

VEHICLE LICENSE PLATE RECOGNITION SYSTEM

Rahul Bankar¹, Pruthviraj Chavan², Sagar kamble³, Mr.R.S. Piske⁴

Electronics and Telecommunication Department, VPKBIET, Baramati, Pune, 413133, India¹⁻⁴

Abstract: A number plate recognition system is a security mechanism. The number plate identification system makes use of the concept of image processing. The vehicle number plate image is also read using an OCR (Optical Character Recognition) approach. Numerous applications exist for number plate recognition systems. Toll road authorities, for instance, use these systems to allow cars to enter toll roads by automatically identifying the license plates of the vehicles, providing them with a pay slip, and then opening the road for that particular vehicle.

The parking authority also uses this technology to give cars authorization to park in their area. Using this method, we first capture an image of the license plate, process it, and then check that every character is read accurately. acknowledgement. The most crucial step is OCR, which transforms the text on the license plate image into letters that can be decoded later. This research article presents the entire network flow and methodology for VLPR along with a few of its useful applications. The exactness (outcome) of the VLPR system, which is based on template matching, was determined to be between 75 and 85 percent for Indian number plates.

Keywords: Vehicle license plate recognition, Recognition System, Image processing, Pattern recognition, Machine learning

I. INTRODUCTION

Vehicle License Plate Recognition (VLPR), also known as Automation Number-Plate Recognition (ANPR), is a technology that utilizes optical character recognition (OCR) to read vehicle registration plates from images, creating valuable vehicle location data.

This technology can be harnessed through existing closed-circuit television (CCTV), road-rule enforcement cameras, or cameras designed specifically for this purpose. VLPR is widely employed by law enforcement agencies worldwide to enforce regulations, verify vehicle registration and licensing, and support various law enforcement functions.

A typical VLPR system comprises three essential components: a camera for capturing vehicle images and their license plates, a computer for processing these images and extracting license plate information, and specialized software for interpreting this data and generating valuable vehicle location information.

The versatility of VLPR technology allows for a range of automated tasks, including toll collection on highways, enforcement of parking regulations, tracking stolen vehicles, identifying vehicles involved in criminal activities, and monitoring traffic flow for better traffic management.

While VLPR holds the potential to significantly enhance road safety and security, it is crucial to acknowledge that these systems can also raise concerns about individual privacy when used for tracking purposes without consent. Therefore, it is of utmost importance to implement appropriate safeguards and regulations to ensure that the use of VLPR systems respects and protects individual privacy rights.

II. LITERATURE REVIEW

Sr No	Title	Publication year	Methodology	Result And Conclusion
1	"Car Plate Recognition Using Machine Learning,".	2022 Advances in Science and Engineering Technology International Conferences (ASET), 2022, pp.	Utilizing machine learning for car plate recognition constitutes the methodology.	proficient car plate recognition through the utilization of machine learning techniques. The conclusive findings emphasize the viability and efficacy of this methodology in advancing vehicle identification systems.
2	"Cognitive Number Plate Recognition using Machine Learning and Data Visualization Techniques,".	2020 6th International Conference on Signal Processing and Communication (ICSC), 2020	applying machine learning and data visualization techniques for cognitive number plate recognition.	Accurate number plate recognition achieved. Positive implications for cognitive recognition.
3	"A Simple Number Plate Detection Technique with Support Vector Machine for On-Road Vehicles,".	2022 International Virtual Conference on Power Engineering Computing and Control	Optical Character Recognition (OCR) technology used to convert images of license plates into editable and searchable data.	Highly effective number plate detection achieved. Support Vector Machine enhances accuracy.
4	"Proposed Automatic Number Plate Recognition System Using Machine Learning,".	2022 IEEE Nigeria 4th International Conference on Disruptive Technologies for Sustainable Development.	OpenCV is a library for real-time computer vision and machine learning.	The proposed system achieves accurate automatic number plate recognition. Machine learning enhances identification precision significantly. Results indicate potential for real-world deployment. Conclusion underscores the viability of the approach.
5	"Multinational License Plate Recognition Using Generalized Character Sequence Detection,".	IEEE Access, vol. 8, pp. 35185-35199, 2020.	k-nearest neighbors algorithm (k-NN) from OpenCV's machine learning library used for classification and regression	Successful multinational license plate recognition achieved. Generalized character sequence detection enhances accuracy.

For these domains we have reviewed papers focusing research on Machine learning and the library of OpenCV and OCR. These papers were published by Research teams working on Machine Learning.

This Paper by C. Henry, S.Y. Ahn, and S.W. Lee offers a global approach to multi-national license plate recognition. The multilingual layout detection, unified character recognition, and license plate detection processes are all included in the method. It combines character segmentation and recognition, treating license plate identification as an object recognition job. The system uses a new layout detecting method and is very flexible. Experiments conducted on plates from different nations, including a demo dataset consisting of 17 nations, demonstrated better performance than previous studies and commercial software. With an average time of 42 ms per image, the suggested approach is quite quick. It functions without the need for additional algorithms or national specifics. [1]

In this research of Mr.Sugeng, Eniman Yunus Syamsuddin on ANPR systems using embedded systems emphasizes the importance of image pre-processing, particularly inversion, for better identification of characters. Component relationship analysis is used in vehicle number plate detection to produce a flawless 100 percent detection rate for both two- and four-wheeled vehicles.

On character group positions enhances character recognition accuracy from 84 to 98 percent using machine learning. Implementation of the K-NN method on embedded systems like Raspberry Pi showcases efficient character recognition without performance issues. Future development prospects include refining component relationship analysis and enhancing algorithms for recognizing characters, especially within the final group that might feature similar characters.[2] In this research paper by N.Abirami, Dr. J.S.Leenahighlights the open-source technologies' preparedness for scientific computing and demonstrates how well they work with Automatic License Plate Recognition (ALPR) systems. The system's robust performance under varying illumination conditions and diverse Indian number plate types establishes it as a preferable alternative to existing proprietary solutions. The proposed algorithms have been successfully demonstrated, paving the way for future implementation using the OpenCV library. This study's importance lies in validating the chosen algorithms' suitability for the application, culminating in successful execution and potential for improved ALPR system performance.[3]

In this project by Ajay kumar Singh, Souvik Roy which focuses on enhancing automatic vehicle license plate recognition by addressing the lack of attention to power efficiency in existing techniques. By reducing power consumption, the proposed design holds potential for significant impact on traffic management and security systems, including anti-theft measures and parking management. Preliminary software algorithm implementations have yielded promising outcomes. For improved robustness, integration of high-precision cameras could elevate overall accuracy, particularly in real-time applications. The concept of a sensor-triggered camera capture adds another layer of efficiency, conserving power by capturing images only when necessary.[4]

III. SOFTWARE DESIGN ALGORITHM

- Collect a database of various car number plates.
- Using CVAT for labeling and segmentation.
- Split the data into training, validation, and test sets.
- Choose YOLO v8 for object detection.
- By using YOLO we train our model on the Google Colab.
- Evaluate the trained model on the validation set.
- Fine-tune the model hyperparameters, if necessary.
- Evaluate the trained model on the test set.
- Use the trained model to detect and recognize car number plates in images and video

IV. STEPS

Image Acquisition:

Noise reduction: Morphological operations can be used to reduce noise in the captured image, making it easier to process and analyze.

License Plate Localization

Edge detection: Morphological operations can be used to enhance edges in the image, making it easier to identify the boundaries of the license plate region. Region of interest (ROI) extraction: Morphological operations can be used to isolate the license plate ROI from the background, focusing the subsequent stages of the processing on the relevant area.

Segmentation

Character separation: Morphological operations can be used to separate individual characters on the license plate, preventing them from being clumped together.

Background removal: Morphological operations can be used to remove background clutter and noise, making the characters more distinct.

Character Recognition

Feature extraction: Morphological operations can be used to extract relevant features from the segmented characters, such as shape, size, and stroke patterns.

Character normalization: Morphological operations can be used to normalize the appearance of characters, making them more consistent and easier to recognize by the OCR algorithm.

By incorporating morphological operations into the VLPR process, the system can better handle variations in contrast and improve the overall accuracy of license plate detection, segmentation, and recognition.

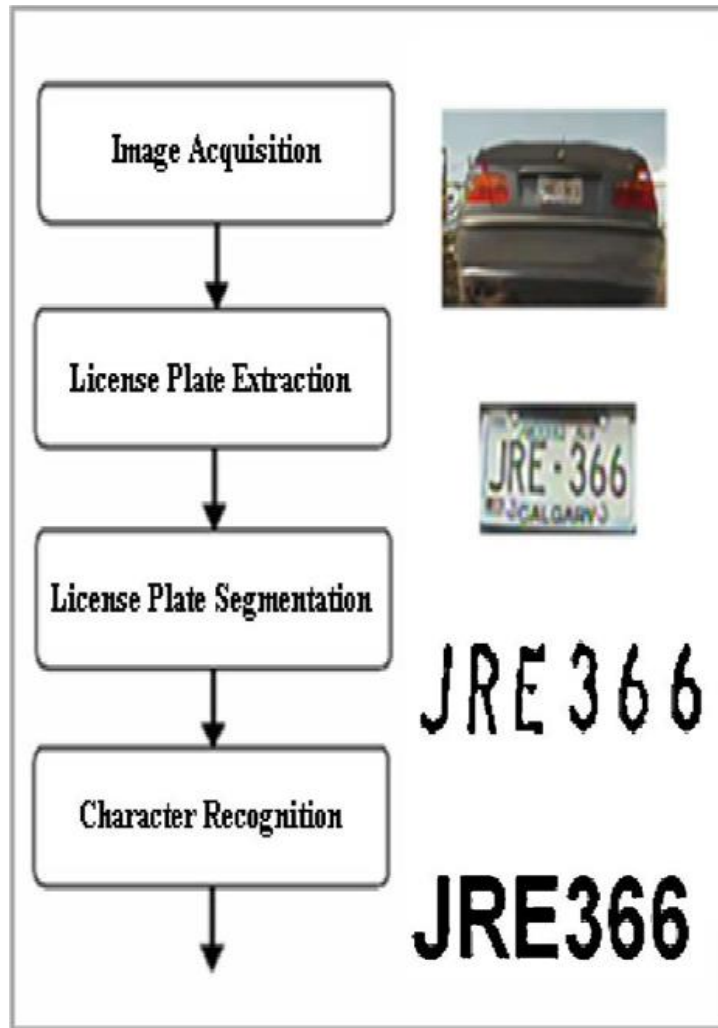


Fig 1: Four. Basic Steps of VLPR

Post-processing and Output:

The final step in the VLPR process is to post-process the recognized characters and generate output. This may involve tasks such as correcting errors in the recognized characters, formatting the license plate number, and storing the license plate number in a database.

V. DATABASE DESCRIPTION

1. Project Dataset:

•A total of 2,296 images of car number plates were collected for the project. These images are used to train a number plate recognition system and improve prediction accuracy.

1. Data Split:

Three sets of the dataset were created for the purpose of developing and evaluating the models:

- (a) Training Set: This set comprises over 2,000 images, serving as the primary dataset for training the model.
- (b) Validation Set: A set of 172 images was allocated for model validation. This subset helps in fine-tuning hyperparameters and monitoring model performance during development.
- (c) Test Set: The test set consists of 96 images, which is used to evaluate the final model's performance.

VI. CONCLUSION

By automating the detection, capture, and interpretation of license plate information from vehicles using optical character recognition (OCR) and image processing techniques, vehicle license plate recognition (VLPR), also known as automatic number plate recognition (ANPR), is a game-changing technology that has had a significant impact on a number of fields.

VLPR systems convert license plate alphanumeric characters into machine-readable text by using specialized cameras and software. VLPR's main goals are to identify and collect license plate data more quickly and automatically, as well as to provide affordable hardware and cloud-based services. and providing a wide range of applications in various fields. Owing to its effectiveness and precision in obtaining license plate data, this technique has gained widespread usage.

REFERENCES

- [1]. Multinational License Plate Recognition Using Generalized Character Sequence Detection, C. Henry, S. Y. Ahn, and S.-W. Lee, IEEE Access, vol. 8, pp. 35185-35199, 2020, doi: 10.1109/ACCESS.2020.2974973.
- [2]. Eniman Sugeng "Designing Automatic Number Plate Recognition (ANPR) Systems Based on K-NN Machine Learning on the Raspberry Pi Embedded System" by Yunus Syamsuddin will be presented at the FORTEI 2020 seminar.
- [3]. "Accurate vehicle Number Plate Recognition and Real-Time Identification using Raspberry Pi," N. Abirami¹, Dr. J.S. Leena Jasmine², IRJET 2018,
- [4]. S.Lurdhu Jayasree,A.Anisha"A Novel Deep Learning Based ANPR Pipeline for Vehicle Access Control"July 2023—IJIRT—Volume 10 Issue 2 — ISSN: 2349-6002
- [5]. Ajay kumar Singh ,Souvik Roy"ANPR Indian system using Surveillance Cameras" 978-1- 4673-7948-9/15/31.002015IEEE