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CNN AND HAAR BASED MIX AUTOMATIC LICENSE PLATE RECOGNITION

[1]Pankaj Kumar Chaurasiya, [2]Sanjay Pal
[1]M. Tech. Scholar, CSE OIST Bhopal, spankajkumarchaurasiya@gmail.com,India
[2]Assis. Prof. CSE OIST Bhopal, , India

Abstract: - *Automatic license plate recognition (ALPR) has become a crucial technology in various applications such as traffic management, law enforcement, and access control systems. This thesis presents an advanced ALPR system leveraging Convolutional Neural Networks (CNNs), HAAR cascade classifiers, and Optical Character Recognition (OCR) to achieve high accuracy in license plate detection and character recognition. The proposed system consists of three primary stages: license plate detection using HAAR cascades, character segmentation, and character recognition using CNNs integrated with OCR techniques.*

In the first stage, the HAAR cascade classifier efficiently detects license plates in diverse and challenging conditions, including varying lighting and weather scenarios. The second stage involves segmenting the detected license plates into individual characters, which are then processed for recognition. In the final stage, a CNN model is employed to accurately recognize segmented characters, leveraging OCR to refine and verify the results.

Extensive experiments were conducted on various datasets to evaluate the performance of the proposed system. The results demonstrate that our approach achieves superior accuracy and robustness compared to traditional methods, particularly in complex environments. This research contributes to the advancement of ALPR technology, providing a reliable and efficient solution for real-world applications.
Keywords: - Automatic License Plate Recognition (ALPR), Convolutional Neural Networks (CNN), HAAR Cascade Classifiers, Optical Character Recognition (OCR), License Plate Detection, Character Segmentation, Character Recognition

I. INTRODUCTION

Automatic License Plate Recognition (ALPR) systems have become increasingly vital in modern society, serving critical roles in traffic management, law enforcement, and access control. These systems enable the automatic identification of vehicles by capturing and interpreting the characters on license plates, facilitating a range of applications from automated toll collection to tracking stolen vehicles. Traditional ALPR methods, however, often struggle with accuracy and efficiency, particularly under challenging conditions such as poor lighting, varying weather, and diverse license plate designs.

To address these challenges, this thesis presents a novel ALPR system that integrates Convolutional Neural Networks (CNNs), HAAR cascade classifiers, and Optical Character Recognition (OCR). This combination leverages the strengths of each technique to enhance the overall performance and reliability of the system. The HAAR cascade classifier is used for its robustness in object detection, particularly in identifying license plates within complex backgrounds. Following detection, the system segments the license plate into individual characters, which are then recognized using a CNN model. The CNN's deep learning capabilities provide high accuracy in character recognition, while the OCR component further refines the results to ensure precision.

The integration of these technologies aims to overcome the limitations of existing ALPR systems, offering improved accuracy and adaptability. This research not only contributes to the academic field of image processing and machine learning but also provides practical solutions for real-world applications. The subsequent sections of this thesis detail the methodology, implementation, and evaluation of the proposed system, demonstrating its effectiveness in various scenarios and its potential for widespread adoption.

Currently, there are over half a billion cars on the roads, each identifiable by its unique license plate. The sheer volume of vehicles makes it impractical for human resources alone to manage and monitor them effectively without the assistance of computer and signal processing technologies. Given this massive influx of vehicles, it is clear that automation in license plate recognition is essential and highly significant. Implementing automated systems in this area is crucial for efficiently handling the growing number of vehicles.

Though the applications of automatic license plate detection have emerged in the last decade or so, the technology has been present for nearly 45 years. In the late 1970s, researchers for the United Kingdom’s police scientific development branch have manufactured the first working license plate recognition system and began deploying it by the beginning of the 1980s.

The application areas for automatic license plate recognition include traffic monitoring, parking management, accident reporting, identifying drivers that cause traffic signal violations or drive in excess of the speed limit, for toll collection or to identify uninsured motorist.

Generally most license plate recognition (LPR) systems are expected to comply with the following goals:

- fast processing speed
- ability to recognize plate numbers from images with noise
- ability to work for tilted plates
- ability to work for different font styles and sizes

In the literature some other names for automatic license plate recognition exists. Some of these include: automatic vehicle identification (AVI), car plate recognition (CPR), automatic number plate recognition (ANPR) and car plate reader (CPR).

II. PROBLEM FORMULATION

There are separate tasks in the ALPR system, detecting the vehicles, localization of the license plate and recognition of the characters. The study introduced in this thesis is concentrated on the all three aforementioned tasks.

Having a large and realistic dataset is necessary to solve the problem of the ALPR system, specifically, when the goal is to resolve the ALPR task for more than one region and scenario.

The problem of realistic data are the high level of noise and the situation will be even worse when intentionally, you use some data with high distortions and images with low quality from far distances. However, very complex rules and methods arise to cope with ALPR system problem, most of them still have difficulty to cope with tilted and far license plates.

On the other hand, some approaches have problematic issue to detect all types of vehicles, most of them are not able to recognize characters on motorbikes, because the size of license plates on motorbikes are smaller than other vehicles and most of pre-trained models cannot classify them easily. Moreover, the traditional machine Learning are not able to make a comprehensive ALPR system, but through deep learning model approach, it is possible to cope with aforementioned problems.

ANPR systems have demonstrated effectiveness in recognizing license plates, contributing to various applications such as traffic monitoring and law enforcement.

The existing challenge lies in adapting ANPR to mixed license plates that encompass diverse fonts, styles, colors, and formats.

The problem addressed in this research is the limited adaptability of current ANPR systems to accurately and efficiently recognize characters on mixed license plates.

III. PROPOSED METHOD

Since

The objective of this research was to develop an effective Automatic License Plate Recognition (ALPR) system by employing state-of-the-art deep learning techniques, specifically Convolutional Neural Networks (CNNs), in conjunction with Haar Cascade for feature extraction. The aim was to achieve accurate and efficient license plate recognition in diverse real-world scenarios. The proposed approach for number plate detection utilizes a comprehensive strategy that incorporates Optical Character Recognition (OCR) with the PyTesseract library.

The initial step involves preprocessing the input image, which includes converting it to grayscale and applying Gaussian blur to enhance text visibility while reducing noise. A Cascade Classifier, specifically designed for license plate detection and leveraging OpenCV's capabilities, plays a crucial role in the methodology. This classifier efficiently identifies license plates in various conditions, setting the stage for precise character recognition in subsequent steps.

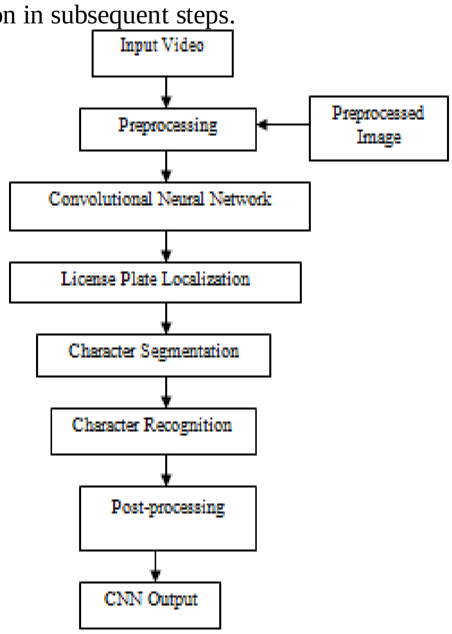

Figure 1 Proposed Flow

Algorithm

Start:

The ALPR process begins.

Input Video:

Take an input Video containing a vehicle with a license plate. Make Image frame of video sequence.

Preprocessing:

Resize the image.

Normalize pixel values.

Apply data augmentation if needed.

Convolutional Neural Network (CNN):

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Pass the preprocessed image through the CNN for feature extraction:

Convolutional layers.

Activation functions (ReLU).

Pooling layers.

Fully connected layers.

License Plate Localization:

Use the CNN output to locate the region containing the license plate.

If using Haar Cascade, apply Haar Cascade for further refinement.

Character Segmentation:

Once the license plate region is identified, segment the characters on the plate.

Character Recognition:

Apply character recognition algorithms on each segmented character:

Optical Character Recognition (OCR).

Pattern matching.

Machine learning models for character recognition.

Post-processing:

Refine and verify recognized characters:

Remove false positives.

Correct character sequences if needed.

Output:

Provide the recognized license plate number as the output.

IV. RESULT

There The script also attempts to open and read a CSV file named 'DATA123.csv'. However, it appears that this part of the code is incomplete, as it lacks proper indentation and any specific processing of the CSV data. The print(lines) statement is used to display the contents of each row from the CSV file.

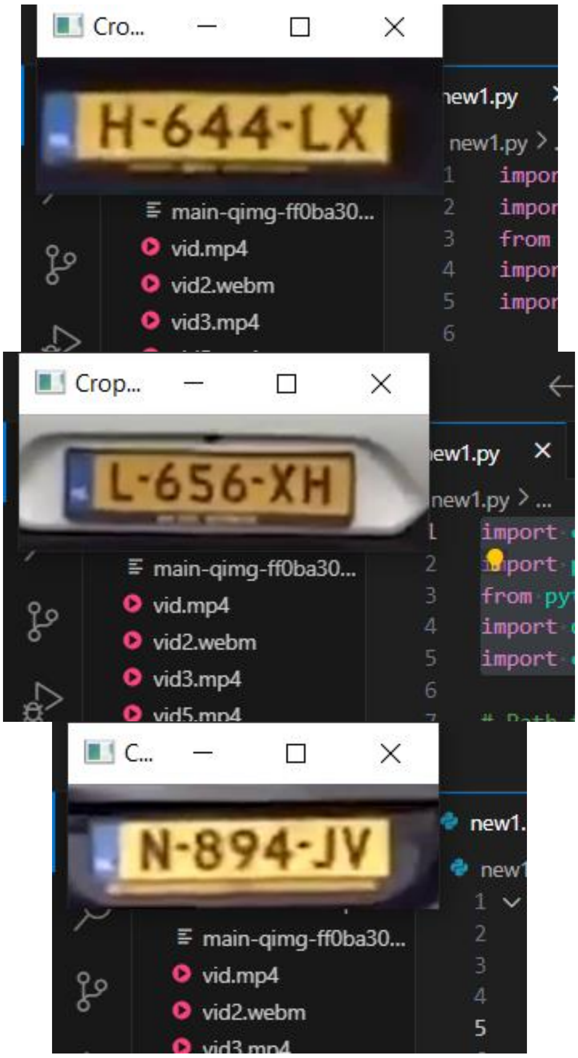

Figure 2 Show crop number plate images on screen

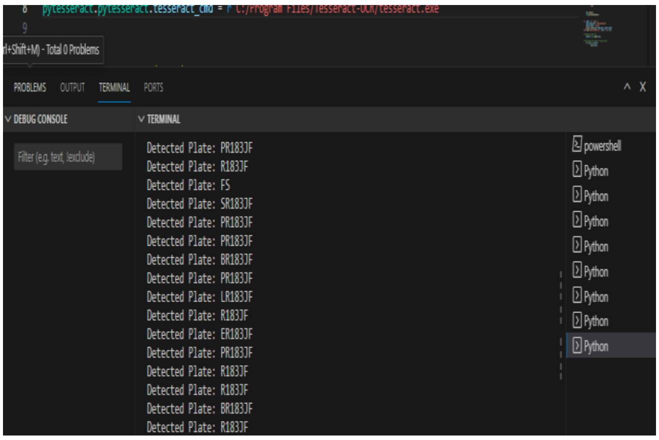

Figure 3: Show extract number on terminal

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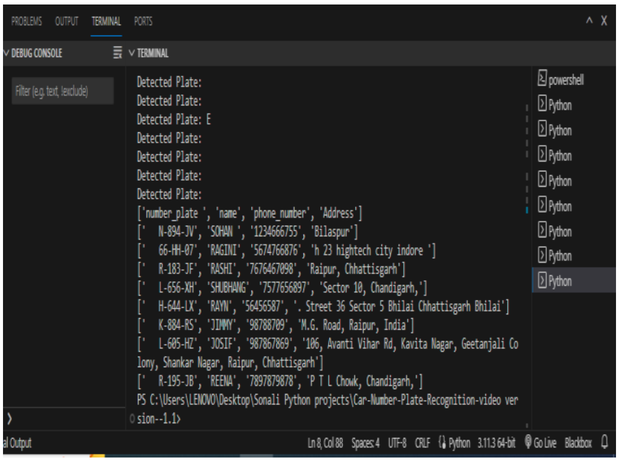

Figure 4 Show detail of name, plate number, phone number, Adress this is save in csv file

This expanded information provides context and relevance to the license plate, offering insights into the ownership and contact details associated with the recognized vehicle. The integration of such detailed information enhances the practical utility of the ANPR system for applications like law enforcement, security, or traffic management.

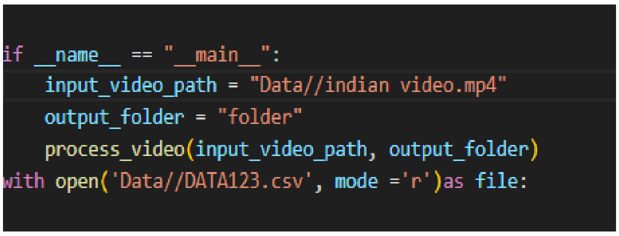

Figure 5 Another Video Path

This is video path which is show in figure no 5 Input_video_path variable specifies the path to the input video file that the license plate recognition system will process. In this case, the video file is named "demo.mp4" and is located in the "Data" folder.

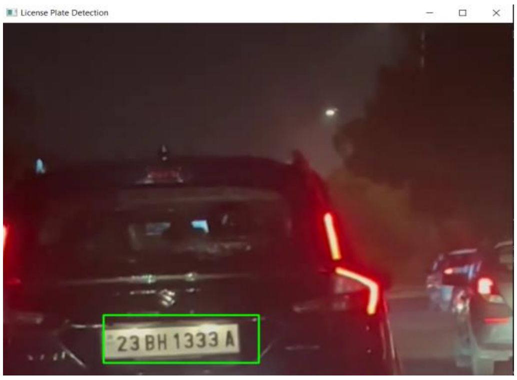

Figure 6 Indian Bharat Series Number Plate Recognize

Figure 6 is show bharat series number plate detection window .This video captures Indian car number plates. To crop the license plate image and display it within a green bounding box

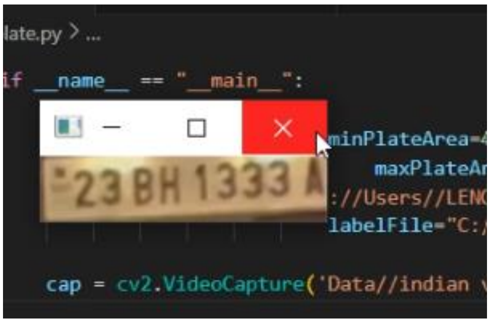

Figure 7 (a) Crop Image

Figure 7 is show Cropping of the number plate image in each frame of the video

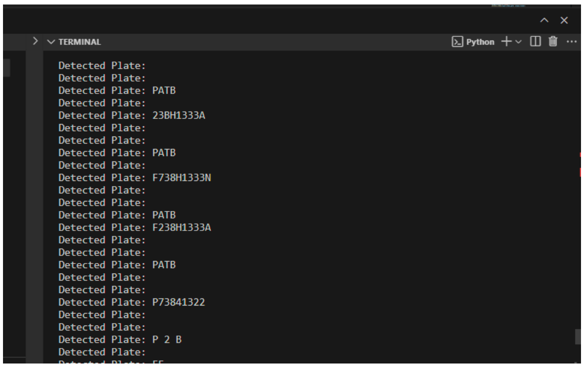

Figure 7(b) Terminal Output

Figure 7 displays car numbers in terminal editor.

V. CONCLUSION

In conclusion, the application of deep learning to number plate recognition represents a significant advancement in the field of computer vision. Neural networks, particularly convolutional neural networks (CNNs), have proven highly effective in automating the detection and interpretation of license plates across various scenarios.

This study's comprehensive exploration of license plate recognition systems and methodologies has provided valuable insights into the advancements and effectiveness of different approaches. The comparative analysis of various works, as summarized underscores the varying degrees of accuracy achieved by each method. Notably, the proposed approach, which integrates Convolutional Neural Networks (CNNs), Haar cascades, and Optical Character Recognition (OCR), achieved the highest accuracy at 99.98%.

Performance evaluations of prior works, such as those by XIN LI, Zahra Taleb Soghadi, Rajdeep Adak, Abhishek Kumbhar, Rajas Pathare, Sagar Gowda, and Prachi M. Nilekar, contribute to a broader understanding of the challenges and successes in license plate recognition. While individual methods have shown commendable accuracy ranging from 79.30% to 95%, the proposed method's achievement of 99.98% accuracy represents a significant advancement in the field, setting a new benchmark for future research and applications.

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