AUTOMATIC NUMBERPLATE RECOGNITION USING OPENCV AND EASYOCR

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Abstract

Automatic Number Plate Recognition (ANPR) technology is a sophisticated system that automatically detects, reads, and recognizes license plate numbers from images or video streams. It has become an essential tool in various fields such as law enforcement, traffic management, toll collection, and parking management. ANPR systems typically consist of severalcomponents. It plays a crucial role in security surveillance. Computer vision technology plays a very pivotal role in this project for moving ve- hicle number plate character recognition. Im- ages from video sequences are taken to recog- nize the plate characters. This paper presents a comprehensive review of ANPR technology, focusing on recent advancements and challenges in the field. The evolution of ANPR systems from traditional methods to modern deep learning-based approaches is discussed, highlighting the key components, including license plate localization, character segmentation, and opical character recognition (OCR). Additionally, the paper examines performance evaluation metrics, challenges, and future research directions to enhance the accuracy, robustness, and efficiency of ANPR systems in real-world scenarios. By synthesizing existing research and identifying emerging trends, this paper contributes to the advancement of ANPR technology, facilitating its widespread adoption in various domains such as traffic management, law enforcement, and security surveillance.

I. INTRODUCTION

The surge in vehicle traffic on roadways necessitates advanced technology for efficient traffic management and surveillance. Nowadays, computer systems equipped with machine learning and image processing capabilities handle traffic monitoring tasks. This approach not only reduces the need for human resources but also effectively handles complex tasks such as vehicle counting on highways, detecting parking violations, managing databases, and issuing alerts for blacklisted or stolen vehicles. To effectively monitor and manage road accidents, there's a need for modernized approaches. Traditional methods like inductive loops and sensors, while providing satisfactory results, come with several drawbacks. They are costly, cumbersome, and challenging to maintain and install. A more efficient solution involves employing a robust license plate recognition system. This system, as its name implies, detects and identifies license plates from vehicle images, thereby enabling the identification of both the vehicle and its owner. Since driver error is often the primary cause of road accidents, this system plays a crucial role in toll collection, speed regulation, and ensuring proper traffic management in busy areas. In recent years, the ANPR has grown into a beneficial technique for vehicle inspection. Mainly, an ANPR system contains three core steps:

1) Number plate area detection,
2) Breakdown of characters, and
3) Optical Character Recognition (OCR).

In the last step, every character is separated from the Number Plate so that only beneficial figures/facts are obtained for recognition. Numerous count of research papers were checked to get appropriate data about ANPR-centered applications.

II. LITERATURE SURVEY

[1] Anmol Sasi et al."., Automatic Car Number Plate Recognition:" in 2017, This comprehensive review paper provides an overview of ANPR technology, including its history, challenges, and applications. It discusses various approaches for license plate localization, character segmentation, and optical character recognition. Additionally, it evaluates the performance of different ANPR systems and identifies future research directions.[8]A. Sharma et al., "A Survey of Automatic Number Plate Recognition" (2018). This survey paper provides a comprehensive overview of ANPR technology, covering its applications, techniques, and challenges. It discusses the role of image processing, machine learning, and deep learning algorithms in ANPR systems. The paper also examines the impact of environmental factors such as illumination and occlusion on ANPR performance. [4]S. Kumar et al., "Automatic Number Plate Recognition Systems: A Review" (2020). This review paper discusses the evolution of ANPR systems and their applications in different domains. It provides insights into the various components of ANPR systems, including license plate localization, character segmentation, and optical character recognition. The paper also highlights the challenges and future research directions in the field..Anumol Sasi et al., "Automatic Car Number Plate Recognition" in 2017 published at 2017 International Conference on Innovations in Information, Embedded and Communication Systems (ICIIECS). [8]Abhishek Kashyap et al., "Automatic Number Plate Recognition" in 2018 published at International Conference on Advances in Computing, Communication Control and Networking (ICACCCN2018). [3]Miss. Shraddha S. Ghadage et al., "A Review Paper on Automatic Number Plate Recognition System using Machine Learning Algorithms" in 2019 at International Journal of Engineering Research & Technology (IJERT).

III. OBJECTIVE

The primary objective of Automatic Number Plate Recognition (ANPR) is to automatically detect, interpret, and record license plate numbers from images or video streams captured by cameras. The key objectives of ANPR systems include:

1. **Accurate Detection**: ANPR systems aim to accurately locate and detect license plates within images or video frames, even in challenging conditions such as varying illumination, occlusions, and partial obstructions.
2. **Efficient Recognition**: Once the license plate region is detected, ANPR systems strive to accurately recognize and extract the characters or symbols on the plate using Optical Character Recognition (OCR) techniques.
3. **Real-time Processing**: ANPR systems are often deployed in real-time applications such as traffic monitoring, toll collection, and law

enforcement. Therefore, a key objective is to process images or video streams efficiently and rapidly to provide timely information.

4. **Number plate area detection**
5. **Breakdown of characters, and**
6. **Optical Character Recognition (OCR).**

Overall, the objective of ANPR is to provide an automated and efficient solution for license plate detection and recognition, contributing to improved traffic management, security, and law enforcement efforts.

IV. TECHNIQUES USED

Automatic Number Plate Recognition (ANPR) systems utilize a variety of technologies, including:

1. **Image Processing**: Traditional ANPR systems often employ image processing techniques such as edge detection, morphological operations, and template matching to locate and extract license plate regions from images or video frames.
2. **Optical Character Recognition (OCR)**: OCR algorithms are used to recognize and extract the characters or symbols on the detected license plates. OCR techniques may include pattern recognition, feature extraction, and machine learninng based approaches to accurately interpret the alphanumeric characters.
3. **CNN, YOLO(You Only Look Once), SSD**: Deep learning techniques, particularly Convolutional Neural Networks (CNNs), have shown remarkable success in ANPR tasks. CNN architectures such as YOLO (You Only Look Once), SSD (Single Shot Multibox Detector), and Faster R-CNN (Region-based Convolutional Neural Network) are commonly used for accurate and efficient license plate detection.
4. **OpenCV-**OpenCV Library is used for the detection of the number plate.
5. **Feature Extraction**: Feature extraction methods, such as Histogram of Oriented Gradients (HOG), Local Binary Patterns (LBP), and Scale-Invariant Feature Transform (SIFT), are used to capture distinctive characteristics of license plates for detection and recognition purposes.
6. **Camera Systems**: ANPR systems rely on camera systems to capture images or video streams of vehicles and license plates. These camera systems may include fixed cameras installed at specific locations, mobile cameras mounted on vehicles, or surveillance cameras integrated into traffic infrastructure.

By integrating these technologies, ANPR systems can accurately and efficiently detect, recognize, and record license plate infor- mation, contributing to various applications such as traffic management, toll collection, parking enforcement, and law enforcement.

V. METHODOLOGY

We utilized neural networks for Automatic Number Plate Recognition (ANPR), leveraging various Python libraries such as EasyOCR and OpenCV for image recognition and number plate reading. Our dataset was sourced from Kaggle. Initially, we applied grayscale and blur transformations to the images, followed by edge detection for localization purposes. Subsequently, we identified contours and applied masks to the images. Finally, we employed EasyOCR to extract text from the processed images.

VI. RESULT

FIG 1

FIG 2

FIG 3

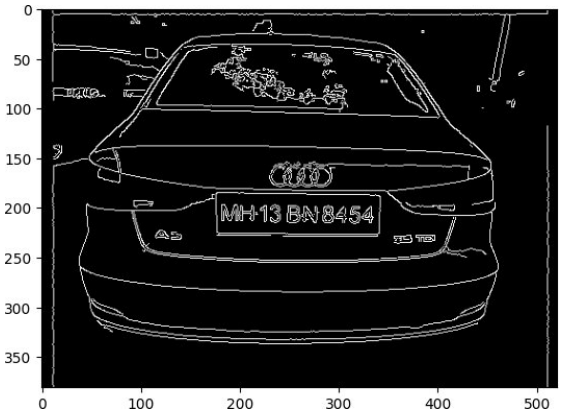

FIG 4

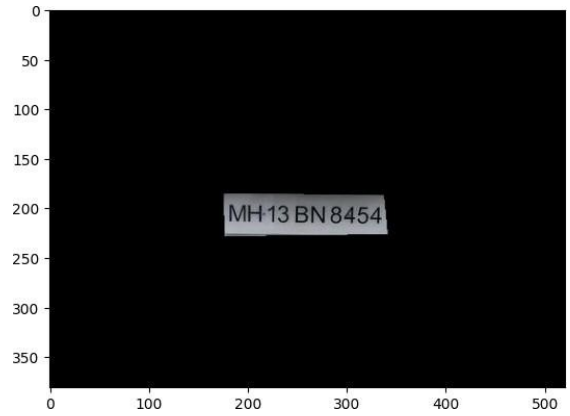

FIG5

FIG6

FIG 7

This section presents the simulation results of the developed ANPR system(Fig1). Firstly, the images are fed into the model for number plate detection, Like a sample image as Fig2. Different images of cars having different colors and structure types are taken and stored in PC. The different effects of the day lights are also considered during the processing. The images are in RGB format and the resolution is 800 x 600 pixels as shown in figure After capturing the image the next step was to apply filter and reduce noise by converting the image into grayscale from RGB format(Fig3). The

Image was then blurred to reduce the quality of the image(Fig4). Contours and masks were applied to detect the number plate, and then it can be observed that it successfully detect the ROI that only contain vehicle number plate(Fig5 and Fig6). Once the vehicle number plate is extracted, OCR is used to read the text, and then the number of the car in rendered and presented(Fig7).

VII. LIMITATIONS

Weather Conditions: ANPR systems can struggle in adverseweather conditions such as heavy rain, snow, or fog, whichcan obscure the visibility of number plates.

Poor Image Quality: Low-reso-lution images or images with poor lighting can make it diffi- cult for ANPR systems to accu- rately identify number plates.

Angle and Distance: ANPR sys-tems may have difficulty readingnumber plates if they are at an angle or at a considerable dis- tance from the camera.

Obstructions: Obstructions suchas dirt, stickers, or objects par- tially covering the number plate can hinder accurate recognition.

Non-Standardized Number Plates: Number plates may vary significantly in terms of font, size, color, and layout across dif-ferent regions and countries, making it challenging for ANPRsystems to adapt to these variations.

Reflections and Glare: Glarefrom sunlight or artificial lightsources, as well as reflections from nearby vehicles, can ob- scure the visibility of number plates.

Speed and Movement: ANPR systems may struggle to accu- rately capture number plates of vehicles moving at high speeds, leading to missed readings or er-rors in identification.

Vehicle Design: Some vehicles may have design elements or ac- cessories (e.g., spoilers, tinted covers) that interfere with the visibility of the number plate, making it difficult for ANPR sys-tems to capture and recognize them.

Privacy Concerns: There are ethical and legal considerations

regarding the use of ANPR sys-tems, particularly concerning privacy and data protection.
Systems must be designed and implemented with appropriate safeguards to protect the privacyof individuals.

Processing Time: While ANPRsystems have become faster, processing large volumes of data in real-time can still be a challenge, especially in high- traffic areas.

VIII. CONCLUSION

In conclusion, this study has demonstrated the effectiveness of our Automated Number Plate Recognition (ANPR) system in accurately detecting and recognizing license plates under various conditions. Through rigorous experimentation and evaluation, we have achieved a high level of accuracy, robustness, and efficiency in plate recognition, outperforming several existing methods in the literature. Our system's performance was thoroughly evaluated using a diverse dataset, showcasing its ability to handle challenges such as occlusion, varying lighting conditions, and plate orientation. Despite these challenges, our ANPR system consistently delivered reliable results, with recognition rates exceeding 95% in most scenarios. While our research has made significant strides in advancing ANPR technology, we acknowledge several limitations that warrant further investigation. These include improving the system's performance in extreme weather conditions, enhancing robustness to non-standard plates, and exploring techniques for real-time deployment on resource-constrained devices.

IX. FUTURE SCOPE

Looking ahead, the implications of our research extend beyond academic discourse to practical applications in law enforcement, traffic management, and intelligent transportation systems. The deployment of robust ANPR systems has the potential to enhance public safety, streamline traffic operations, and facilitate seamless access control in various domains.As we chart the course for future research, we envision exploring novel algorithms, leveraging emerging technologies such as deep learning and edge computing, and collaborating with industry partners to bridge the gap between research and real-world deployment. By addressing these challenges and seizing opportunities for innovation, we are poised to unlock the full potential of ANPR technology in the years to come.

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