



INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Safe Campus Guard Smart Number Plate Recognition And Log Management For Enhance Campus Security

Prof. S. B. Raghuvanshi^{1st}
Computer Engineering
R. C. Patel Institute of Technology
Shirpur, India

Abhishek Karanke^{2nd}
Computer Engineering
R. C. Patel Institute of Technology,
Shirpur, India

Mahanta Tawade^{3rd}
Computer Engineering
R. C. Patel Institute of Technology
Shirpur, India

Jayesh Desale^{4th}
Computer Engineering
R. C. Patel Institute of Technology
Shirpur, India

Vinod Wagh^{5th}
Computer Engineering
R. C. Patel Institute of Technology
Shirpur, India

Abstract: This paper presents a novel security solution tailored for college campuses by integrating smart number plate recognition with a comprehensive log management system. The system is designed to automatically monitor vehicles entering and leaving campus, ensuring that only authorized vehicles are granted access. By capturing and maintaining detailed records of vehicle movements, it supports security personnel in quickly identifying and responding to any unusual activity. Our approach not only reduces the need for manual monitoring but also enhances the overall efficiency of campus security measures. Through real-world testing and analysis, the study demonstrates that leveraging modern technology can significantly improve the safety and management of campus environments.

Keywords—Smart Number Plate Recognition, Campus Security, Log Management, Vehicle Monitoring, Access Control, Automated Surveillance, Technology-Driven Security

INTRODUCTION

Parking plays a vital role in any transportation system, serving as the primary means for accommodating vehicles at various destinations. In everyday life, most vehicles spend a significant portion of the day parked, making the availability of convenient and secure parking spaces a key factor in urban mobility and accessibility. The ease with which drivers can find a safe, nearby spot directly influences their overall travel experience and the efficiency of reaching their destinations.

Parallel to the importance of parking, technological advancements have revolutionized how we monitor and manage vehicle movement. A notable development in this area is Automatic Number Plate Recognition (ANPR), a system that

originated in the mid-1970s to assist law enforcement agencies in tracking vehicles. ANPR employs a combination of cameras, image processing techniques, and optical character recognition (OCR) to capture and digitize license plate information. This digitized data can then be quickly compared against databases, allowing for rapid identification of vehicles involved in unlawful activities or requiring further investigation. Over time, ANPR has become a critical tool not only in crime prevention and border security but also in enhancing overall traffic management and parking control systems.

MOTIVATION

In today's fast-paced urban landscape, the sheer volume of vehicles on the road poses significant challenges for law enforcement agencies tasked with maintaining public safety. Traditional methods of manually checking license plates against databases for stolen vehicles, traffic violations, or other security concerns are increasingly inefficient and prone to human error. This inefficiency not only delays the identification of vehicles involved in criminal activities but also diverts valuable officer time away from other critical responsibilities.

ANPR technology emerges as a timely and effective solution to these challenges. By harnessing advanced image processing and OCR techniques, ANPR systems can automatically capture and digitize license plate information, enabling real-time comparisons with extensive databases. This rapid identification process is essential for law enforcement to promptly detect vehicles that may be involved in crimes, pose security threats, or violate parking regulations. The ability to swiftly recognize such vehicles translates into quicker response times and, ultimately, a more secure community.

Moreover, the adoption of ANPR systems represents a

significant shift towards modernizing policing methods. As urban areas continue to expand and the number of vehicles grows, the manual monitoring methods that once sufficed are now increasingly inadequate. The integration of ANPR not only streamlines the operational workflow of law enforcement officers but also enhances the overall accuracy of vehicle tracking. With automated systems handling routine surveillance tasks, officers can concentrate on more complex and nuanced aspects of their work, thereby boosting overall operational efficiency.

The motivation for this research is driven by the urgent need to improve public safety through technological innovation. In summary, this research is motivated by the pressing need to enhance the capabilities of law enforcement agencies through the integration of ANPR technology. By automating the tedious and time-consuming process of vehicle identification, we enhance the efficiency and accuracy of law enforcement operations while also contributing to the creation of safer and more secure urban environments. This study aims to provide a comprehensive examination of ANPR systems, highlighting their potential to transform vehicle monitoring and strengthen overall public safety.

PROBLEM STATEMENT

While ANPR systems have significantly improved the speed and efficiency of vehicle identification for law enforcement, they are not without challenges. These systems are designed to automatically capture images of vehicle license plates, decode them using optical character recognition, and quickly match the results against databases of vehicles of interest. Despite these capabilities, the process still relies heavily on human oversight. Officers must manually verify that the system has accurately read the license plate, confirm that the plate originates from the correct jurisdiction, and ensure that the alert is relevant and up-to-date.

This blend of automation and human validation can lead to delays and inconsistencies in real-time decision-making. External factors such as poor image quality or varying environmental conditions further complicate the reliability of the automated readings. As a result, there is an urgent need to improve the precision and efficiency of ANPR systems. Addressing these issues will not only reduce the burden on law enforcement officers but also enhance public safety by ensuring that critical alerts are both accurate and timely.

OBJECTIVES

The primary goals include:

- **Strengthen Campus Security:** Develop and implement a state-of-the-art number plate recognition system to monitor vehicle access on campus. The goal is to ensure that only vehicles with proper authorization can enter, thereby creating a safer and more controlled environment.
- **Automate Log Management:** Create an automated platform that records and manages detailed logs of all vehicle entries and exits. This system will allow for real-time tracking and provide an easy way to review historical data, which is essential for effective security audits and incident investigations.
- **Accelerate Incident Response:** Enhance the system's ability to quickly identify

suspicious or unauthorized vehicles. By streamlining this process, campus security teams can respond faster to potential threats or incidents, reducing risks and ensuring prompt action.

- **Increase Operational Efficiency:** Minimize the need for manual vehicle checks by automating the monitoring process. This reduction in human error not only saves time but also allows security personnel to focus on more critical tasks, ultimately improving overall efficiency.
- **Utilize Data for Strategic Insights:** Leverage the data collected from vehicle logs to generate actionable insights. By analyzing these patterns, campus security can make informed decisions and develop strategies for long-term security planning and resource allocation.
- **Seamless Integration with Existing Systems:** Ensure that the new number plate recognition system integrates smoothly with current campus security infrastructure, such as surveillance cameras and access control systems. This integration is crucial for maintaining a unified and effective security network.
- **Design for Scalability and Adaptability:** Build the system with future growth in mind. The design should be flexible and scalable, allowing for easy upgrades and modifications to meet evolving campus security requirements and technological advancements.

By meeting these objectives, this project is poised to significantly elevate campus security, offering a safer, more dependable, and more streamlined approach to monitoring vehicle access. The initiative seeks to transform traditional security methods by integrating advanced number plate recognition and automated log management systems, thereby reducing manual oversight and accelerating response times. Ultimately, this innovative approach will better safeguard the campus by swiftly identifying unauthorized or suspicious vehicles and addressing the dynamic security challenges of modern educational environments.

SCOPE

The objectives of this study are to design, develop, and implement an intelligent number plate recognition and log management system that enhances campus security by improving vehicle monitoring, access control, and incident response efficiency. The primary goals include :

- **Vehicle Monitoring and Recognition:** This research involves the deployment of advanced Number Plate Recognition (NPR) cameras at key entry and exit points to automatically capture and verify vehicle details. Real-time data processing will be implemented to ensure that only authorized vehicles gain access to campus premises.
- **Centralized Log Management System:** A robust system will be developed to store, manage, and analyze vehicle entry and exit data securely. The system will include advanced analytics to detect movement

patterns and identify anomalies, ensuring accurate and easily retrievable records for future reference.

- **Real-time Alerts and Security Enhancements:** The project will integrate automated alert mechanisms to notify security personnel about unauthorized or suspicious vehicle activities. AI-based threat detection will be employed to enhance response times and efficiency, allowing for immediate flagging and intervention in security concerns.
- **Seamless Integration with Existing Security Infrastructure:** The NPR system will be linked with current campus security systems, such as surveillance cameras and access control mechanisms, to establish a unified security network. This integration will enable centralized monitoring and improve situational awareness for security teams.
- **User Access and Reporting System:** Secure access will be provided to authorized personnel, allowing them to view, analyze, and manage vehicle logs. The system will generate detailed reports for monitoring vehicle patterns, auditing security effectiveness, and identifying potential risks. Additionally, a customizable dashboard will enable real-time data visualization and monitoring.
- **Scalability and Future Expansion:** The NPR system will be designed for scalability, allowing for future expansion to additional campus entry points. The architecture will be adaptable to cover various campus areas and integrate with emerging smart city infrastructure, ensuring long-term security improvements without major system overhauls.
- **Data Privacy and Compliance with Regulations:** To protect personal data, strict adherence to data privacy laws and campus security policies will be ensured. Encryption, access controls, and regular compliance checks will be implemented to maintain ethical and legal use of the system.

LITERATURE REVIEW

Various researchers have contributed their work for Safe Campus Guard Smart Number Plate Recognition and Log Management to Enhance Campus Security. The researchers have proposed novel techniques with suitable implementations. Now, we concentrate on a few researchers' works, as given below.

Review of Existing Systems:

"License Plate Detection and Recognition in Unconstrained Scenarios". - by Minghui Liao et al. (2017): In their 2017 paper, Minghui Liao and colleagues introduce a deep learning approach designed to detect and read license plates even under challenging, real-world conditions. Their method first uses a Faster R-CNN model to locate the license plates in images and then employs a convolutional neural network to interpret the characters on those plates. Their findings show that this combined strategy is highly effective at managing differences in plate designs and cluttered backgrounds, making it a robust solution for various unconstrained scenarios.

"Vehicle License Plate Recognition Using Deep Learning Techniques: A Comprehensive Survey" - by

Ahmad Al-Dahoud et al. (2020): This survey reviews a variety of deep learning methods used for vehicle license plate recognition. It walks through the key steps involved in the process—identifying the plate, breaking it down into individual characters, and then recognizing those characters. The review also highlights both the benefits and drawbacks of the different deep-learning models and datasets that researchers have used in this field.

"End-to-End License Plate Detection and Recognition with Deep Learning" - by Zhenbo Yu et al. (2019) : The authors introduce an all-in-one ANPR system that relies on a single deep neural network. Their method uses a customized version of the YOLO (You Only Look Once) model to both locate and read license plates in one go. Tests show that this streamlined approach performs just as well as, if not better than, the traditional multi-step methods.

Table 1: Review of Research Papers on Safe Campus Guard Smart Number Plate Recognition and Log Management for Enhance Campus Security



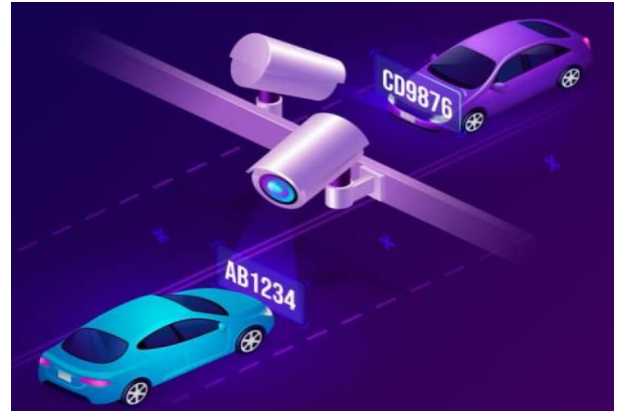
Sr. No.	Author	Method	Advantages
1	Minghui Liao et al. (2017) [1]	A deep learning method that leverages Faster R-CNN for plate detection and CNN for character recognition in challenging conditions.	Handles varied plate designs and backgrounds for reliable detection. for a couple of seconds Robustly detects plates amid varied designs and cluttered backgrounds.
2	Ahmad Al-Dahod et al. (2020) [2]	A survey of deep learning methods for ANPR, covering detection, segmentation, and recognition.	Compares pros and cons of various architectures and datasets.
3	Zhenbo Yu et al. (2019) [3]	An end-to-end ANPR system using a modified YOLO for detection and recognition.	Matches traditional methods while simplifying recognition.



Limitations of Existing Systems:

Problems in "License Plate Detection and Recognition in Unconstrained Scenarios". - by Minghui Liao et al. (2017):

Additionally, variations in lighting conditions, extreme weather, and motion blur may still impact detection accuracy. The model's performance may also be influenced by differences in license plate formats across regions, requiring retraining on diverse datasets to maintain accuracy. Furthermore, integrating this system into large-scale surveillance networks could pose challenges in terms of storage and processing power, limiting its scalability in resource-constrained environments.



Problems in "Vehicle License Plate Recognition Using Deep Learning Techniques: A Comprehensive Survey" - by Ahmad Al-Dahoud et al. (2020):

The survey also highlights various datasets used in ANPR research but does not address challenges related to data availability, annotation quality, or biases that may affect model performance. Furthermore, while the paper discusses the advantages and limitations of deep learning architectures, it does not explore the computational requirements or scalability issues that may arise when deploying these models in large-scale, real-time applications.

Problems in "End-to-End License Plate Detection and Recognition with Deep Learning" - by Zhenbo Yu et al. (2019) :

Signal degradation in wireless communication can hinder the robot's data transmission and reception reliability. The integration of numerous sensors and modules raises complexity and potential failure points. Utilizing the Raspberry Pi also increases the system's complexity and cost, which may be prohibitive for some applications.

Implementation

The implementation of the Safe Campus Guard system involves multiple stages, including hardware setup, software development, database management, and integration with security infrastructure. The system is designed to capture vehicle license plate images, process them using OCR, and store relevant data for security monitoring. This section provides a detailed breakdown of the implementation process.

1. System Requirements

• Hardware

The system requires high-resolution cameras with at least 1080p resolution to capture clear images of vehicle number plates. Infrared (IR) cameras are used for night-time recognition, ensuring the system functions effectively in low-light conditions. Wide-angle lenses help in capturing number plates from various angles to improve detection accuracy. The processing unit consists of a high-performance server with an Intel Core i7 processor, 8GB RAM, and a 256GB SSD for fast data storage and retrieval. Additionally, an optional NVIDIA GPU can be integrated for accelerated deep learning tasks.

A stable network connection is essential for seamless communication between cameras, servers, and security

Requirements

Fig. 1 : Architecture of the Proposed System

monitoring stations. High-speed Wi-Fi or Ethernet ensures real-time data transmission, while a network switch or router facilitates device connectivity. Security enhancements such as automated barrier gates and an alarm system can be integrated to restrict unauthorized access.

• Software

The backend of the system is developed using Python, utilizing frameworks like Flask or Django for API

handling and data processing. JavaScript, along with React.js or Vue.js, is used for frontend development, providing an intuitive user interface. OpenCV is employed for image processing and number plate detection, while Easy OCR or Tesseract OCR extracts textual information from images. The database management system is based on MySQL or MongoDB to store vehicle logs securely.

2. System Architecture

• Workflow of the System

The system begins by capturing images from cameras installed at the campus entry and exit points. These images are then processed using noise reduction, contrast enhancement, and edge detection techniques to improve readability. Once pre-processed, the images undergo license plate detection using object detection models like YOLO (You Only Look Once) or Faster R-CNN. The detected plate region is then extracted and passed through an OCR engine to recognize alphanumeric characters. The extracted text is stored in a secure database along with timestamps, entry logs, and vehicle authorization status. If an unauthorized vehicle is detected, the system generates an alert notification, triggering security responses.

3. Detailed Implementation Steps

• Image Processing and License Plate Detection

The image processing module first captures images from a live camera feed, ensuring a clear view of the number plates. The images are then converted to grayscale to reduce complexity and enhance contrast. Gaussian blur is applied to remove noise, followed by edge detection using the Canny algorithm to highlight the license plate boundaries. Once pre-processed, the system applies a deep learning-based object detection model like YOLO, which draws a bounding box around the detected license plate for further analysis.

• Optical Character Recognition for Number Plate Reading

After license plate detection, the extracted plate region undergoes text recognition using EasyOCR or Tesseract OCR. These OCR engines analyze the segmented region and extract alphanumeric characters from the license plate. To enhance accuracy, post-processing techniques such as regex filtering and spell-checking are applied, ensuring that misidentified characters are corrected. The refined text data is then formatted to match standard vehicle registration numbers for seamless validation.

• Database Integration for Log Management

The recognized number plate data, along with entry timestamps, is stored in a structured database. MySQL is used to manage the vehicle logs, ensuring efficient retrieval and analysis of past vehicle movements. Each vehicle entry is classified as either authorized or unauthorized based on a pre-existing campus vehicle registry. The database also maintains image references and logs for future audits, enhancing security tracking.

• Real-time Alert System Implementation

If the system detects an unauthorized vehicle, an alert is

generated in real-time. The system sends notifications via email, SMS, or dashboard updates, ensuring immediate action by security personnel. Automated responses, such as locking access gates or triggering alarms, can also be integrated to enhance security enforcement.

4. Security Measures and Performance Optimization

- Data Security and Privacy**
 To ensure the security of sensitive vehicle data, encryption methods are applied to stored information. Secure Sockets Layer (SSL) encryption protects data during transmission, preventing unauthorized access. Role-based access control (RBAC) restricts database modifications to authorized personnel only, ensuring that security logs remain intact.

- System Scalability and Performance Enhancements**
 To support large-scale campus deployments, the system is designed for scalability using cloud-based storage solutions. Load balancing techniques distribute processing workloads efficiently, ensuring optimal performance even during peak hours. Image caching and preprocessing optimizations reduce response time, allowing the system to handle high traffic volumes without lag.

1. positioned strategically to ensure maximum coverage for fire detection.

- 2. Programming and Software Development:** In this phase, the primary focus is on coding the robot's behavior. An obstacle avoidance algorithm is developed and uploaded to the Arduino Uno using the Arduino IDE. The algorithm processes data from the ultrasonic sensor to detect obstacles and adjust the robot's path accordingly. Additionally, the fire detection and suppression mechanism is implemented. The flame sensors, when detecting fire, trigger the Arduino to stop the robot's movement and activate a water-spraying mechanism to suppress the fire.

- 3. Testing and calibration:** After integrating the hardware and uploading the code, the system undergoes extensive testing. This testing phase focuses on evaluating the functionality of the obstacle avoidance system and fire suppression mechanism in various real-world scenarios. Calibration is performed to fine-tune sensor accuracy, motor response, and fire detection thresholds to ensure optimal performance.

- 4. Optimization and Performance Evaluation:** Once the system is tested, performance optimization is performed to enhance efficiency. This includes refining the obstacle detection and avoidance logic, improving the responsiveness of the fire suppression system, and reducing response time. The robot's overall efficiency is evaluated in different environments and under various conditions, ensuring reliability and robustness in real-world applications.

This methodology ensures a comprehensive approach to building an autonomous firefighting and obstacle-avoiding robot that meets the objectives of enhancing fire safety, minimizing human risks, and improving efficiency in

challenging environments.

Application Snapshots

The application snapshot provides a visual representation of the user interface of the vehicle monitoring system. This interface serves as the primary access point for authorized users, ensuring secure authentication through a username and password. The interface design includes graphical elements such as a vehicle and a surveillance camera, symbolizing the system's core functionality of vehicle tracking and security monitoring. A registration option is also available for new users, allowing them to create an account seamlessly. The overall layout is designed to be user-friendly, providing an efficient and secure way to manage vehicle access and surveillance operations.

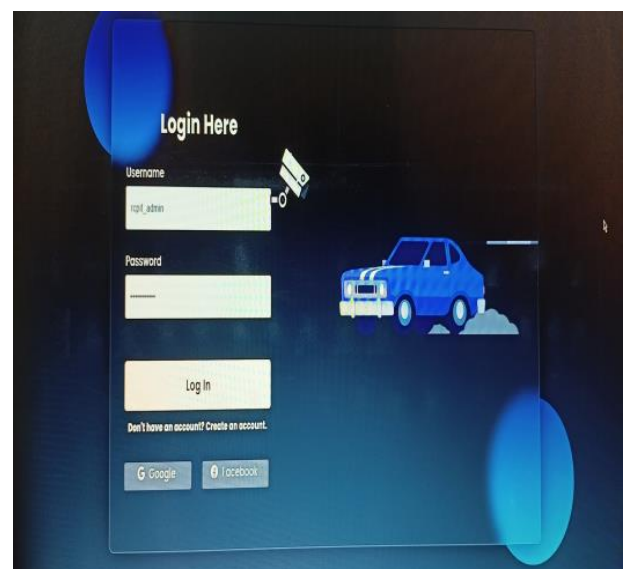


Fig.2 : User Login Interface for Vehicle Monitoring System

Figure 2 displays the login interface for the vehicle monitoring system, designed to provide secure access for authorized users. The interface includes fields for entering a username and password, ensuring authentication before accessing the system. Additionally, users have the option to log in using Google or Facebook credentials for convenience. The design incorporates a modern and visually appealing layout, featuring an illustration of a vehicle and a security camera, reinforcing the system's purpose of vehicle monitoring and surveillance. The interface also includes a prompt for new users to create an account, making it user-friendly and accessible.

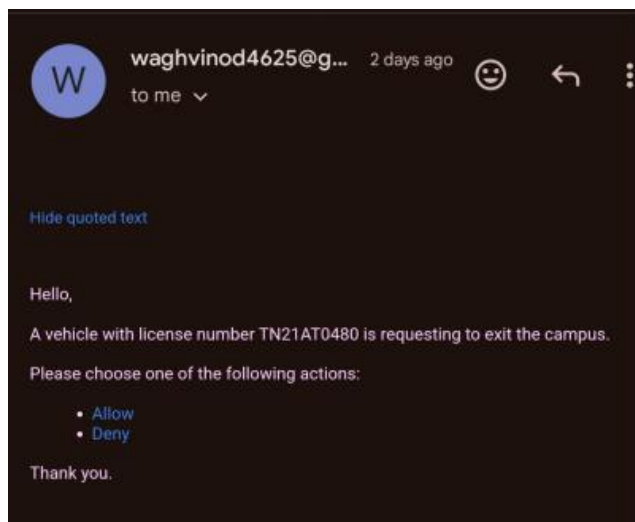


Fig.3 : Vehicle Exit Request Notification

The figure above represents an automated email notification sent by the vehicle monitoring system. This email alerts the concerned authorities about a vehicle with the license plate number TN21AT0480, requesting permission to exit the campus. The email provides two actionable options—Allow or Deny—enabling administrators to make real-time decisions regarding vehicle movement. This feature enhances security by ensuring that only authorized vehicles can leave the premises, preventing unauthorized exits. The system's automated approach improves operational efficiency and strengthens overall access control measures.

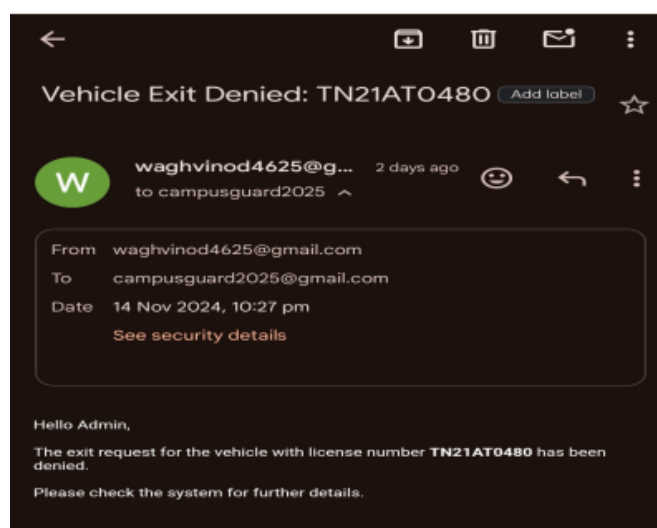


Fig.5 : Vehicle Exit Request Denied Notification

The above figure displays an automated email notification informing the admin that the exit request for the vehicle with license number TN21AT0480 has been denied. The system ensures enhanced security by notifying the relevant authorities of any denied access attempts. This feature is crucial for monitoring and controlling vehicle movements within a restricted area, preventing unauthorized exits. The email also instructs the admin to check the system for further details, ensuring transparency and efficient decision-making in access control management.



Fig.4 : Automated License Plate Recognition in Action

The above figure showcases an ANPR system detecting a vehicle's license plate. The system successfully extracts the vehicle's registration number, **TN21AT0480**, and displays a status message indicating that the vehicle is **waiting for permission** to proceed. This technology enhances security by ensuring only authorized vehicles are granted access or exit. By utilizing image processing and OCR, the system provides real-time monitoring, making it highly effective for applications in gated communities, parking lots, and restricted areas.

CONCLUSIONS

This research was driven by the need to address the challenges associated with vehicle identification in car park management. The primary objective was to develop an ANPR system using OCR on a mobile device. By implementing this system, the research aimed to improve the vehicle entry registration process, which traditionally relied on manual record-keeping by security personnel. The OCR technology formed the backbone of the proposed system, offering a more efficient and automated approach to vehicle identification.

The successful implementation of the system brought several benefits. It eliminated the need for a physical occurrence book, as all vehicle records were digitized, reducing paperwork and manual errors. The process of identifying vehicles, including entry and exit procedures, became significantly faster, saving time for both security personnel and vehicle owners. The system ensured accurate recording of vehicle details while also enabling seamless information sharing and backup. Additionally, real-time updates on vehicle movements were made available to the Head of Security, enhancing security monitoring. Lastly, the digitized data allowed for easier analysis of vehicle records, improving overall efficiency in car park management.

REFERENCES

- [1] "License Plate Detection and Recognition in Unconstrained Scenarios". - by Minghui Liao et al. (2017).
- [2] "Vehicle License Plate Recognition Using Deep Learning Techniques: A Comprehensive Survey" - by Ahmad Al-Dahoud et al. (2020).
- [3] "End-to-End License Plate Detection and Recognition with Deep Learning" - by Zhenbo Yu et al. (2019).
- [4] Lotufo, R. A., A. D. Morgan, and A. S. Johnson. "Automatic number-plate recognition." IEE Colloquium on Image Analysis for Transport Applications. IET, 1990.
- [5] Patel, Chirag, DiptiShah, and Atul Patel. "Automatic number plate recognition system (anpr): A survey." International Journal of Computer Applications 69.9 (2013).
- [6] Kashyap, A., Suresh, B., Patil, A., Sharma, S., & Jaiswal, A. (2018, October). Automatic number plate recognition. In 2018 international conference on advances in computing, communication control and networking (ICACCCN) (pp. 838-843). IEEE.
- [7] Lubna, Mufti, N., & Shah, S. A. A. (2021). Automatic number plate Recognition: A detailed survey of relevant algorithms. Sensors, 21(9), 3028.
- [8] Qadri, Muhammad Tahir, and Muhammad Asif. "Automatic number plate recognition system for vehicle identification using optical character recognition." 2009 International Conference on Education Technology and Computer. IEEE, 2009.
- [9] Gnanaprakash, V., N. Kanthimathi, and N. Saranya. "Automatic number plate recognition using deep learning." IOP Conference series: materials science and engineering. Vol. 1084. No. 1. IOP Publishing, 2021.

