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Automatic Number Plate Recognition (A.N.P.R)

Devom Jaiswal
Department of computer Engineering
PVPIT

Rhea Patankar
Department of computer Engineering
PVPIT

Harsh Ladda
Department of computer Engineering
PVPIT

Sushma Addagatla
Department of computer Engineering
PVPIT

***Abstract*— In an era marked by rapid urbanization and the proliferation of vehicles, efficient management of traffic flow and enhanced security measures have become paramount concerns for communities worldwide. To address these growing challenges, the use of Automatic Number Plate Recognition (ANPR) systems has become an indispensable tool. ANPR systems, also known as License Plate Recognition (LPR) systems, utilize advanced image processing, pattern recognition, and machine learning algorithms to automatically detect, segment, and recognize license plates from images or video streams captured by surveillance cameras or other sensors.**

Furthermore, ANPR devices can only recognise horizontal number plates, making tilted plates impossible to identify. In this study, we provide various methods for overcoming these difficulties. The system recognises the number on the plate and compares it to a database to extract the owner's information. Pytesseract and TensorFlow were used to localise the plate and extract text.

With their exceptional versatility, ANPR systems are a reliable and effective solution for enhancing traffic management and improving security measures

***Keywords*— Automatic Number Plate Recognition (ANPR), Tensorflow, OCR (optical character recognition) ,Pytesseract, , K Nearest Neighbour (KNN), Support Vector Machine (SVM) Processing, Localizing , Character Segmentation and text extraction, Template Matching**

I. INTRODUCTION

In today's fast-paced world, manually tracking car information, such as vehicle history and traffic infraction status, is becoming increasingly difficult. Recognising this necessity, Automatic Number Plate Recognition (ANPR) systems have evolved as a viable answer to these challenges. While ANPR systems handle many concerns, some situations still require manual intervention, which we hope to examine and resolve in this paper.

The Automatic Number Plate Detection system is exceptionally valuable in various scenarios. Our system operates by taking an image containing only a car as input, extracting the text from its number plate, and comparing it with a database to retrieve the owner's information. This constitutes the primary objective of our system.

The advantages of ANPR technology are manifold. Firstly, it aids law enforcement by helping authorities identify stolen vehicles promptly. Additionally, in cases of traffic violations, our system empowers law enforcement officers to issue fines simply by capturing an image of the offending vehicle. Moreover, ANPR systems can be used to regulate access to private premises by verifying the authorization of vehicles seeking entry.

In this paper, we delve into the functionality and significance of ANPR systems, exploring how they streamline vehicle identification processes and enhance security measures. By elucidating the capabilities and

applications of ANPR technology, we aim to underscore its pivotal role in modern traffic management and law enforcement efforts.

II. LITERATURE SURVEY

"Automatic Number Plate Recognition System", by Abhishek Kashyap, B. Suresh, Anukul Patil, Saksham Sharma, Ankit Jaiswal: This paper provides a comprehensive overview of the operation of ANPR systems, aiming to deepen understanding at a high level. An ANPR system typically encompasses three primary stages: 1) detection of the number plate area, 2) segmentation of individual characters, and
3) Optical Character Recognition (OCR). In this particular investigation, the ANPR system implementation relies on a template matching technique for vehicle number plate recognition. The central objective is to identify the vehicle's number plate by comparing it against a predefined template. Moreover, the paper explores various existing methodologies, including the Log r-theta Mapping method and the Maximum Average Correlation Height Filter, providing detailed insights into their functionalities. The techniques utilized in the study demonstrate commendable outcomes, achieving an accuracy rate of 82% with characters recognized through Character Segmentation. Nevertheless, the paper acknowledges limitations in identifying images that are motion-blurred or obscured by other parts of the vehicle's body, underscoring areas for potential improvement and future research endeavours.

"A Review Paper on Automatic Number Plate Recognition", by BJ Praveena, Nampalli Shravan Kumar, Sudaveni Nishita, T Akhil Kumar: This paper presents an exploration of diverse approaches utilizing a range of techniques aimed at addressing the limitations encountered in traditional ANPR systems. Following the recognition of the number, the system conducts a cross-comparison with the database to extract the owner's information. The primary objective of the system outlined in the paper is to intake an image featuring a vehicle, extract the characters from its number plate, and subsequently compare the extracted data with the database to retrieve the owner's information. Furthermore, the paper delves into the system proposed, providing comprehensive insights into image processing techniques employed for vehicle recognition within the database. Additionally, it sheds light on methods for recognizing number plates positioned at unconventional angles, thereby broadening the scope for addressing diverse challenges encountered in ANPR systems.

III. COMPARISON STUDY ON ALGORITHM USED

A) Image Preprocessing: Preprocessing of images involves several steps:

1. Image Acquisition: This step involves capturing images of vehicles, which can be done using stationary cameras placed at locations like toll booths or traffic lights, or using mobile cameras.

2. Image Enhancement: Techniques such as contrast adjustment, noise reduction, and standardization are employed to enhance the quality of the captured images.

3. Image Segmentation: In this phase, areas of interest within the images, which may contain license plates, are identified. Common techniques utilized for this purpose include edge detection, morphological operations, and colour-based segmentation.

B) License Plate Localization: License Plate Localization involves the following methods:

1. Object Detection: Employing various different techniques such as Haar cascades, Histogram of Oriented Gradients (HOG), or deep learning approaches like convolutional neural networks to identify and locate potential areas within the image that might contain license plates.

2. Template Matching: This method involves comparing subsections of the original image with predefined templates of license plate shapes to pinpoint potential plate locations.

C) Character Segmentation: In Character Segmentation involves two key techniques:

1. Connected Component Analysis (CCA): This method isolates individual characters within the recognized license plate area by assessing attributes such as colour, intensity, and shape.

2. Projection Profiles: By examining vertical and horizontal histograms of pixel intensities, this technique identifies spaces between characters, aiding in their segmentation. of weeds across intricate terrain, significantly boosting overall operational efficiency and effectiveness in weed control efforts.

D) Character Recognition: Optical Character Recognition (OCR) involves:

1. Recognition Techniques: Employing methods such as template matching, neural networks, or deep learning models (such as convolutional neural networks) to identify characters within segmented areas of the license plate.

2. Dictionary-based Approaches: Verifying the recognized characters against dictionaries or databases containing known license plate patterns, enhancing recognition precision.

3. Language Modelling: Enhancing character recognition by integrating language models that consider the probability of specific character sequences occurring in license plates

E) Post-Processing: Post-processing involves:

1. Error Correction: Utilizing algorithms to rectify inaccurately classified characters by considering contextual clues or established patterns.
2. Validation: Cross-referencing the identified license plate with databases or regulations, like plate format specifications, to validate its authenticity.
3. Tracking and Authentication: Continuously monitoring recognized license plates across successive frames in a video feed and validating the consistency of recognition outcomes to enhance precision and dependability.

F) Training the Model: For training the model, K Nearest Neighbour (KNN) and Support Vector Machine (SVM) are used.

K-Nearest Neighbours (KNN) can be employed in training the ANPR model to recognize characters on License plates.
By using features extracted from segmented characters, such as pixel intensity values or shape descriptors, KNN learns to classify characters based on their similarity to training examples. This method helps the ANPR model accurately identify characters on license plates, contributing to the overall effectiveness of the system.

Support Vector Machine (SVM) can be utilized in training the ANPR model to recognize characters on license plates. SVM works by finding the optimal hyperplane that best separates different classes of data points in a high-dimensional feature space. In the context of ANPR, features extracted from

segmented characters can be used as input to train an SVM classifier. The SVM learns to differentiate between different characters based on their feature representations, thereby enabling accurate character recognition within the ANPR system.

III. FUTURE DIRECTIONS

As we look to the future of ANPR systems, we can focus on two major areas for advancement. First, we want to create ANPR systems that can identify and process number plates in many languages, catering to India's unique linguistic terrain. This would ensure that traffic restrictions are enforced equitably across areas. Second, we are working to improve the connection of ANPR devices with digital databases, allowing for real-time access to information about car ownership, insurance status, and legal compliance. This will improve the efficiency of law enforcement operations and help overall road safety

IV. CONCLUSION

This paper has investigated the capabilities and potential enhancements of the Automatic Number Plate Recognition (ANPR) system. Utilizing image processing methods, ANPR systems offer efficient recognition of vehicles from stored databases. While the current system demonstrates satisfactory performance across various conditions and plate types, opportunities for improvement exist. Suggestions for enhancement include the adoption of high-resolution cameras to boost processing speed and achieve clearer image capture. Additionally, the integration of ANPR systems onto embedded devices allows for autonomous operation, with seamless communication of

outcomes. Looking ahead, the ongoing advancement and refinement of ANPR technology hold the promise of further progress, thereby contributing to more effective traffic management and law enforcement efforts.

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