

Review Paper on Automated Number Plate Recognition Techniques

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Abstract:

Automatic Number plate recognition is a real time embedded system which identifies the characters directly from the image of the vehicle Number plate. Due to rapid development of technology and increasing use of vehicles, Number plate recognition has become necessary and it is playing an important role in variety of applications related to automated transport system such as road traffic monitoring, detection of stolen vehicles, automatic payments of tolls on highways or bridges, parking lots access control etc. Number plate recognition system is composed of three parts, which are Number plate detection, character segmentation and recognition. Systems for Automated Number Plate Recognition (ANPR) can provide a valuable data source for transport planning and engineering. Multiple tasks can be solved with ANPR systems located at one or more survey points. The paper describes some characteristics of ANPR-systems and presents different techniques of number plate recognition.

Keywords: Automated number plate recognition, Segmentation, Recognition, preprocessing.

I. INTRODUCTION

Automatic Number Plate Recognition (ANPR) system is an important technique, used in Intelligent Transportation System. ANPR is an advanced machine vision technology used to identify vehicles by their number plates without direct human intervention. It is an important area of research due to its many applications. The development of Intelligent Transportation System (ITS) provides the data of vehicle numbers which can be used in follow up, analyses and monitoring. ANPR is important in the area of traffic problems, highway toll collection, borders and custom security, premises where high security is needed, like Parliament, Legislative Assembly, and so on. Real time NPR plays a major role in automatic monitoring of traffic rules and maintaining law enforcement on public roads. Since every vehicle carries a unique license plate, no external cards, tags or transmitters need to be recognizable, only license plate [1]. The ANPR work is generally framed into the steps: Number plate extraction, character segmentation and character recognition. From the entire input image, only the number plate is detected and processed further in the next step of character segmentation. In character segmentation phase each and every character is isolated and segmented. Based on the selection of prominent features of characters, each character is recognized, in the character recognition phase. Extraction of number plate is difficult task, essentially due to: Number plates generally occupy a small portion of whole image; difference in number plate formats, and influence of environmental factors. This step affects the accuracy of character segmentation and recognition work. Different techniques are developed for number plate extraction. ALPR 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 cause challenges in the detection and recognition of license plates. They are summarized as follows.

1) Plate variations:

- a) location: plates exist in different locations of an image;
- b) quantity: an image may contain no or many plates;
- c) size: plates may have different sizes due to the camera distance and the zoom factor;
- d) color: plates may have various characters and background colors due to different plate types or capturing devices;

2) Environment variations:

- a) Illumination: input images may have different types of illumination, mainly due to environmental lighting and vehicle headlights;
- b) Background: the image background may contain patterns similar to plates, such as numbers stamped on a vehicle, bumper with vertical patterns, and textured floors [2].

1. APPLIANCE OF ANPR-SYSTEMS

With ANPR-systems it is possible to solve a multiple set of tasks. In this Paper five types of applications are presented. Table 1 lists these applications and discusses which applications permit the encrypting of the number plate strings

Table 1: Appliace of ANPR-systems [3]

Application	Encrypting of the number plate strings possible?
Vehicle classification No.	. Authentic string required to identify vehicle class.
Travel time measurements	Yes. Encrypting does not significantly reduce the sample size of observed vehicles.
Determination of through traffic volume	Yes, but it reduces the quality of results as this application requires the complete sample of vehicles. If not all vehicles are detected the detected vehicle volumes must be projected using additional count data.
Analysis of route choice behaviour	Yes, but it reduces the quality of results as this application requires the complete sample of vehicles. If not all vehicles are detected the detected vehicle volumes must be projected using additional count data.
Estimation of O-D matrices from the area code	Yes, if only the second part of the string is encrypted and not the area code.

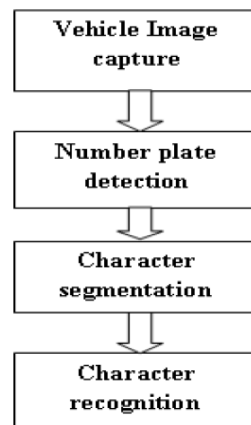


Fig.1. ANPR system [5].

Automated Number plate recognition system consists of three stages: Number plate extraction, extracting the characters, Character recognition. The purpose of this paper is to provide researchers a systematic survey of existing ANPR research by categorizing existing methods according to the features they used, by analyzing the pros/cons of these features, and by comparing them in terms of recognition performance and processing speed, and to open some issues for the future research .In this paper, there are following sections.

III. LITERATURE SURVEY

In [6],license plate recognition methods are:(1)Image Acquisition: By digital camera (2) License Plate Extraction: vertical edge detection by sobel algorithm ,filtering by seed filling algorithm ,vertical edge matching (3) Segmentation:(4) Character Recognition: Normalization, Template matching using hamming distance approach. **Result:** License Plate Extraction: 587/610, over all system efficiency: 95% **Limitation:** Detection only for white, black, red, and green colour plate or numbers. In[7],(1)Extraction of plate region: edge detection algorithms and smearing algorithms (2)segmentation of Characters: smearing algorithms, filtering and some morphological algorithms (3)recognition of plate characters : template matching. **Result:** extraction of plate region :%97.6 segmentation of the characters :%96 , recognition unit :%98.8.overall system performance: %92.57 recognition rate . **Limitation:** it having some limitation like it recognition of car license plate only, and This system is designed for the identification of Turkish license plates. In[8], recognition steps are as follow:(1)Image Enhancement: by histogram equalization method (2)Structuring Elements : by thickening. (3) Hat transformations: which is use for contrast, enhancement (top has & bottom has)setting (4) Morphological Operations like dilation and erosion (5) Plate region confirmation (6) Character Segmentation and Recognition by neuron implementation model . **Result:** 95%. work very well in the real time environment. **Limitation:** for the overall system, while the some more work is to be done to make the technique more efficient In[9],recognition by(1) Target recognition: by using feature-salience theory, features of license plates (2)license plate locating by Hough

transform (HT). (3) recognizing license characters by different steps like binarization, noise removal, and orientation adjustment, Optical Character Recognition. **Result:** in this paper, the success rate for the identification with the set of 1144 license plates is 95.7%. Combining this rate with the location success (97.3%), the overall rate of success for our LPR algorithm is 93.1%. **Limitation:** this system is intended for the recognition of Chinese license plates only. In[10], mainly focused on Edge Detection(Sobel Edge Detection)technique and then filtering of noise by Median Filter, Smoothing, Connector, Masking, and then Colour Conversation is done. **Limitation :** we can see that the detection is not that clear and proper, which we find, is due to improper light segment or varying illumination effects. **Result:** all over system result is not mention in this paper. In[11], (1)extracting the Plate region, edge detection algorithm and vertical projection method are used.(2) in segmentation part filtering, thinning and vertical and horizontal projection are used. And finally, (3)chain code concept with different parameter is used for recognition of the characters. **Result:** final system Efficiency : 98%. **Limitation :** The proposed method is mainly designed for real-time Malaysian license plateIn[12],involve three approaches:(1)in plate localization Noise alleviation, Changing color space, Intensity dynamic range modification, Edge detection, Separating objects from background, Finding connected component, Candidate selection, all above process are used (2) in segmentation part multistage model are used.(3) for the recognition artificial neural network is used. **Result:** The method achieved accuracy over 91% for localizing plates. **Limitation:** detection only for English and Parisian number plate. In[13] For the Number plate recognition first image conversion in binary and apply to neural network, and apply mpl algorithm, then detection individual symbol, by matrix mapping. **Result:** Training by this approach obtained 96.53% average recognition rate using double hidden layer and 94% using single hidden layer. **Limitation:** The captured image 2-3 meters taken away from the cameras. In[14] (1)Pre-processing of Image by histogram equalization(2)Extraction of plate region by edge detection algorithm(canny operator) and Plate Area Detection by various morphological operations (3)Segmentation of characters by *connected component *bounding box method, *Median filter, all above methods. **Result:** observed final result as Extraction :71/78 which gives 91.02% efficiency, Segmentation 69/78 which gives 88.46%efficiency. overall accuracy of our system is 89.74%. **Limitation:** proposed method is sensitive to the angle of view, physical appearance and environment conditions. In[15] Given All 3 process by 2D Haar after the discrete wavelet Transform technique : (1)locate and extract the license-plate (2)train of the license-plate (3)real time scan recognize of the license-plate. **Result:** Recognition rates (%) :93.0%. **Advantage** of this approach is Haar Discrete Wavelet Transform are that it each time transform only needs 1/4 of the original image. Hence, this method can fast execution speed. **Disadvantage** is that in this paper only specified cameras used like Using the CASIO EXILIM, 10.1 MEGA PIXELS DIGITAL CAMERA EX-S10, adjusting the resolution 480 x 640 for photography vehicle license plates.In[29] detection steps are :(1)Image acquisition by capturing an image of a vehicle from video (2)License plate detection extraction, by Spectral Analysis Approach and Connected Component Analysis (3)extract the region of license plate process use spectral analysis (4)Character segmentation use Connected component analysis approach and SVM feature extraction techniques. **Advantage** of this approach is success full recognition of a moving vehicle. In[16] (1)PVW approach is used in this orientation, ratio of scale to character height, and relative position in the character region are done by clustering (2)visual word matching by comparing the extracted SIFT features and histogram approach is used (3) for license plate location. **Result:** this technique achieves a 93.2% “true” detection rate. **Limitation :** The weakness of this approach is that it may fail when the license plate resolution is too low, or when the distortion from the observation angle is too severe In[17] (1) detect a license plate region by vertical or a horizontal edge based method (2) pre-processing: is also needed in this approach .so first converted in to binary image then eliminate noise using morphological operation (3) character segmentation by thresholding method (4) feature extraction and character recognition by Euler number formation. **Advantage** of this approach that skewness is not present in the detected vehicle number plate compare to other methods. **Disadvantage** is it limits the efficiency of the total system. In[18] (1) plate extraction by Mathematical Morphology approach and then, Dilation and Erosion is apply to image,(2)segmentation by Structuring Elements approach, Median Filter technique and Edge Detection Methods are use,(3)character extraction by Preprocessing, Text/non-text classification approach .result derived by this paper is as given, Real Time Data:100,Images correctly Detected:93. **Results:** Accuracy 93%.**Limitation:** it says that Very much damaged plate cannot be recognized.

III. METHODOLOGY

There are following methods which are used to detect number plate recognition.

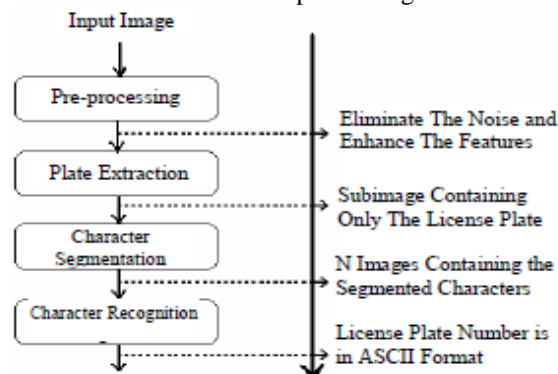


Fig.2: Number Plate Recognition Modal [19].

A. Image Acquisition and Pre-processing:

In this system a high resolution digital camera is used to acquire an image. Images are taken in different background, illumination conditions, and at various distances from the camera to vehicle. Image converted RGB to gray scale all the processing steps are executed on gray scale image. In order to reduce the problem of low quality and low contrast in car images[20].

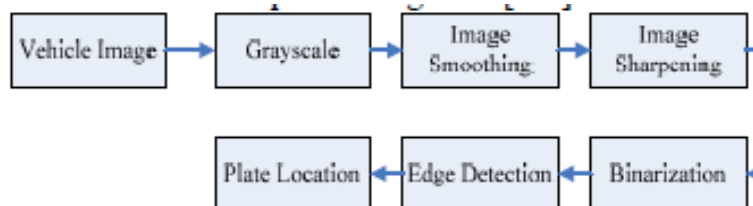


Fig.3. The preprocessing flow chart of vehicle image [21]

B. Preprocessing Techniques:

A. Gray scale conversion: From the 24-bit color value of each pixel (i,j) the R, G and B components are separated and the 8-bit gray value is calculated using the formula: $gray(i, j) = 0.59 * R(i, j) + 0.30 * G(i, j) + 0.11 * B(i, j) \dots (1)$

B. Median filtering: Median filter is a non-linear filter, which replaces the gray value of a pixel by the median of the gray values of its neighbors. This operation removes salt-and-pepper noise from the image [22].

C. Number plate detection:

Most of the number plate detection algorithms fall in more than one category based on different techniques [23]. These are a few methods as following.

- Image binarization
- Edge detection
- Hough Transform
- Blob detection
- Connected Component Analysis (CCA)
- Mathematical morphology.

Image binarization: Image binarization is a process to convert an image to black and white. In this method, certain threshold is chosen to classify certain pixels as black and certain pixels as white. But the main problem is how to choose correct threshold value for particular image. Sometimes it becomes very difficult or impossible to select optimal threshold value. Adaptive Thresholding can be used to overcome this problem.

Edge detection: It is fundamental method for feature detection or feature extraction. In general case the result of applying edge detection of algorithm is an object boundary with connected curves. Different edge detection algorithm / operators such as Canny, Canny-Deriche, Differential, Sobel, Prewitt and Roberts Cross are used for edge detection.

Hough Transform: It is a feature extraction technique initially used for line detection. Later on it has been extended to find position of arbitrary shape like circle or oval.

Blob detection: Blob detection is used to detect points or regions that differ in brightness or color as compared to surroundings. The main purpose of using this approach is to find complimentary regions which are not detected by edge detection or corner detection algorithms. Some common blob detectors are Laplacian of Gaussian (LoG), Difference of Gaussians (DoG), Determinant of Hessian (DoH), maximally stable extremal regions and Principle curvature based region detector [24].

Mathematical morphology: It is based on set theory, lattice theory, topology, and random functions. It is commonly applicable to digital image but can be used in other spatial structures also. Initially it was developed for processing binary images and then extended for processing gray scale functions and images. It contains basic operators such as Erosion, dilation, opening, closing [2].

D. Character Segmentation:

Segmentation is one of the most important processes in the automatic number plate recognition. In this segmentation we use two types of segmentation [25]:

1. Horizontal segmentation: Vertical scanning method is employed to dig out each character from the image found on first and last column pixel. It looks into the image by pixel vertically from [0, 0] until [width, height] which is executed in column by column scanning. At last, every character or number will be slice to split it from the plate background. Each element will be stored in array separately for next horizontal scanning process[26].

b. Horizontal Scanning:

Once every element is saved separately in preceding step horizontal scanning will identify the first and last rows of the image. The intention is to eradicate extra upper and lower region from the image[27].

E. Character Recognition:

After the segmentation of elements (characters and numbers), the final module in the number plate recognition process is character recognition. Although there are many techniques present and applied for character recognition like statistical,

syntactic and neural networks in this research, character recognition is performed by using feature extraction. The feature extraction is a process of transformation of data from a bitmap representation into a form of descriptors, which are more suitable for computers. The recognition of character should be invariant towards the user font type, or deformations caused by a skew. In addition, all instances of the same character should have a similar description.

IV. RESULT

Table.1: Table of %efficiency/month or year [8]

YEAR/MONTH	%EFFICIENCY
2003	95
2005 Nov	92.57
2008 June	95
2009 Sept	98
2010	94
2011 July	95
2011 July	89.74
2012 Sept	93.2
2012 Oct	93
2013 April	95.3
2013 July	96.5
2013 Sept	96
2013 Oct	97

V. CONCLUSION

ANPR can be further oppressed for vehicle owner identification, vehicle model identification traffic control, vehicle speed control and vehicle location tracking. It can provide various benefits like traffic safety enforcement, security- in case of suspicious activity by vehicle, easy to use, immediate information availability- as compare to searching vehicle owner registration details manually and cost effective for any country for low resolution images some improvement algorithms like super resolution of images should be focused. In multiple vehicle number plate images are considered for ANPR while in most of other systems offline images of vehicle, taken from online database. To segment multiple vehicle number plates a coarse-to-fine strategy could be helpful.

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