IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 11, Issue 5, May 2023

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.379

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 |

|| Volume 11, Issue 5, May 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1105219 |

Performance Evaluation of ANPR Systems with OpenCV, CNN, and YOLOv8: A Comparative Study

Dr. P. M. Hasabnis[1], Pooja Chugwani[2], Durga Rathi[3], Pallavi Zadokar[4], Vaishnavi Ingle[5], Anshul Kukade[6]

Department of Computer Science and Engineering, Mauli Group of Institution's, College Of Engineering and Technology, Shegaon, India[1,2,3,4,5]

ABSTRACT: Automatic number plate detection is an essential task in computer vision with various applications. In this study, we have compared three popular methods for automatic number plate detection, namely OpenCV, CNN, and YOLOv8. OpenCV is a computer vision library, while CNN and YOLOv8 are deep learning algorithms. OpenCV-based methods usually involve the following steps: image pre-processing, feature extraction, object detection, and post processing. CNN (Convolutional Neural Network) based methods usually involve training a neural network on a large dataset of images and corresponding labels. The trained network can then be used for automatic number plate detection on new images. YOLO (You Only Look Once) uses a single neural network to predict the bounding boxes and class probabilities for objects in an image. YOLOv8 has been shown to be very fast and accurate for object detection tasks, including automatic number plate detection. We evaluate the performance of these methods and compare their speed, accuracy, and complexity of implementation.

I.INTRODUCTION

Various methods have been proposed for automatic number plate detection, including traditional computer vision techniques, deep learning-based methods, and hybrid methods that combine both. OpenCV is a computer vision library that provides several built-in functions for image processing, while CNN and YOLO are deep learning algorithms that have shown high accuracy and speed for object detection tasks. Our objective is to evaluate and compare the performance of these methods and to analyze their strengths and limitations. This comparative study aims to provide insights into the advantages and disadvantages of each method and to help researchers and practitioners choose the most appropriate method for their specific application.

OpenCV: OpenCV (Open-Source Computer Vision) is a popular open-source computer vision and machine learning software library. It offers a wide range of image and video processing functions that can be used to build real-time computer vision applications. Automatic number plate detection (ANPR) is a common application of computer vision,
CNN: CNN stands for Convolutional Neural Network, which is a type of artificial neural network commonly used in computer vision applications, including automatic number plate detection. CNN is particularly useful for image recognition tasks because they are able to automatically learn features from images by applying a set of filters to each part of the image. This allows them to identify patterns and features that are important for recognizing the object in the image, such as edges, corners, and other distinctive featuresCNN is popular for license plate characterrecognition. [2]

YOLOv8: YOLO (You Only Look Once) is an object detection algorithm that is widely used in computer vision applications, including automatic number plate detection (ANPR). YOLOv8 is the latest version of this algorithm. YOLOv8 is a single-stage detector that is able to detect objects in an image in real-time. It uses a deep convolutional neural network to identify the location of objects within an image and classify them based on their appearance. This makes it a popular choice for applications where real-time processing is important, such as ANPR systems.

II.LITERATURE REVIEW

Over the years, several approaches have been proposed to perform Automatic number plate detection using different techniques such as edge detection, feature extraction, and machine learning algorithms. In recent years, deep learning based techniques such as OpenCV, Convolutional Neural Networks (CNN), You Only Look Once (YOLO) have gained popularity for ANPR. Deep learning-based techniques such as OpenCV, CNN and YOLO have shown great promise for Automatic number plate detection. These techniques have been shown to be highly accurate and robust in detecting and recognizing number plates in different scenarios.

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 |

|| Volume 11, Issue 5, May 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1105219 |

1. An Automatic Number Plate Recognition System using OpenCV and Tesseract OCR Engine: The proposed ANPR system is capable of using either Edge-detection or Template matching combined to mathematical morphology to ex-tract the number plate from the input image. Character recognition is done by the open-source Tesseract OCR engine. [1]
2. Automatic License Plate Recognition System for Vehicles Using a CNN: This system presents an efficient ALPR system that uses a CNN for character recognition. [2]
3. Automatic Number Plate Recognition (ANPR) using Yolo Algorithm: The proposed work consists of four main steps and deep learning model uses the Image AI library. [3]

COMPARISION BETWEEN THREE TECHNOLOGIES:

Comparison	**OpenCV**	**CNN**	**Yolov8**
Introduced	1 Jan 2000	1 June 1980	10 Jan 2023
Understandable	Easily	Difficult	Moderate
Accuracy	66%	80%	91%
Speed	Less	Speed is more as compared to OpenCV	Faster as compared to both
Cost effectiveness	Low cost	High cost	Moderate

III.PROPOSED SYSTEM

ANPR (Automatic Number Plate Recognition) is a technology that allows for the automatic detection and recognition of vehicle license plates from digital images. In recent years, ANPR has gained a lot of attention because of its potential for use in various applications, including parking management, traffic monitoring, and lawenforcement.

Architecture of OpenCV:

OpenCV (Open-Source Computer Vision) is a popular library of programming functions used for real-time computer vision. It is written in C++ and provides a collection of algorithms and tools for image and video processing, feature detection, object recognition, and machine learning.

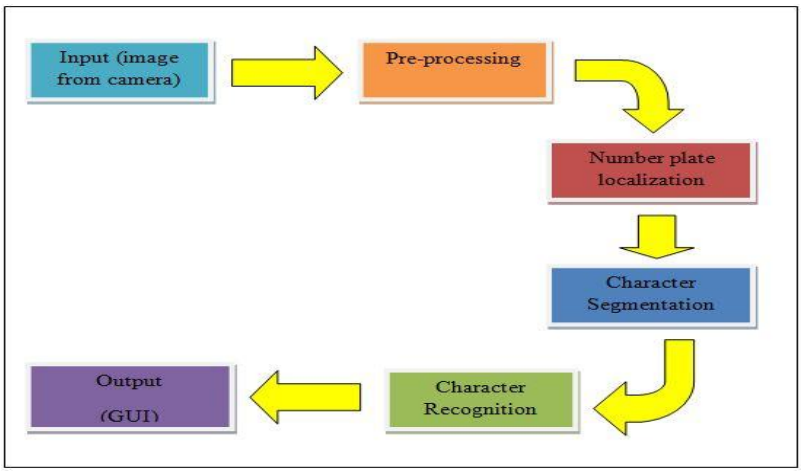

Fig 1: Working Process of OpenCV

The typical working process of OpenCV involves the following steps:

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 |

|| Volume 11, Issue 5, May 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1105219 |

1.Importing and loading the image or video data: OpenCV supports various file formats, such as PNG, JPEG, BMP, and MP4, and it provides functions to read, write, and display these files.
2.Pre-processing the data: Pre-processing stage prepares the captured image for the whole plate recognition process. It involves reducing the cost of computing the image information. The coloured image from the camera is grayscale using the OpenCV. [1]

3.Applying image processing algorithms: OpenCV provides a wide range of image processing algorithms for tasks such as edge detection, corner detection, featureextraction, image segmentation, and object recognition. These algorithms can be used individually or combined in complex pipelines.
4.Visualizing and analysing the results: After processing the input data, OpenCV provides functions for visualizing and analysing the results. For example, it can display the processed image or video, draw bounding boxes around detected objects, compute metrics such as accuracy or precision, or output the results to a file or network.
5.Interfacing with other libraries or languages: OpenCV can be used in conjunction with other libraries or programming languages, such as NumPy, SciPy, TensorFlow, or Python, to build complex computer vision applications.

Architecture of CNN:

CNN stands for Convolutional Neural Network. It is a type of deep learning algorithm that is widely used in computer vision applications such as image and video recognition, object detection, and segmentation.CNN is considered as a special architecture of artificial neural
networks and the top-performing model which is currently being employed by researchers in license plate recognition (LPR) systems [4]

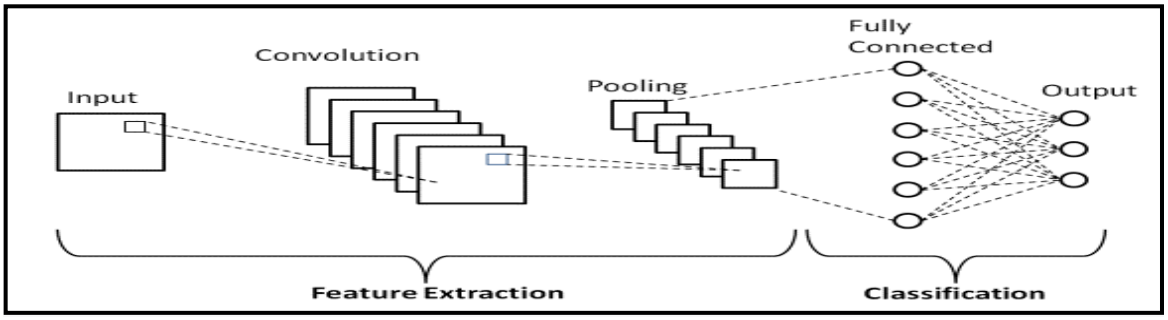

Fig 2: Architecture of CNN

A typical CNN architecture consists of the following layers:
1.Input layer: This layer accepts the raw input data, which could be an image, a sound waves,or any other multidimensional data with a grid-like topology.
2.Convolutional layer: This layer applies a set of learnable filters, also known as kernels, to the input data, extracting local features such as edges, corners, and textures. The output of this layer is called a feature map.
3.Pooling layer: This layer down samples the feature map, reducing its size and increasing its robustness to variations in the input data. The most common poolingoperation is max pooling, which selects the maximum value within a window.
4. Fully connected layer: This layer connects all the neurons of the previous layer to the output layer to produce the final predictions.
5.Output layer: This layer produces the final predictions, which could label for classification tasks, bounding boxes for object detection, or pixel-wise labels for segmentation tasks.

YOLOv8:
YOLOv8 is not a known version of YOLO (You Only Look Once) object detection model. However, I can provide you with a general overview of how YOLOv4 or other versions of YOLO can be used in an ANPR (Automatic Number Plate Recognition) system.

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 |

|| Volume 11, Issue 5, May 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1105219 |

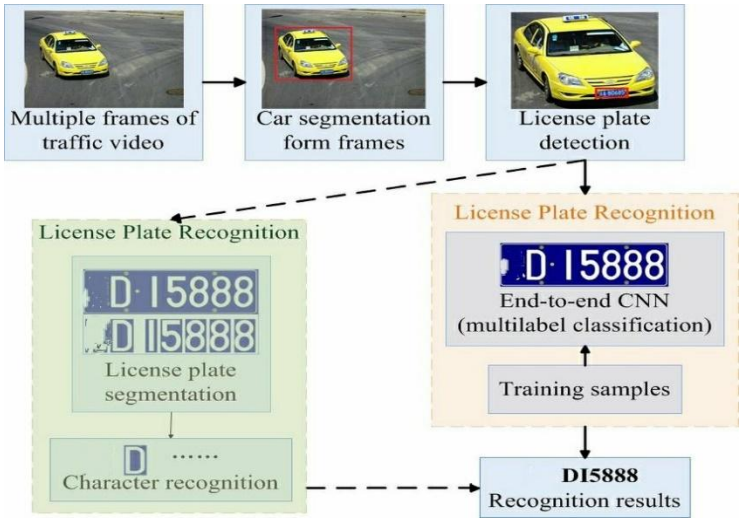

Fig 3:Architecture of YOLOv8

Regardless of the specific version of YOLO used, the working process for using YOLO in an ANPR system is similar. Here are the general steps:

1.Data collection: A dataset of images containing license plates is collected. The images may be captured from surveillance cameras or other sources.
2.Data annotation: Each image in the dataset is labeled with the location and content of the license plate using a bounding box annotation tool. This is necessary to train the YOLO model to detect license plates accurately.
3.Training the model: The labeled dataset is used to train the YOLO model using a deep learning framework such as TensorFlow or PyTorch. The YOLO model learns to detect license plates by processing the input images through multiple convolutional layers and predicting bounding boxes and class probabilities.
4.Post-processing: The ANPR system applies post-processing techniques such as noise reduction, filtering, and verification to improve the accuracy of the extracted characters.

Overall, using YOLOv4 or other versions of YOLO in an ANPR system can provide fast and accurate detection of number plates, which is a critical component of the system's performance. However, it is important to ensure that the training dataset is representative and diverse, and that the model is tested and validated on real-world data to ensure its reliability

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 |

|| Volume 11, Issue 5, May 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1105219 |

IV.RESULTS

1.OpenCV

Figure 4: Number Plate Detection using OpenCV

In fig 1 we take input image and perform some image processing techniques such as thresholding, edge detection, and morphological operations to detect and extract the number plate region by using OpenCV. The extracted region is then passed through an Optical Character Recognition (OCR) algorithm to recognize the characters of the plate.After image pre-processing, we get detected and recognized number plate by using OpenCV. OpenCV is a simple and efficient but by using this technology we didn't get accurate result. We got 66% of accurate result with the help of OpenCV.

2. CNN:

Figure 5: Number Plate Detection using CNN

For CNN algorithm we required trained dataset for annotated number plate images. So, we take the trained dataset for detecting and recognizing the character on the number plate. we get detected and recognized number plate by using

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 |

|| Volume 11, Issue 5, May 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1105219 |

CNN algorithm. CNN approach is accurate but slow and also it required a large amount of trained dataset. We got 80% of accurate result with the help of CNN.

3. YOLOv8:

Figure 6: Number Plate Detection using YOLOv8

In fig 3 we take input image for testing Car Number Plate by using Yolov8.In ANPR, YOLOv8 can be trained to detect the number plate region and recognize the characters on it. We got 91% of accurate result with the help of YOLOv8.
So, we had resulted all the three technologies and our study show that, the performance of three technologies varies in terms of accuracy, speed and processing time. The OpenCV approach is fast but less accurate, while the CNN approach is accurate but slow. The YOLOv8 approach offers a good balance between accuracy and speed.

ADVANTAGES

Efficient parking enforcement: ANPR technology can be used to monitor parking areas and detect vehicles that are parked illegally or have overstayed their allotted time. This enables parking enforcement officers to be more efficient in their duties, as they can quickly identify offending vehicles without having to manually check each car.

Improved security: ANPR cameras can also be used to improve the security of parking areas by monitoring incoming and outgoing vehicles. This can help to deter crime, such as theft, vandalism, or unauthorized access.

Accurate data collection: ANPR cameras can collect accurate data on parking patterns, such as the duration and frequency of parking, which can be used to inform parking management strategies.

DISADVANTAGES:

Privacy concerns: NPR systems collect and store large amounts of personal data, which can be used for tracking and surveillance.

Limited to certain types of vehicles: NPR systems are limited to recognizing license plates, and thus will not be able to recognize other types of vehicles such as motorcycles or bicycles.

APPLICATION:

1. Law enforcement.
2. Smart parking management.
3. Journey time analysis.
4. Intelligent traffic management.
5. Retail Park security.
6. Tollbooth records.

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 |

|| Volume 11, Issue 5, May 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1105219 |

V.CONCLUSION

Number plate recognition using OpenCV, CNN, and YOLOv8 is a sophisticated and powerful computer vision technique that can be used for a variety of applications. In order to determine the best model for an ANPR system, we carefully compare the three technologies i.e., OpenCV, CNN, and Yolov8 across a range of criteria including accuracy, speed, cost effectiveness, and other factors. Based on our evaluation, the accuracy of OpenCV is 66%, CNN is 80% and Yolov8 is 91% therefore by observing the accuracy of all the three algorithm's, we concluded that Yolov8 is the best model for an ANPR system. It provides the highest accuracy rate and the fastest processing speed, making it the most effective technology for real-time license.

REFERENCES

[1] Andrew Selasi Agbemenu, Jephthah Yankey's Automatic Number Plate Recognition System using OpenCV and Tesseract OCR Engine Volume 180 - No.43, May 2018
[2] Parneet Kaur1, Yogesh Kumar1, Shakeel Ahmed2, Abdulaziz Alhumam, Ruchi Singla3 and Muhammad Fazal Ijaz Automatic License Plate Recognition System for Vehicles Using a CNN vol.71, no.1 Posted: 2021-11
[3] Balkumar, Naveen M2, Siva Sakthi T3 Automatic Number Plate Recognition (ANPR) using Yolo Algorithm Volume 9 Posted: 2022-05
[4] Oladapo Ibitoye, Temitayo Ejidokun, Olufemi Dada Convolutional Neural Network Based License Plate Recognition Techniques: A Short Overview
[5] Priyesh Sharma1, Vyom Bansal2, Sabi Mustaqeem 3, Karan Maulekhi4, Pushpendra Singh5 Automatic License Plate Recognition using OpenCV Volume 07 Posted: 2020- 05
[6] Chinmayi Gurav, Vedika Kamble, Rupali Gurav, Neha S. Sakhalkar A Review Paper on Vehicle Number Plate Recognition Volume 04 Posted:2019-04
[7] Dr.Vishwanath Burkpalli*1, Abhishek Joshi*2, Abhishek B Warad*3, Akash Patil*4 Automatic Number Plate Recognition Using Tensor flow and EasyOCR Volume 04 Posted: 2022-09

INNO SPACE
SJIF Scientific Journal Impact Factor

Impact Factor: 8.379

doi cross ref

ISSN INTERNATIONAL STANDARD SERIAL NUMBER INDIA

निस्केयर NISCAIR

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

9940 572 462 6381 907 438 ijircce@gmail.com

www.ijircce.com

Scan to save the contact details