Robust Approach of Automatic Number Plate Recognition System Using Deep CNN

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Abstract – Automatic License plate / Number plate / Registration plate recognition is recognized as an automation which evolved mostly based on image processing techniques. It has been extensively used in recognizing vehicles in applications such as red-light enforcement, over speeding, parking control, toll collection. The main objective of the paper is to identify the most well-planned way to identify the registration plate from the digital image (gained from the camera) and recognize with high accuracy. ANPR is employed to localize the license plates, segment each character and extract the text from the license plate and then recognition each character successfully. The main issue of registration plate recognition rely on the accuracy rate. Advancement in deep learning methods has improved the ability to solve visual recognition task. Henceforth using deep Convolutional Neural Networks (DCNN) will intensification the precision, recall, processing speed, reduce the error rate in solving the ANPR process. The use of deep learning CNN helps in identification of license plates of any aspect ratio which would work good for places like India where license plate style differs remarkably. The CNNs are up skilled and balanced so that they are strong under various states like variations in pose, lighting, occlusion etc. In our dataset we have used 100 images to train our network and obtained an 99% accuracy for plate localization and 93% accuracy for recognition.

Keywords – ANPR, CNN, Deep Learning, Recognition.

I. INTRODUCTION

With increase in the count of vehicles each day vehicle traffic monitoring becomes a challenging task. It becomes hard to recognize the vehicle or person who violates road traffic rules and does not obey the road safety rules and drives fast.

There are several ANPR systems available now-a -days, these systems are based on different methodologies w.r.t factors like vehicle number plate which are non- uniform, with different languages, illumination effects etc.

The key intention of this project is to find the efficient way to recognize the license plate registration information with high accuracy.

This process usually comprises of three main steps.

1. Localization of License plates.
2. Segmentation of the characters in the detected plate.
3. Recognition of the characters

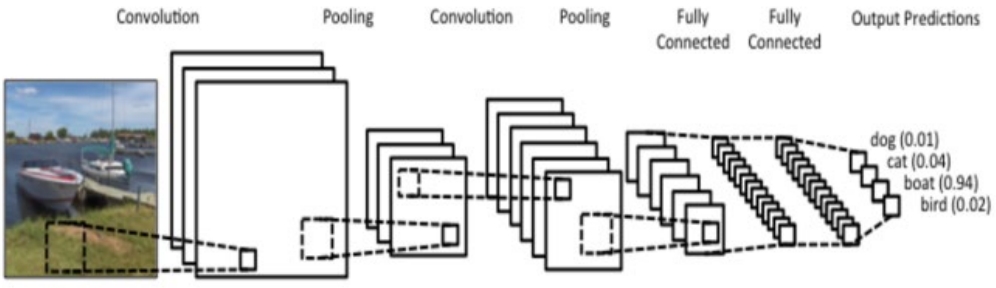

Fig 1. Deep Convolutional Neural Networks.

Image classification and image recognition is the foundation of any computer vision problems such as detection, segmentation, and recognition. The major hindrance of other approaches (neural networks) was accuracy of the classification task in the feature extraction stage.

Hence Deep learning models are used which exploit multilevel layers of non-linear data processing for feature extraction and transformation, pattern analysis and classification.

In Deep CNN the intermediate layers are "fully connected". However, in case of CNN each neuron is connected to a target group of neurons (or a patch). **Fig 1** shows deep convolutional neural networks.

II. LITERATURE SURVEY

The ALMD-YOLO framework yields new state-of the-art accuracy with the introduction of an attention-like pre positive CNN model. Anyhow, the multi-directional license plate detection method presented in this paper can handle challenging real-world scenarios very well. Canny edge and sobel edge methods are some of the edge detection techniques that has been incorporated. For character extractions Combined feature of Vertical Traverse Density VTD vector and Horizontal Traverse Density HTD vector has been applied [1]. In this paper author uses a deep learning system based on CNN model for License Plate localization and recognition. To ensure the correct functioning of localizing and recognition system, a certain number of pre-processing steps have been applied in the image. These steps involve a certain geometric filtering, adaptive thresholding, morphological operations, fine contours etc. How to improve the system accuracy rate in the license plate detection and recognition is discussed in future work [2].

Corneeto,G et.al [3] suggests to categories images based on scenes. The network which is pretrained is used jointly with classifiers to group scenes or sections into eight various classes. Similarly, the impact of different colour spaces such as HSV, CIEL, RGB, and YCbCr is used to evaluate the accuracy of the suggested system for scene classification using CNN in contrast with the classification accuracy. The investigation is experimented on the standard OT benchmark data set which includes eight categories. The study shows that classification accuracy is affected by various colour space representation and intensity of the planes, and colour-to-gray scale conversion techniques will also affect the conductance of ALPR.

III. METHODOLOGY

The key ideas of DCNN are 1) to apply deep convolution networks (DCNN) for classification and feature extraction and to learn a single classifier for detecting Number plate from multiple views, 2) to minimalize the complexity and simplify the detector as much as possible. The representation of the Deep Convolution Neural Network based proposed methodology is shown in **Fig 2.** The process of convolution includes the formation of the featured extraction layer by increasing the values in the filter by multiplying the value with the original pixel values of the image.

To reduce variations and noise the inputs received from the convolution layer are smoothened. After localizing the number plate registration characters are segmented and recognized. **Fig 3** shows data flow of DCNN and **Fig 4** shows phases involved in ALPR.

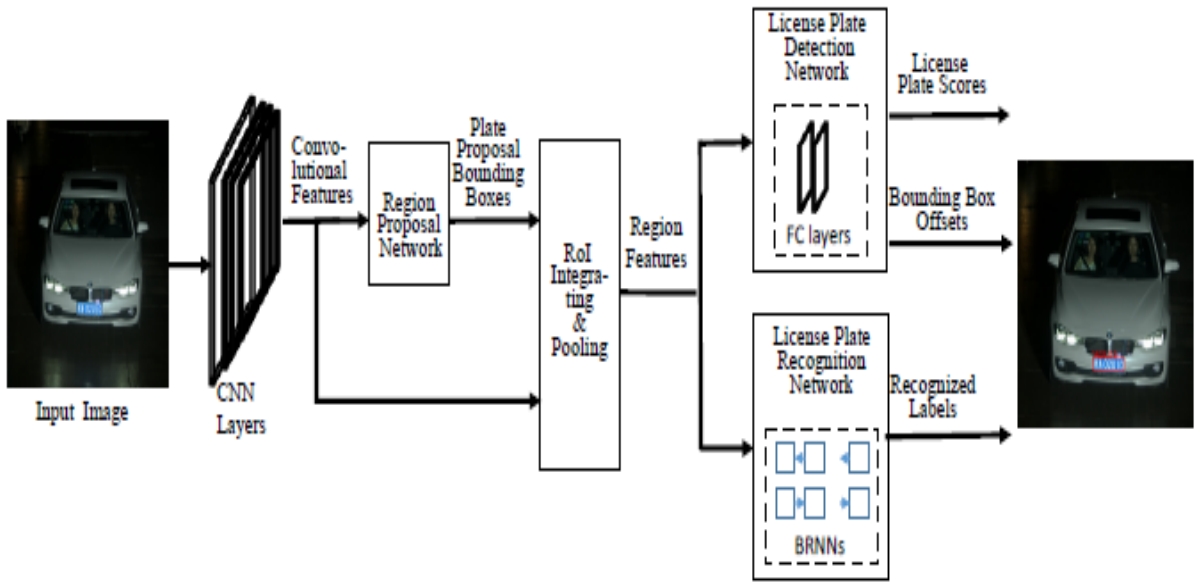

Fig 2. Structure of Proposed Model for Number Plate Recognition.

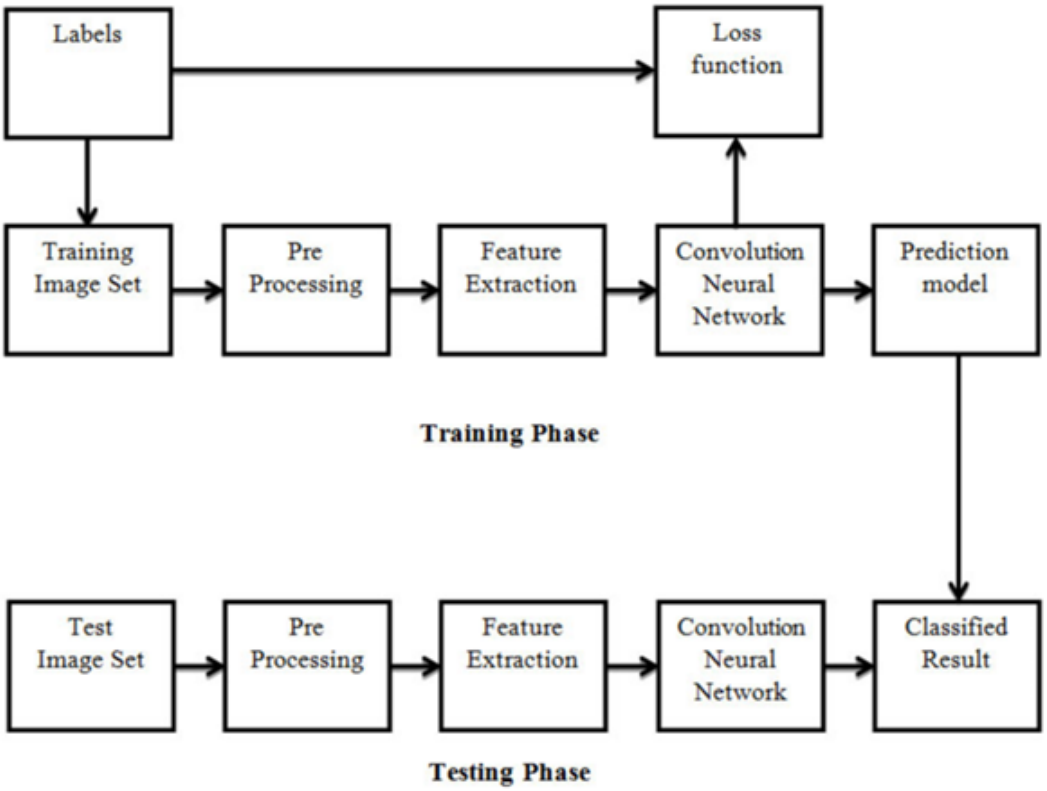

Fig 3. Data Flow of DCNN.

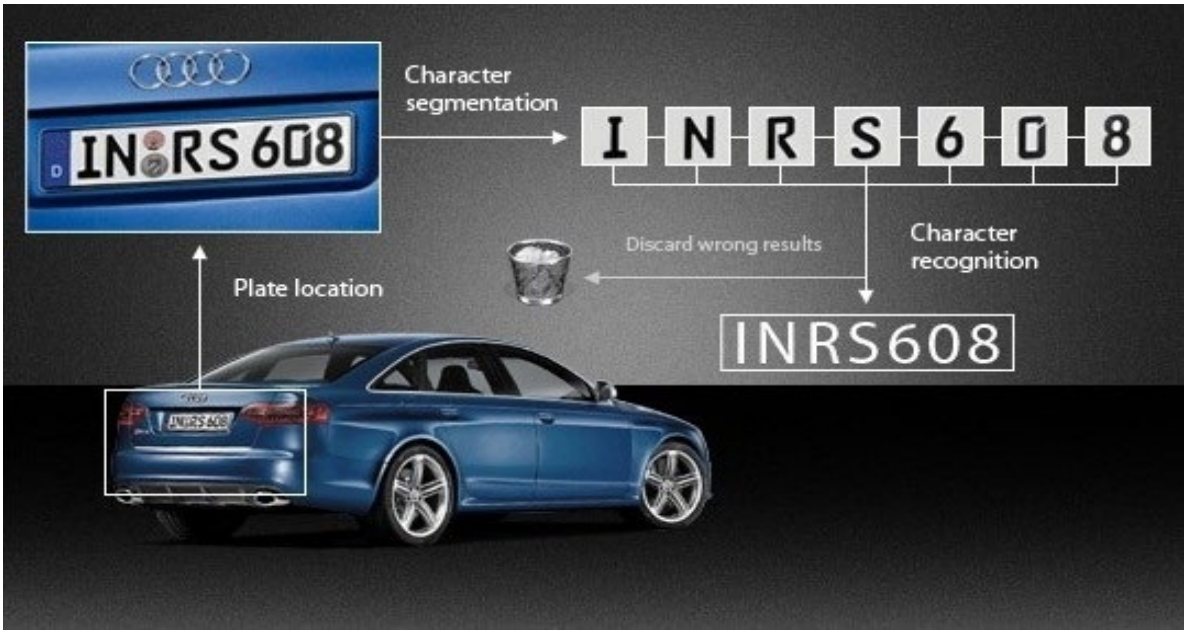

Fig 4. Phases involved in ALPR.

License Plate Detection

This is the initial step and at the end of this step, we will be able to recognize the position of the license plate on the vehicle. For this, we need to translate the input image to gray scale. In a gray scale image, each pixel is the range of 0 to 255. Then the gray scale image is transformed to a binary image with pixel values as complete black or white [4]. **Fig 5** shows input vehicle image and **Fig 6** shows number plate localization.

Fig 5. Input Vehicle Image.

Fig 6. Number Plate Localization.

Segmentation

It is the second stage in Automatic Number plate recognition. There are some issues in the number plate retrieved from the first step such as spots, tilt, dirt and different lighting condition across the registration plate [5].

Yet, these issues can be resolved by pre-processing techniques such as histogram, vertical edge projection and mathematical morphology techniques [6]. After the retrieval of the Number plate, the subsequent step is separation of the license plate. This method partitions the images into separate characters or divide an image of characters to sub images of individual character. This stage is important in any ANPR system as individually separated character will control the character recognition accuracy rate [7].

Recognition

For this process we use CNN classifiers and statistical classifiers, and the multilayer feed forward networks are used for character identification. The classical training method is used, the network is trained for several cycles to attain good performance.[8] The number of hidden layers and the respective neurons has to be defined during the training of network.[9] The recognition process is time consuming, and training process requires large amount of datasets, and involves high computational cost. Advantage associated with DCNN is accuracy and better feature extraction [10]. **Fig 7** shows license plate recognition using CNN.

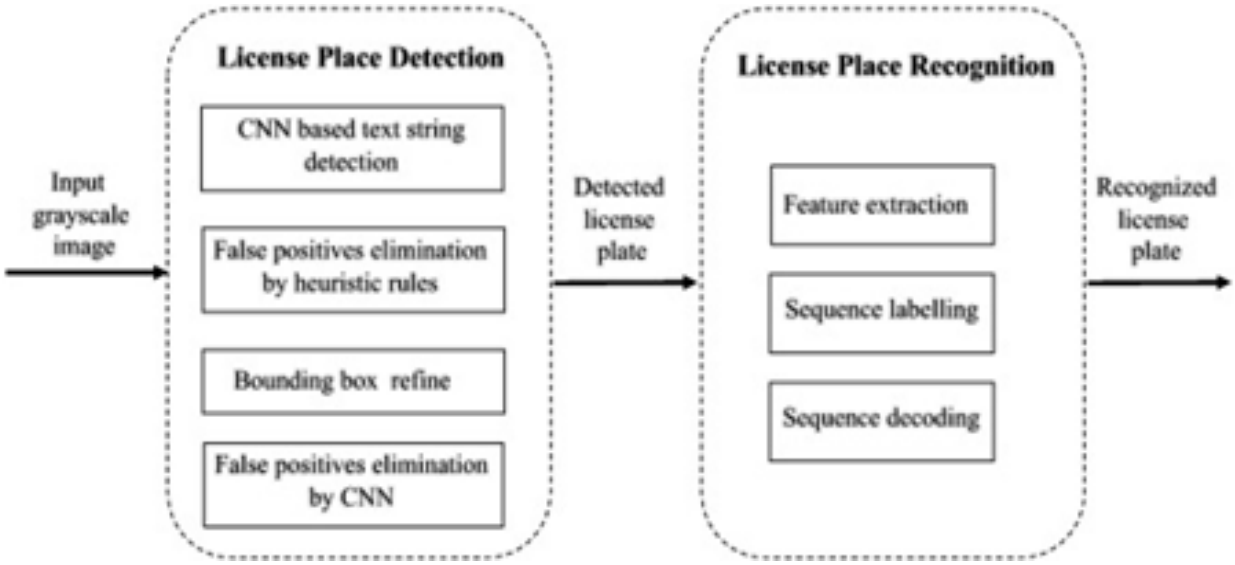

Fig 7. License Plate Recognition using CNN.

IV. ALGORITHM

1. The whole vehicle image frame is taken as input, from that license plate part is cropped from the entire frame.
2. Necessary preprocessing are done and convert the input image to grayscale image which is easy to compute in any image processing applications.
3. The grayscale image and the threshold image is given as input. Apply the findcontour function to detect the edges to extract the characters from the threshold image.
4. After localizing the license plate and image os resized to 1:6 aspect ratio and again apply the preprocessing

operation.

5. A Trained CNN classifier is used for recognition. The model is trained with 100 training images with characters from A-Z and 0-9
6. The final layer has softmax function. The Root Mean Square optimizer is used in the classifier with learning rate strating from 0.01 and gradually decrease by 0.005 after each epoch and repeat for 5 epochs.

V. RESULTS AND DISCUSSION

The objective of the paper is to suggest and design a deep learning technique based Automatic license plate recognition system and test whether it encounters real-life application necessities like metrics valuation, precision of recognition and computation speed. The major need for a recognition system lies on where it is applied, nevertheless the requirements are it must be nearer to manual recognition accurateness, as specified former to be around 98% for our dataset, and rather computation speed to run on video streams in real time without reducing more frames. The estimated precision condition might be reduced if the architecture had a higher correctness level, when it is required for manual-assistance. The final part of the project was to assess if the architecture can encounter the need of easily acclimating to a collection of various real-time applications. In our dataset we have used 100 images to train our network and obtained an accuracy of 99% for plate detection, 93% for character recognition. **Fig 8** shows the obtained output, **Fig 9** shows segmented license plate and **Fig 10** shows desired output on the console. **Table 1** shows summarized result of training.

Table 1. Summarized Result of Training

Training Dataset	Threshold	Mismatched Char	False Positive	Accuracy
51	70%	16	1	96.1%
55	70%	10	1	97.3%
56	60%	9	1	97.6%
54	75%	12	0	97.1%
59	70%	43	2	89.5%

Fig 8. Obtained Output.

Fig 9. Segmented License Plate.

```
C:/Users/user/Desktop/Main Program/corimg1.jpg
Do you want to see the Intermediate images: y
corrected No. Recognized: DL10CTS806
alternative No. Recognized: DL10CT580S
Press any key to continue...
```

Fig 10. Desired Output on The Console.

Metrics Evaluation

Fig 11 shows accuracy, **Fig 12** shows MCC, **Fig 13** shows F1 score, **Fig 14** shows precision and **Fig 15** shows recall.

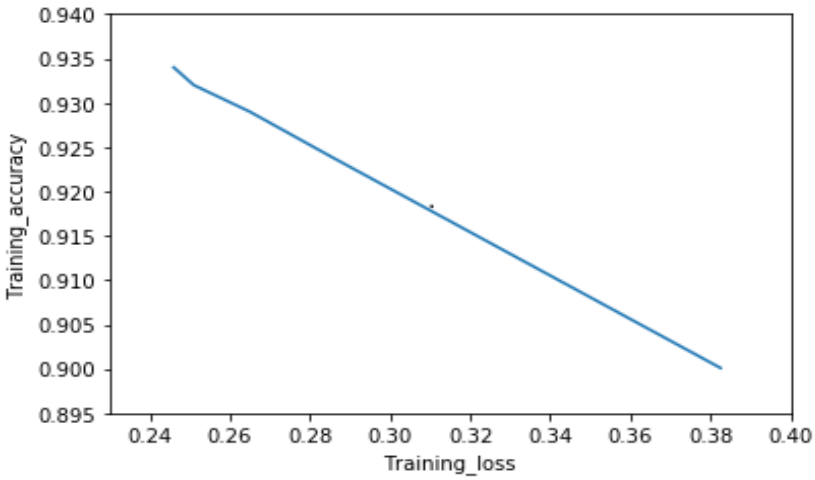

Fig 11. Accuracy.

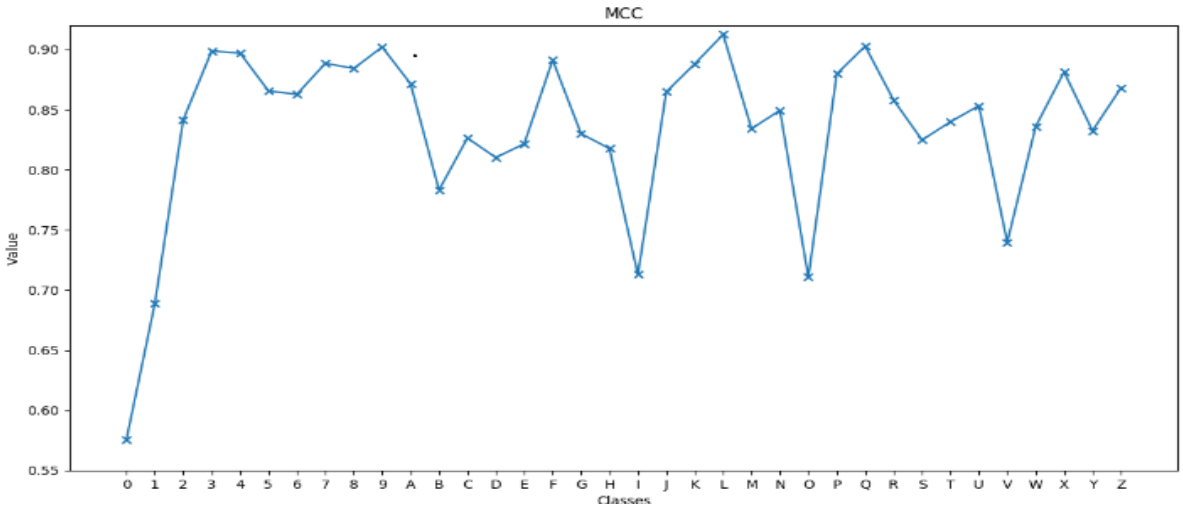

Fig 12. MCC.

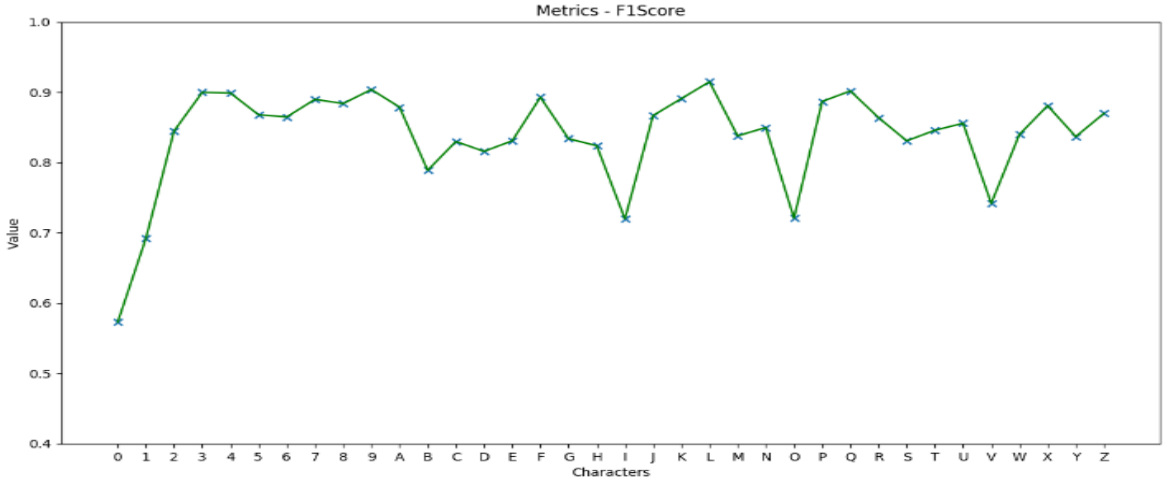

Fig 13. F1 Score.

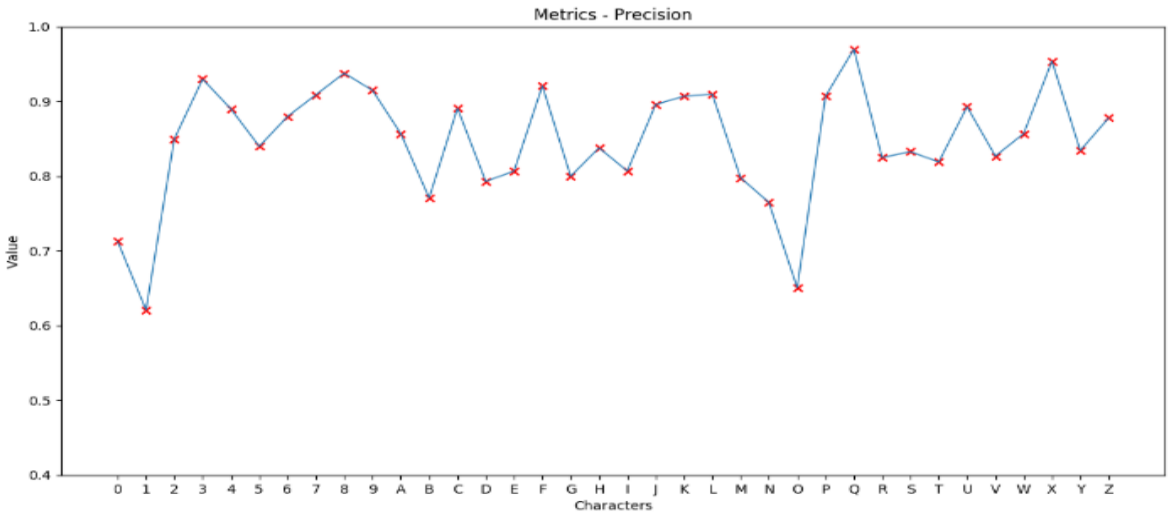

Fig 14. Precision.

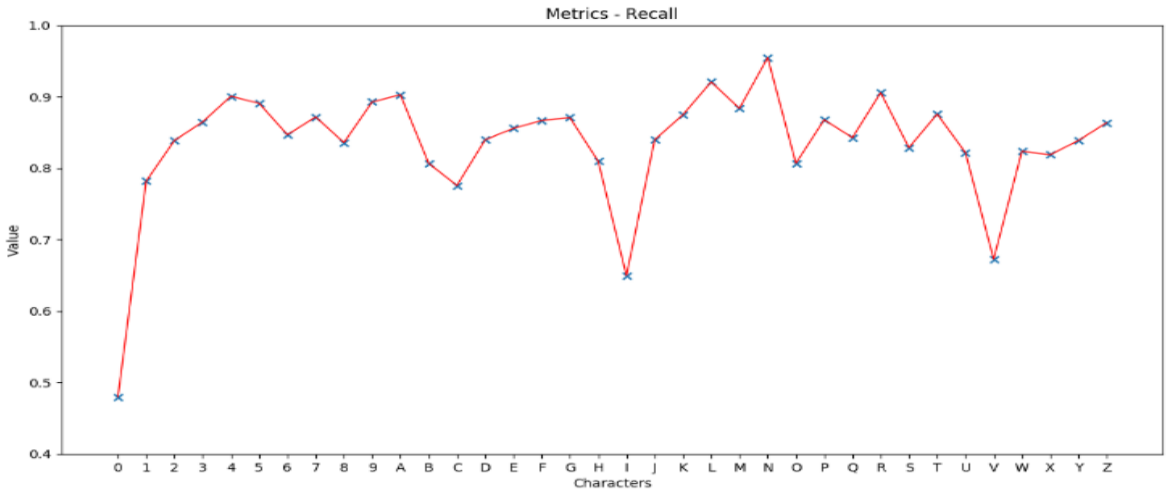

Fig 15. Recall.

VI. CONCLUSION

The license plate detection and localization will be achieved by Deep CNN, so that using Deep CNN license plate can be detected very efficiently and robustly. License plate recognition method proposed is based on the depth in the convolutional neural network recognition rat performance than other methods of the prior art, but also relatively time efficiency short, effective and reasonable application, greatly improving the accuracy of license plate recognition, and when the license plate characters in the harsh environment can enhance the recognition rate and robustness of the license plate characters, the method proposed by the present invention has a strong practical value .

Examine the likelihood for Portability

Though the planned technique is having high computation complex, it can be conceivable to port it to mobile phones with enough computation speed. All contemporary mobile phones have integrated GPUs and by minimizing the system results an arbitration between accuracy forecasting and processing speed, we hope an ANPR system using the projected method would be suitable for on portable mobile phones.

Data Availability

No data was used to support this study.

Conflicts of Interests

The author(s) declare(s) that they have no conflicts of interest.

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Competing Interests
There are no competing interests

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