



Automatic Number Plate Recognition (ANPR): an Experiment

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Automatic Number Plate Recognition (ANPR): An Experiment

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Abstract: The objective of ANPR is to extract vehicle license plate information from number plate of vehicles. As the traffic control and vehicle owner identification is a major issue in every country, it is important to develop such device which automatically detect those vehicle owner who violates traffic rules and drives fast. There are many ANPR systems are present but there is challenging factor like accuracy of extraction, speed of vehicles, lightening condition, quality of images. In this paper, different methods of ANPR and emerging technologies are used to get accurate result. The important work is the detection and recognition of the number plate which is accomplished by the Convolution Neural Network (CNN). Reason to choose CNN is the high accuracy of 90% even with very low training size. We categorize many ANPR techniques as per their features they used in each stage and compare them in terms of their advantages and disadvantages, accuracy and processing speed.

Keywords: Automatic Number Plate Recognition (ANPR), Character Segmentation, Number Plate, Optical Character Recognition(OCR), Convolution Neural Network (CNN).

1. Introduction

Automatic number plate recognition (ANPR) plays an important role in many real-life applications such as automatic toll collection, traffic laws, parking access control, and road traffic monitoring. As vehicles are increasing day by day, it is hard

to keep their record manually so we need ANPR system.

And also road accidents, road traffic are increasing that also cause usage of ANPR System. As we all know that the traffic system in developed cities like Dubai, Canada, Italy etc. is pretty good as compared to developing country like India just because of automatic number plate recognition systems. Just because of these systems, the traffic rules are strictly followed by citizens otherwise action will be taken against them. Also the number of accident are also reduced because of ANPR system so it is necessary to implement ANPR system to whole India or other developing country for their development and protection of citizens.

ANPR recognizes a vehicle's license plate number from an image taken by a camera. It is fulfilled by the combination of lots of techniques such as object detection, image processing, and pattern recognition.

Systems of the ANPR use many methodologies such as Artificial Neural Network, Probabilistic neural network, Optical Character Recognition, Back-Propagation Neural Network, inductive Learning, Convolution Neural Network. The limitation of previously model was the accuracy of the system and time taken by system to recognize the number plate, but in this paper we use latest and emerging technologies which help the system to maintain the accuracy of model and make it faster and better to extracts the number

plate.

The important work is the detection and recognition of the number plate which is accomplished by the Convolutional Neural Network (CNN). Reason to choose CNN is the high accuracy of 90% even with very low training size. Convolutional neural networks have been one of the most influential innovations in the field of computer vision. They have performed a lot better than traditional computer vision and have produced state-of-the-art results. These neural networks have proven to be successful in many different real-life case studies and applications, like:

- Image classification, object detection, segmentation, face recognition;
- Self driving cars that leverage CNN based vision systems;
- Classification of crystal structure using a convolutional neural network;

2. ANPR System Model

ANPR algorithms can be divided in four steps:

- (1) Vehicle image capture
- (2) Pre-processing
- (3) Number plate detection
- (4) Character segmentation and
- (5) Character recognition

All the papers and methods cover all the 5 process. As it is shown in Fig.1, the first step is to capture image of vehicle, it looks

quite easy but it is very difficult to capture image of moving vehicle in real time such that all the numbers and alphabets clearly visible. After capturing the image, pre

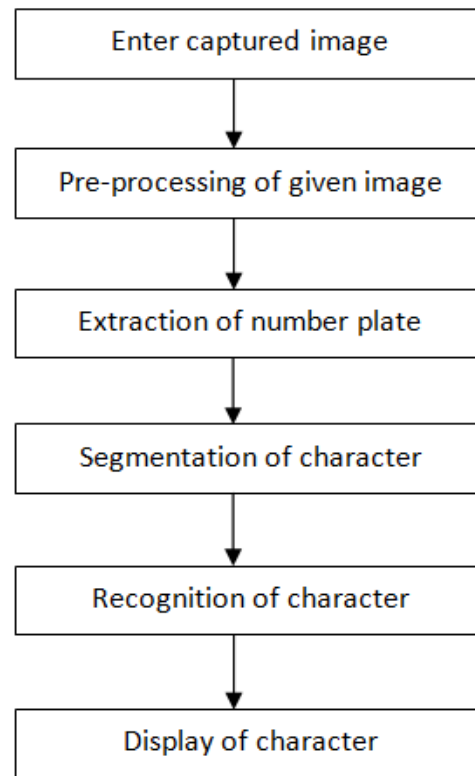


Fig: Flow diagram of ANPR

processing is done so that it is easy to extract the number plate. Most of the models cover two techniques.

1. RGB to gray scale conversion using Average method.
2. Edge detection and noise reduction using Sobel Operator.

After the pre processing dilation is done for the removal of stationary objects and background image. As the dilation complete image will be ready for the number plate detection using Hough transform. Then the final step character recognition comes which is done by using Optical character recognition technique and Histogram approach.

2.1 Image Acquisition

First step is to capture the image of car using digital camera connected with PC. The captured image is in the RGB format

so we need to convert it into suitable form for further process of the Number Plate extraction. The captured image is further process for detection of number plate.



Fig-2.1: Captured image by camera

2.2 Image Processing

After capturing the image, preprocessing is done. The main function of this process is to enhance the quality of the image that will be used for the character recognition. The captured image is influenced with many elements such as: quality of image, brightness of image, lack of presentation, motion of the camera and the bad influence to the further image processing. Various processes that we are going to apply are converting RGB image to Grayscale, noise reduction and binarization of image.

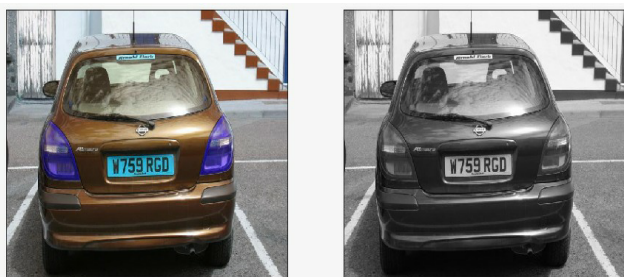


Fig-2.2: Conversion of RGB into gray scale

2.3 Plate Localization

As the preprocessing of image is done, the next task is to detect the number plate from the given gray scale image. The basic idea behind the recognition is to identify the plate size. For doing so, we have many methods

like Sobel's edge detection method and Hough's Line detection method. Further by using the intersection points of the shapes, we get to know whether it is a rectangle of not depending upon the number of points in the group. As we get point of rectangles, we successfully extract the rectangular parts from the image, out of which we are able to find the license plate depending upon the properties of plate like major and minor axis length, area, bounding etc.

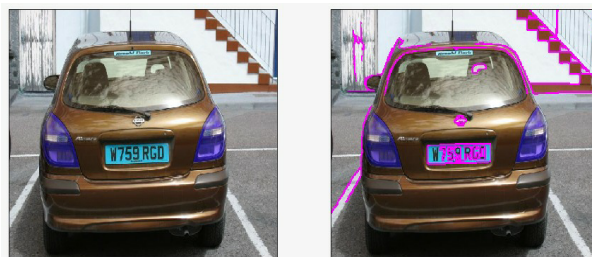


Fig-2.3: Detection of license plate

2.4 Plate Segmentation

After detecting the number plate, segmentation of plate is done. Character segmentation is done on the binary image of the extracted license plate. Segmentation is one of the most important processes in the automatic number plate recognition, because all further steps depend on it. If the segmentation fails, a character can be improperly divided into two pieces, or two characters can be improperly merged together. We can use a horizontal projection of a number plate for the segmentation, or one of the more sophisticated methods, such as segmentation using the neural networks. In this segmentation we use two types of segmentation: 1. Horizontal segmentation 2. Vertical segmentation. First we have performed vertical segmentation on the number plate then the characters are vertically segmented. After performing vertical segmentation we have to perform horizontal segmentation by doing this we get character from the plate.

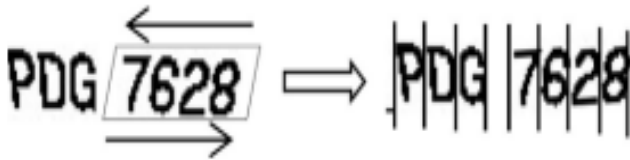


Fig-2.4.1: Segmentation of image

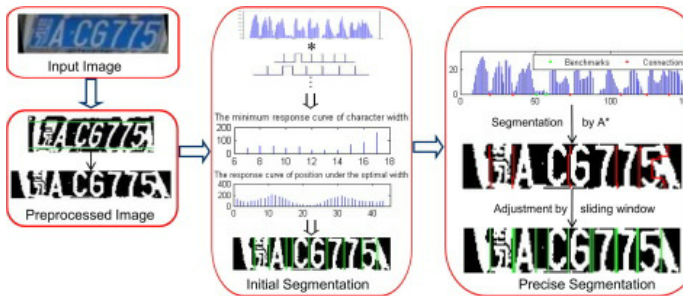


Fig-2.4.2: Segmentation of image

form of description, which is more suitable for computers. The classification is based on the extracted features. These features are then arranged using either the statistical, syntactic or neural methodologies. Distinctive strategies were used for character recognition, letters and characters in the paper. The extracted characters taken from number plate and the characters on database which we have stored are presently coordinated. The following phase is template matching. Another technique for character recognition is the optical character recognition (OCR) is used to look at the every individual character against the complete alphanumeric database. The OCR really uses relationship strategy to match individual character and finally the number is recognized and stored in string format in a variable. The character is then contrasted and the database for the vehicle authorization. The resultant signs are offered according to the consequence of comparison. Templates will exist for every one of the characters i.e. A-Z and 0-9 as appeared in figure.

2.5 Character Recognition

After segmentation of image, character recognition is done. This is the most basic and essential phase of ANPR model. In this process, we have to recognize the characters, we should perform feature extraction which is the basic concept to recognize the character. The feature extraction is the process of transformation of data from a bitmap representation into a

A B C D E F G H I J K L
M N O P R S T U V Y Z
0 1 2 3 4 5 6 7 8 9

Fig 2.5: Character used for template matching



Table. A1- Summary of ANPR related works

S.No	Year	Title	Technique	Result/Accuracy
1	2018	Automatic Number Plate Recognition	Using Matlab	82.6%
2	2018	A vehicle number plate recognition system	region-of-interest based filtering method	89%
3	2015	ANPR(Automatic Number Plate Recognition)	ALR(Automatic Line Tracking Robot)	87%
4	2017	Multi-task Convolutional Neural Network System for License Plate Recognition	Multi-task Convolutional Neural Network System	98%
5	2012	License Plate Recognition: A Review	Artificial Neural Network	88%
6	2016	research papers on license plate recognition (LPR)	Using Matlab	86%
7	2007	morphological based LPR	using dilation	83%
8	2017	LPR in ANPR systems	Using dilation	91%

9	2010	automatic license plate localization	using the filtering approach	98%
10	2013	using the filtering approach	motion detection	87.4%
11	2016	Vehicle Number Plate Recognition System: A Literature Review and Implementation	using Template Matching	80.8%
12	2013	Automatic Number Plate Recognition System (ANPR): A Survey	Artificial Neural Network (ANN)	99%
13	2017	License Plate Recognition Using Convolutional Neural Network	Convolutional Neural Network	98%
14	2016	Automated Car Number Plate Detection System to detect far number plates	Using Matlab	80%
15	2017	Automatic Number Plate Recognition Using CNN Based Self Synthesized Feature Learning	Using CNN	90%
16	2011	Automatic License Plate Recognition (ALPR): A State of the Art Review	Using ANN	86%
17	2019	Automatic Vehicle License Plate Extraction	Using CNN	92%

3. Table of comparative methods

S . N o	Title	Pub.Na me/org.	Publis hing Year	Technology	Drawback	Acc urac y	Summary
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1	Automatic Number Plate Recognition	Kashyap /IEEE	2018	<p>A. Binary Image Processing</p> <p>1) Gray-Level Processing</p> <p>2)Color Processing</p> <p>B. Adaptive Thresholding</p> <p>C. Contrast Extension</p> <p>D. Median Filtering</p> <p>E. Character Segmentation</p> <p>F. Feature Extraction</p> <p>G. OCR by use of Template Matching</p> <p>H. MATLAB</p> <p>ALGO-USED:</p> <p>1.Soble filter technique</p> <p>2.MACH filter</p> <p>3.Bayes' method</p> <p>4.Histogram equalization</p> <p>5.Regionprops of Matlab</p> <p>6.Zonal density feature</p>	Low accuracy	82%	<p>1. Image processing concept is used in ANPR.</p> <p>2. Number plate area detection.</p> <p>3. OCR scheme is also applied in this for reading the image of vehicle number plate.</p> <p>4. The concept of ANPR system is based on the matching of templates and exactness (result) of this system was established as 75-85% for Indian number plates.</p>
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2	License Plate Recognition of Myanmar Vehicle Number Plates A Critical Review	Nwe Ni Kyaw/IEEE	2018	<p>1. Pre-processing and Noise removal-Histogram Based Method</p> <p>2. Plate Localization and Segmentation-K means and fuzzy k - means method</p> <p>3. Feature Extraction and matching-Template from database</p> <p>4.Performance evaluation-by K-means segmentation method</p>	<p>1.Development of large databases of various types of plates of different types of vehicles.</p> <p>2.</p> <p>Considering not only still images but video frames of moving images, which means online and offline recognition that would be useful for all automated vehicle management system.</p>	98%	<p>This paper studies major research contributions on LPR for various license plates of different countries. An emphasis is made to find out the current status of the work for Myanmar vehicle number plates. An extensive survey of related research suggests few important observations which are highlighted along with few recommendations that could overcome the major challenges of existing research in context with.</p>
3	Automatic Number Plate Recognition System : A Survey	Chirag Patel/IJCA	2013	<p>1.Plate Localization :-Image binarization is used.</p> <p>2.Edge detection: By Sobel,or Canny algo used.</p> <p>3.Hough Transform(detect position of shape i.e circle or oval).</p> <p>4.Blob detection – to detect points of diff in brightness.</p>	<p>Certain factors like different illumination conditions, vehicle shadow and non-uniform size of license plate characters, different font and background color affect the performance of ANPR</p>	85%	<p>In this Paper, different approaches of ANPR are discussed by considering image size, success rate and processing time as parameters. Towards the end of this paper, an extension to ANPR is suggested.</p>
4	Vehicle Number Plate	Umadevi V./IJCA	2016	<p>1.Sobel filter</p> <p>2. Contourlet Transform and</p>	<p>1.Low Accuracy.</p> <p>2.Can be further use as</p>	80.8 %	<p>The ANPR system has been implemented</p>

	<p>Recognition System: A Literature Review and Implementation using Template Matching</p>			<p>Support Vector Machine (SVM) :were used in to find out the model of the vehicle</p> <p>3.OCR algorithm based on feed-forward neural network</p> <p>4.Neural network</p> <p>5.the binary images of the characters are resized to the same size</p> <p>6.No. plate Localization: width by height factor is set between 3 and 7</p> <p>7.Contrast extension by Histogram equalization</p> <p>8.Median Filtering</p> <p>9.Character Segmentation:Regionprops fn of MATLAB.</p> <p>10.Template Matching</p>	<p>recognition of number plates of multiple vehicles in a single image frame by using multi-level genetic algorithms.</p> <p>3.taking inputs from live video feed and selecting the best vehicle frame for classification of vehicle types and recognizing the number plates using neural networks.</p>		<p>using template Matching and its accuracy was found to be 80.8% for Indian number plates.</p>
5	<p>Automatic Vehicle Detection , Tracking and Recognition of License Plate in Real Time Videos</p>	<p>NIT ROURKE LA/ LUCKY KODWANI</p>	<p>2013</p>	<p>1.Vehicle detection and tracking:</p> <p>1.a.Frame differencing</p> <p>1.b. Optical flow</p> <p>1.c. Background Subtraction</p> <p>2.License plate extraction:</p> <p>2.a. Preprocessing using MATLAB</p> <p>2.b. Sobel filter technique</p>	<p>1.Can be developed for night surveillance.</p> <p>2.Performance of the system can be improve i.e character recognition can be increased using neural networks for recognizing all font characters using back propogation</p>	<p>87.4 %</p>	<p>video analytics as computer-vision-based surveillance algorithms and systems to extract contextual information from video. In traffic scenarios several monitoring objectives can be supported by the application of computer vision and pattern</p>

				<p>2.c. Hough Transform algorithm.</p> <p>2.d. Template Matching</p> <p>2.e Region Growing</p> <p>2.f Histogram Approach</p> <p>3.Character Extraction:</p> <p>3.a. Histogram approach</p> <p>3.b Connected pixel method</p> <p>3.c Template based OCR</p>			<p>recognition techniques, including the detection of traffic violations (e.g., illegal turns and one-way streets) and the identification of road users (e.g., vehicles, motorbikes, and pedestrians).</p>
6	Automatic Vehicle Number Plate Localization Using Symmetric Wavelets	V. Himadeepthi/Springer	2014	<p>1.Preprocessing</p> <p>1.a Novel Method</p> <p>1.b. Median Filtering</p> <p>2.Localization of number plate:</p> <p>2.a Wavelet analysis</p> <p>2.b. Morphological processing</p>	<p>1.Fails in poor lighting conditions.</p> <p>2.Fails if shadow of vehicle occur.</p> <p>3.Fails on text around the plate region.</p> <p>4.long distance captured image with multiple cars created problem</p>	78%	<p>Experiments were performed on a database and also on a sample of 280 images of different countries taken from various scenes and conditions; results show that success rate of 77.14% on database and 92.14% on sample images achieved.</p>

7	A vehicle number plate recognition system using region-of-interest based filtering method	Rajib Ghosh/IEEE	2018	<p>1. Locating number plate:</p> <p>1.a Region of Interest based filtering Method.</p> <p>1.b Sobel Operator</p> <p>2. Character Extraction: OCR</p> <p>2.a Vertical edge projection</p> <p>2.b morphological dilation</p>	<p>1. Test on their own dataset and not on real conditions so there was a big doubt on accuracy.</p> <p>2. Study cannot also be compared with any study in Indian context due to unavailability of significant research works on Indian vehicle number plate recognition.</p>	92% {on their own dataset}	an open topic for future research is the readability improvement of NP text using image processing techniques and to develop an approach for deciding the best frame among consecutive frames to get the best possible result
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4. Conclusion

The important work is the detection and recognition of the number plate which is accomplished by the Convolutional Neural Network (CNN). Reason to choose CNN is the high accuracy of 90% even with very low training size. Convolutional neural networks have been one of the most influential innovations in the field of computer vision. They have performed a lot better than traditional computer vision and have produced state-of-the-art results.

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