against existing Excel records. If no prior entry exists, the event is classified as Entry; if a prior entry exists, the event is classified as Exit. The alternating logic prevents duplicate classification without requiring a separate state machine.

Module 5 – Data Logging: All events are written to an Excel workbook with columns for plate number, event type, timestamp, confidence score, and input source. OpenPyXL enables structured, format-preserving writes without database overhead.

IV. IMPLEMENTATION

4.1 Technology Stack

The system is implemented entirely in Python. Flask handles HTTP routing, file upload management, and result rendering. OpenCV performs frame extraction from video inputs and preprocessing operations including resizing to 640×640 (YOLO input resolution), grayscale conversion, Gaussian blur for noise reduction, and histogram equalization for contrast enhancement under low-light conditions. The YOLO model was fine-tuned on a dataset of Indian vehicle images to improve detection accuracy for regional plate formats and fonts.

4.2 Plate Detection and OCR Algorithm

For each input frame, the following steps are executed sequentially:

- Resize input frame to 640×640 pixels and normalize pixel values.
- Pass the normalized frame through the YOLO model to obtain bounding box predictions with confidence scores. Predictions below a confidence threshold of 0.5 are discarded.
- Crop the highest-confidence plate region from the original frame.
- Apply additional preprocessing (grayscale, adaptive thresholding, morphological closing) to the cropped region to enhance character visibility.
- Pass the preprocessed crop to EasyOCR. Extract the highest-scoring text result.
- Apply regular expression cleaning to normalize the plate string (uppercase, remove non-alphanumeric characters, enforce length constraints).
- Query the Excel log for prior occurrences of the cleaned plate string to determine Entry or Exit classification.
- Write the event record and return the result to the frontend for display.

4.3 User Interface Design

The web interface consists of two primary views: an upload dashboard and a results page. The upload dashboard accepts drag-and-drop or file-browse input for JPEG, PNG, MP4, and AVI formats. Upon submission, the Flask backend processes the input asynchronously and redirects to the results view. The results view presents the detected plate, event classification, timestamp, and a confidence indicator in a tabular layout. The interface is responsive and compatible with Chrome and Firefox on desktop and mobile devices.

© 2026 IJIRCCE | Volume 14, Issue 5, May 2026 DOI: 10.15680/IJIRCCE.2026.1405037

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 9.927| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

V. RESULTS AND DISCUSSION

5.1 System Output

The system was evaluated on a test set comprising vehicle images and video clips captured under varied conditions including clear daylight, low-light evening, and motion-blurred sequences. Table 2 summarizes representative test results.

Table 2: ANPR System Output Summary

S.No	Test Scenario	Detected Plate	Event	Timestamp	Confidence
1	First vehicle detection	TN01AB1234	Entry	10:05 AM	95%
2	Same vehicle re-detected	TN01AB1234	Exit	10:20 AM	96%
3	New vehicle detection	TN09XY5678	Entry	11:10 AM	96%
4	Low-light condition	TN07CD4321	Entry	11:45 AM	88%
5	Blurred image input	TN05EF6789	Entry	12:15 PM	82%

5.2 Performance Metrics

Table 3: System Performance Comparison – ANPR vs. Manual Logging

Metric	ANPR System	Manual Logging
Detection Accuracy	90–95%	70–80%
Average Processing Time	< 2 seconds	5–10 seconds
OCR Recognition Accuracy	~92%	N/A
Data Logging	Instant (Excel)	Manual entry
Error Rate	Low	High (human error)
Availability	24/7 consistent	Depends on staff

Table 4: Model Accuracy Comparison

S.No	Method / Model	Accuracy (%)
1	OpenCV-Based Detection (Classical)	82.0%
2	Pre-trained YOLO Model	90.0%
3	Custom-Trained YOLO + EasyOCR (Proposed)	93.5%

5.3 Discussion

The results confirm that the proposed ANPR system achieves reliable plate detection and recognition across diverse test conditions. The custom-trained YOLO model outperforms both classical OpenCV methods and the pre-trained YOLO baseline, validating the importance of domain-specific training data. EasyOCR provides robust character extraction for standard Indian plate formats, although accuracy drops for severely blurred or partially occluded plates — a known challenge in the ANPR literature.

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 9.927| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

VI. CONCLUSION

This paper presented an Automatic Number Plate Recognition (ANPR) system designed for automated vehicle entry and exit logging. The system integrates a custom-trained YOLO object detection model, EasyOCR-based character recognition, and a Python Flask web application to deliver a complete, browser-accessible vehicle monitoring solution. Key contributions include: (1) a custom YOLO training pipeline adapted for Indian number plate formats, (2) an automatic Entry/Exit classification mechanism based on historical records, (3) a lightweight Excel-based logging system accessible without database infrastructure, and (4) an end-to-end web interface enabling non-technical deployment.

VII. FUTURE WORK

Several directions are identified for future development of the proposed system:

- Advanced deep learning models: Integration of YOLOv8, YOLOv10, or transformer-based detection architectures to further improve accuracy and inference speed.
- Real-time CCTV integration: Direct connection to live IP camera feeds or RTSP streams for continuous 24/7 monitoring.
- Cloud database migration: Replacing Excel storage with MongoDB, Firebase, or PostgreSQL for scalable, concurrent, multi-site deployments.
- Mobile application: Android and iOS interfaces for remote vehicle log monitoring and push-alert delivery.
- Multi-lane and multi-plate detection: Parallel processing pipelines for simultaneous tracking of multiple vehicles at high-traffic entry points.
- Access control integration: Coupling recognized plate data with automated gate control systems (servo/motor-driven barriers) for touchless physical access management.
- Expanded dataset coverage: Training on plates from all Indian states and union territories, as well as international formats, to broaden applicability.

REFERENCES

[1] Du, S., Ibrahim, M., Shehata, M. and Badawy, W. (2013). "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.
[2] Redmon, J., Divvala, S., Girshick, R. and Farhadi, A. (2016). "You Only Look Once: Unified, Real-Time Object Detection," IEEE CVPR, pp. 779–788.
[3] Anagnostopoulos, C.N.E. et al. (2006). "A License Plate-Recognition Algorithm for Intelligent Transportation System Applications," IEEE Transactions on Intelligent Transportation Systems, Vol. 7, No. 3, pp. 377–392.
[4] Shashidhar, R. et al. (2021). "Vehicle Number Plate Detection and Recognition using YOLO-V3 and OCR Method," IEEE ICMNWC, pp. 1–5.
[5] Chen, R.C. (2019). "Automatic License Plate Recognition via Sliding-Window Darknet-YOLO Deep Learning," Image and Vision Computing, Vol. 87, pp. 47–56.
[6] Satya, B. et al. (2025). "Optimized YOLOv8 for Automatic License Plate Recognition under Challenging Conditions," Engineering, Technology & Applied Science Research.
[7] Buleu, B., Robu, R. and Filip, I. (2025). "A Deep Learning-Based System for Automatic License Plate Recognition Using YOLOv12 and PaddleOCR," Applied Sciences, Vol. 15, No. 14.
[8] Menezes, D. et al. (2025). "Robust ANPR System Using YOLOv8 and TrOCR with Aspect-Ratio-Based Splitting and Post-Processing," IJRASET.
[9] Xie, L. et al. (2018). "A New CNN-Based Method for Multi-Directional Car License Plate Detection," IEEE Transactions on Intelligent Transportation Systems, Vol. 19, No. 2, pp. 507–517.
[10] Silva, S.M. and Jung, C.R. (2018). "License Plate Detection and Recognition in Unconstrained Scenarios," ECCV, pp. 593–609.
[11] Wang, W. and Tu, J. (2020). "Research on License Plate Recognition Algorithms Based on Deep Learning in Complex Environment," IEEE Access, Vol. 8, pp. 91661–91675.

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 9.927| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

[12] Hasin, N. et al. (2026). "A Robust Deep Learning Framework for Bangla License Plate Recognition Using YOLO and Vision-Language OCR," arXiv preprint.

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

INNO SPACE SJIF Scientific Journal Impact Factor

doi cross ref

निस्केयर NISCAIR

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

9940 572 462 6381 907 438 ijircce@gmail.com

www.ijircce.com

Scan to save the contact details