

# Automatic Number Plate Recognition System Using Optical Character Recognition

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## ABSTRACT

In the last few decades, the number of active vehicle population has increased drastically which has made it difficult for the authorities to keep a track of them as well as to identify the vehicle owner in case of any traffic violation. Automatic Number Plate Recognition System (ANPR) is a real-time machine-intelligent and embedded system which identifies the characters directly from the image of the number plate. Due to crucial research and development of technology and the increasing use of vehicles, the need for a machine-oriented recognition and monitoring system is of immense importance. The technology has become a major requirement and is playing a crucial role in a vast sea of applications related to automated transport monitoring and control system such as traffic monitoring, challan management, detection of stolen vehicles, electronic payment of tolls on highways or bridges, parking lots access control, etc. This technology requires extensive mobility and station flexibility which causes it to be installed on such hardware that is very mobile enough so that the operator can use it very efficiently. ANPR System through the use of Optical Character Recognition (OCR) makes the system to be used as an application on smartphones. This provides the operator to use the system and identify number plates by just capturing the image and processing by neural networks working in the background of OCR. The ANPR system as a whole will result in easy and safe monitoring of the traffic and to keep an easy record in case of any violation. Also, it will save individuals to save their time in standing at long queues at toll taxes and paying cash which will be done with the ANPR system and using E-wallet.

**Keywords :** Android, Neural Networks, Optical Character Recognition, Segmentation.

## I. INTRODUCTION

Intelligent Transportation System is based on Automatic Number Plate Detection System (ANPR). Identification of number plates is carried out in the absence of direct human intervention by ANPR which is an advanced machine vision technology. It is an important area of research due to its many applications like parking, access control, road tolling, law enforcement and so on. The research and development of the Intelligent Transportation System (ITS) provides data about vehicle identification via plate numbers which can be used in analyses, control,

and monitoring. Real-time number plate recognition provides immense significance in the automatic monitoring of traffic rules and maintaining law enforcement on civilian roads due to instantaneous seizing and quick response. Each vehicle unique number impression on a plate, hence there is no need for external cards, tags or transmitters to recognize the vehicle. The ANPR process is segmented into the following three phases: Number plate extraction, character segmentation, and character recognition. Out of the entire input image, only the number plate is extracted and processed further in the next step of

character segmentation. In the character segmentation phase, each and every character is isolated and segmented. Based on the selection of prominent and distinguishable features of characters, each character is recognized via the character recognition phase. Extraction of the number plate is a complex process, essentially due to number plates occupying only a small section of the whole image, a difference in number plate formats, and the effect of environmental factors. This step affects the accuracy and computation of the character segmentation and recognition process.

Different techniques are developed for number plate extraction. From [1] image acquisition and preprocessing to the morphological operation, of thresholding operation to vertical edge and candidate plate area detection each routine has its own value. ANPR is also known as automatic vehicle identification, car plate recognition, automatic number plate recognition, and optical character recognition (OCR) for cars. The variations of the plate types or environments also possess challenges in the detection and recognition of license plates.

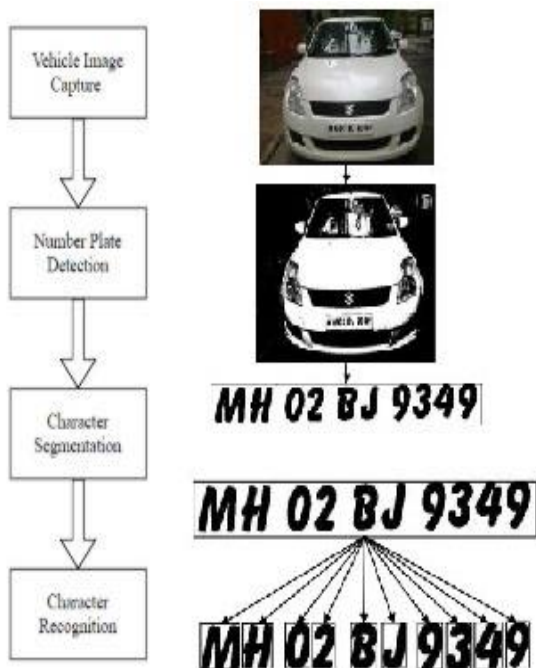


Fig. 1. Conventional ANPR System

Injustice will be done to contrasting research papers dealing with a variety of methodologies adopted to execute the ANPR system. For any approach whenever possible parameters like speed, accuracy, performance, image size and platforms are considered. The scope of this paper concentrates on the concise description of implemented techniques with the prospective ANPR. The paper concludes with a dialogue of additional highlights of the expected system.

The paper is divided into five sections. The first section deals with a brief introduction of the research paper followed by the second segment discussing the existing techniques to frame the desired results. Section three mentions about the proposed work, experiments and results explored in part four. The fifth and final section summarizes the paper with a conclusion.

## II. LITERATURE REVIEW

There are various functional methods for localization of license number plate detection from different situations to distinct regions from capturing images video of authenticated vehicles to taped snapshots. Certain algorithms for vehicle license number plate extraction, character segmentation and recognition is conferred where a directory of images of varied size, backdrop, brightness, the angle of the camera, length, etc. Number plates are extracted [1] faithfully based on vertical edge detection and connected component algorithm, with the success rate of 90%. After analyzing through diverse processes for obtaining particular features of the license number plates of vehicle within different countries and their respective states considering its precision and accuracy along with swiftness in determining number plates, we have encountered huge amount of the vehicle number plates in these paper but there are some other types of number plates where such a character study can't be implemented using our [2] fuzzy logic of character analysis. The study reflects

that [3] the identification of yellow plate worked with huge certainty for the shots captured from various distances between vehicle and camera. During concession there will be flat acceptance of script if the character height is not consistent throughout the script, considering the space between characters must be uniform.

With a diversified resolution to gain information from captured images analyzers came across techniques which are an asset as well as a burden to the system. Vertical Edge detection [4] can read images during the motion of a car on a straight road or making some angle with the installed camera leading to the treatment of vertical edges to be erect and other edges become skewed. It is effectively applicable when automobiles have the front plane inclined with respect to the extension of the camera face to the vertical plane of the road. Since processing is done considering the vertical edge of the image, it curbs its performance when the image shot is blurry in nature. Further methodologies by applying soft computing and neural network, researchers have deduced approaches like fan beam feature [5] which has more features in training a neural network to obtain higher accuracy. Applying Fan-beam for feature extraction, Back Propagation and Learning Vector Quantization Neural Networks are trained. Segmentation of characters and recognizing them leads to discrete results with variance in connected components and projection analysis on them. The experimental success rate of 85% for vertical projection during results has been faithfully observed [4]. Feature-based character recognition on neural networks gave relatively unexpected outputs using [6] template method consequently success rate for image processing and extraction achieved is 84%.

We need such systems that can provide[2] results with great precision and reduce response time considering the common specifications with respect

to the current country as well as considering its uniformity worldwide.

Development of the Automatic number plate detection system has benefited in the evolution of [6] automatic parking system, determining parking lots status and related guidance including electronic billing. The performance of such systems is directly proportional to the algorithm deduced in implementation which can localize license number plate and recognize in an acceptable range.

### III. PROPOSED WORK

In the implementation of the ANPR System, hardware and software specifications were both considered. In view of portable and easily deployable hardware, smartphones had an upper hand. The open source software that works on the modified version of Linux kernel also known as Android provides efficient hardware and software resource usage. The proposed ANPR System is designed and deployed for Android-based smartphones. It involves the development and testing of developed software under various scenarios.

The whole system uses OCR for identifying the number plate information from the input image. The software also acts as a database for various users, vehicles and their related information including vehicular parking and vehicular offenses during transit. The system also provides facility to law enforcement personnel to issue and resolve challans to offenders. There is also functionality for toll check officers to collect toll charges and also allow the users to pay for challans and tolls from the system. Another great feature is the identification and tracking of vehicles by vehicle owners. The software which runs on the Android platform and uses MySQL database where it sends data via JSON objects. These JSON objects are processed by NetBeans Database services which act as an intermediary between application software and database.

### A. Artificial Neural Networks

Artificial Neural Network (ANN) popularly known as the neural network is a mathematical computational term that contains artificial neurons. It is a model of the brain and nervous system which performs various tasks such as pattern matching, classification, optimization, and data clustering. ANN possesses a large number of processing elements called nodes/neurons which operate in parallel. Neurons are connected with others by connection link. Each link is associated with weights which contain information about the input signal. Each neuron has an internal state of its own which is a function of the inputs that neuron receives known as Activation level. Several algorithms are based on ANN in a two-layer probabilistic neural network with the topology of 180-180-36 whereas the multilayer perceptron model (MLP) is used for classification of characters. This model of computation comprises an input layer for up-taking values, hidden layer to compute and output layer for results. A neural network is trained prior before implementation.

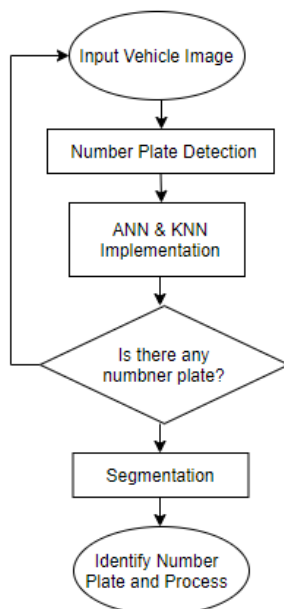


Fig. 2. ANPR Flow-Chart

The proposed ANPR system which varies from a plate and environment variations walk over following footsteps:

#### 1. Collection of Data Set

The dataset for the experiment is collected in order to demonstrate the working of OCR. Snapshots are extracted from various online platforms to test and process, captured either from surveillance cameras during parking or on streets and roads.

#### 2. Number Plate Detection

Various number plate detection algorithms are categorized on different approaches based on plate size, plate location, background, illumination, and pixels. Hough transform[7] is a feature extraction technique used for line detection, detecting horizontal and vertical lines from rectangular vehicle number plate and then processing it to hue-intensity-saturation(HIS). This algorithm was originally generalized by D.H. Ballard. It is extended to find the position of arbitrary shapes.

#### 3. Character Segmentation

After detecting license number plates, characters are further recognized.[8] Implicit segmentation is also known as recognition based segmentation. In this procedure segmentation and recognition of characters are achieved at the same time. The implicit segmentation program is to split words into segments that should be characters, and then pass each segment to a classifier. If the classification results are not adequate, summon segmentation once more with the feedback message about declining the previous sequence.

#### 4. Character Recognition

Character Recognition enables the system to identify and convert the image into text form. Most of the number plate recognition algorithms use a single method for character recognition. In

this section, the algorithm implemented for the proposed system is briefly explained.

**B. k-Nearest Neighbor Algorithm**

k-Nearest Neighbor (kNN) algorithm is one of the simplest classification algorithms and it is one of the most used learning algorithms. kNN is a non-parametric as it has no explicit assumptions about the relationship between the predictor and the dependent variable. Characteristics of kNN declare it to be a lazy learning algorithm since they make predictions based on local information and do not build explicit models. Its purpose is to use a database in which the data points are separated into several classes to predict the classification of a new sample point. In this procedure, k training samples, whose attributes are relatively similar (closest) to the test samples are obtained. Hence, the test samples are classified based on the class labels of the closest training samples. These training samples are known as the nearest neighbors. Nearest neighbor (NN) algorithm is also called an instance-based method as the test instances are compared with training instances that have been stored in memory.

it is impossible to build a machine with the same recognition abilities as a human has. Because of this, a test like this is extremely difficult to distinguish. In practice, it is more useful to find a representative set of number plates, which can be captured by an ANPR camera. Thus the position of the camera has a significant impact on the quality of captured images, and a successfulness of the whole recognition process. The suitable position of the camera towards the lane can lead to a better set of all possible snapshots. In some situations, we can avoid getting skewed snapshots by suitable positioning of the camera. Sometimes, this is cleverer than a development of the robust de-skewing mechanisms.

The following table shows recognition rates, which has been achieved while testing on a various set of number plates. According to the results, this system gives good responses only to clear plates since it bears the highest accuracy rate of nearly 87%, blurred plates achieved accuracy to 47% whereas skewed plates and plates with difficult surrounding environment cause significant degradation of recognition abilities with 52% and 73 respectively.

**IV. EXPERIMENT & RESULTS**

We have captured many of static snapshots of vehicles for the test purposes. Random moving and standing vehicles with license number plates have been included. At first, our objective was to find a representative set of number plates, which are recognizable by humans. Of course, the set like this contains an extremely wide spectrum of plates, such as clear and easily recognizable as well as plates degraded by the significant motion blur or skew. Then, the recognition ability of a machine is represented by a ratio between the number of plates, which have been recognized by the machine, and the number of plates recognized by a human. Practically,

Type of Plate	Total No. Of Plates	Total No. Of Characters	Weighted Scores
Clear Plates	68	470	87.2
Blurred Plates	52	352	46.87
Skewed Plates	40	279	51.64
Average Plates	177	1254	73.02

Table 1: Character Recognition Rate for Various Number Plates

Fig 3 demonstrates the working of OCR where an image is recognized from the dataset given to the system and number plate detection is performed followed by character segmentation and character recognition resulting in image characters on number plate in text format.

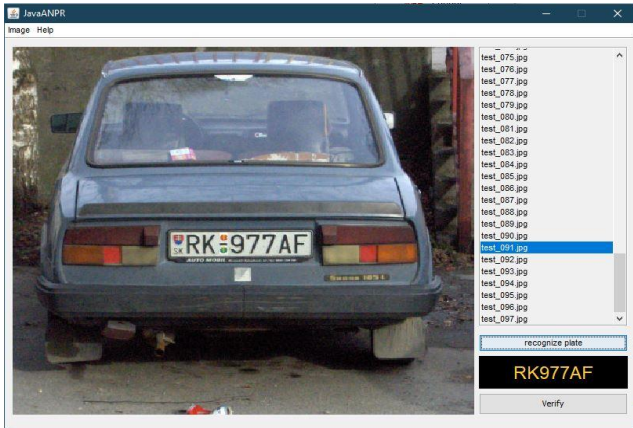


Fig. 3(a): Working Image of OCR

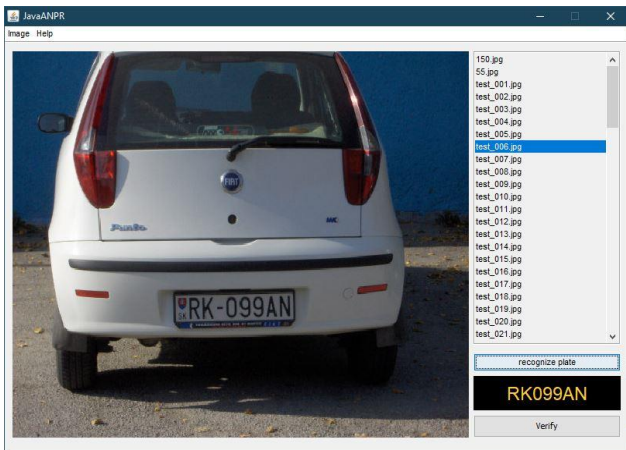


Fig. 3(b): Working Image of OCR

## V. CONCLUSION

In this paper, the ANN and kNN model is stipulated for character recognition in an OCR technology, giving rise to automatic number plate recognition that can be incorporated into various handheld applications. ANPR solution has been tested on static snapshots of vehicles, which has been divided into several sets according to difficulties. Sets of blurry and skewed snapshots give worse recognition rates than a set of snapshots, which has been captured clearly. Along with this, an android application is

deduced in order to stand the modern world needs naming as Comrade Patrol.

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**Cite this article as :**

Monika Arora, Anubha Jain, Shubham Rustagi, Tushar Yadav, "Automatic Number Plate Recognition System Using Optical Character Recognition", International Journal of Scientific Research in Computer Science, Engineering and Information Technology (IJSRCSEIT), ISSN : 2456-3307, Volume 5 Issue 2, pp. 986-992, March-April 2019. Available at doi : <https://doi.org/10.32628/CSEIT1952280>  
Journal URL : <http://ijsrcseit.com/CSEIT1952280>