



A Review on License Plate Extraction in Various Illumination Conditions

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Abstract—License number plate recognition is the most interesting and challenging research topic from past few years. Number plate recognition system (NPRS) is applicable to wide range of uses such as Border crossing vehicle, Highway toll-collection, traffic management, parking management at various locations and many more. Although there are numerous of number plate extracting systems available today based on different methodologies but still it is a challenging task to make an intelligent system that can be successfully implemented. In this paper, different existing number plate extraction techniques are surveyed and general steps for number plate extraction are introduced.

Keywords- pre-processing, License plate recognition, character extraction, character segmentation.

I. INTRODUCTION

Number plates are used for identification of vehicles all over the nations. Vehicles are identifying either manually or automatically. Automatic vehicle identification is an image processing technique of identify vehicles by their number plates. Automatic vehicle identification systems are used for the purpose of effective traffic control and security applications such as access control to restricted areas and tracking of wanted vehicles. Number plate recognition is easier method for Vehicle identification. NPR system for Indian license plate is difficult compared to the foreign license plate as there is no standard followed for the aspect ratio of license plate. The identification task is challenging because of the nature of the light.

The variations of the plate types or environments cause challenges in the detection and recognition of license plates. They are summarized as follows:

- Plate variations:

- 1) Location: Plates exist in different locations of an image.
- 2) Quantity: An image may contain no or many plates.
- 3) Size: Plates may have different sizes due to the camera distance and the zoom factor.
- 4) Color: Plates may have various characters and background colors due to different plate types or capturing devices.
- 5) Font: Plates of different nations may be written in different fonts and language.
- 6) Occlusion: Plates may be obscured by dirt.
- 7) Inclination: Plates may be tilted.
- 8) Other: In addition to characters, a plate may contain frames and screws.

- Environment variations:

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

II. LITERATURE SURVEY

Automatic Number Plate Recognition Using Artificial Neural Network [1].

Automatic Number Plate Recognition is a rapidly evolving area of research and development in the field of Intelligent Transportation System. Different researchers have provided different methods and techniques for this system. However, every technique has its own advantages and disadvantages. This paper presented a detailed explanation of the proposed ANPR system by categorizing it according to the features used in each stage. We have used morphological operations for extracting the LP from the image. We have successfully extracted the number plate from most of the images and performed segmentation. The feed forward back propagation neural network gives an excellent recognition rate of 94.12% along with acceptable processing time (400ms) which makes it suitable for real time applications.

Survey on Automatic Number Plate Recognition (ANR) [2].

The ANR (automatic number plate recognition) plays an important role in many systems like traffic monitoring system,

Crime detection system, stolen vehicle detection etc. Thus, ANR is used by city traffic department to monitor the traffic as well as to track the stolen vehicle. Though ANR is a very old research area in image processing but still it is evolving year In number plate detection system image processing plays an important role, the system consist of basic operations preprocessing, image conversion from RGB to Gray, apply edge detection, apply morphological operators on same image then extract plate region from image and last process the plate region using OCR (optical character recognition).Every algorithm in this category always follows this basic steps, each algorithm has some pros and cons, because same algorithm cannot be useful for different environmentalcondition.

Automobile Number Plate Recognition And Extraction Using Optical Character Recognition [3].

The process of Automobile Number Plate Recognition and Extraction System implemented in this system has successfully optimizing the speed and efficiency of the system by reducing the image recognition algorithm for alphabets and number reading into one algorithm only which easily and efficiently reduces the complexity of splitting and merging the image of the extracted number plate. The system consists of the standard four main modules in the Automobile Number Plate Recognitions and Extraction System viz. Image acquisition, Automobile Number plate extraction, Automobile Number plate segmentation and Automobile Number plate recognition.It has also reduced the noise from the final output image and provides an output which is noise free and the background suits the font color of the number on the automobile license plate. We get an overall efficiency of 98% for this system.

Automatic Vehicle Number Plate Recognition Using Morphological Edge Detection and Segmentation [4].

This paper presents a combination of both theoretic practice and the visual results on the vehicle number plate recognition through the hybridization of the morphological edge detection and proposed Otsu's algorithm for the segmentation. The approximate results show that this approach gives the potential of the morphological edge detection and segmentation for vehicle number plate classification that has been assessed. This method have better theoretical properties than the traditional filters that represent images but still not used for vehicle verification. The five main modules that worked together one after one for the improved results even lead to the satisfaction to the natural moving vehicle number plates.

NUMBER PLATE RECOGNITION USING OCR TECHNIQUE [5].

In this paper we have checked and evaluated the accuracy of the OCR technique. The Template matching affects the accuracy of number plate recognition. We have found that there are some factors which affect the effectiveness of template matching based on OCR technique i.e. font type, noise in image, tilting etc. In future the work can be done on these factors and efficiency may be increased further for better results.

An Efficient Approach for Number Plate Extraction from Vehicles Image under Image Processing [6].

Automatic Number Plate Recognition (ANPR) is an image-processing technology and an important field of research that identifies vehicles by their number plates in which the number plate information is extracted from vehicle's image or from sequence of images without directhuman intervention. This paper presents an efficient approach for number plate extraction from preprocessed vehicle input image using morphological operations, thresholding, sobel vertical edge detection andconnected component analysis. The input image is firstly preprocessed using iterative bilateral filter and adaptive histogram equalization.

RECOGNITION OF VEHICLE NUMBER PLATE USING MATLAB [7].

In this paper, application software is designed for the detection of number plate of vehicles using their number plate. At first plate location is extracted using morphological operation then separated the plate characters individually by segmentation. Finally template matching is applied with the use of correlation for recognition of plate characters.

Some of possible difficulties:

1. Broken number plate.
2. Blurry images.
3. Number plate not within the legal specification.
4. Low resolution of the characters.
5. Poor maintenance of the vehicle plate. Similarity

Between certain characters, namely, O and D; 5 and S; 8 and B, E; O and 0, etc.

III. GENERAL OVERVIEW

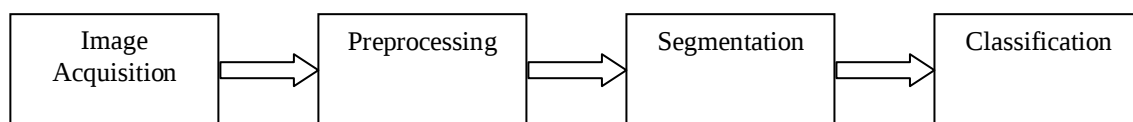


Figure.1- A general overview

As every system is designed for specific application, so the design of system depends on the function and environment conditions. Number plate recognition systems can generally be divided in four common steps: (1) Image Acquisition (2) Preprocessing (3) Character Segmentation and (4) Classification.

IV. IMAGE ACQUISITION

A. Image Pre-processing

In pre-processing requirement is enhancement and restoration. it involve processes which improve the quality of image by eliminating noises, reversing the damages, de blurring to recover the original sharpness of an image, highlighting edges of the images.

a) Gray scale processing

The captured image can be altered by various factors like: camera distortion, noise, excessive relative motion of camera or vehicle etc. The result is the downgrading of a captured vehicle image which adversely influences the further image processing So before the main image processing, preprocessing of the image should be done. It includes converting RGB to gray for noise removal, border enhancement for brightness. Colored images are also complex in space and time, therefore it is necessary to convert them to gray scale to reduce time and space complexity. The basic idea behind gray conversion is to eliminate hue and saturation by not affecting its luminance. For this, we compute the threshold of an image by using the suitable gray scale value. This separates the object of

interest from background. Thresholding is important to provide sufficient contrast of an image such that, varying level of intensity between foreground and background are considered. Gray scale conversion enhances the quality of an image for later computational processes. Gray scale images consist of different ranges of gray values; from 0 to 255. MATLAB function `rgb2gray` converts a RGB image to gray scale image.

b) Median Filtering

It comes under the category of nonlinear filters. It changes the gray value of the pixels to the median of the gray value of surrounding pixels. We use a 3x3 mask and calculate the corresponding gray value of each pixel using the 8 neighboring pixels. This helps in noise removal. Median filtering gives advantages such as no reduction in contrast since output values are its neighborhood values, boundaries remain unchanged. Median filters are very useful in the presence of impulse noises also called salt and pepper noise because of its appearance as white and black dots superimposed on an image.

c) Histogram equalization

This technique is used to enhance color distribution in unclear images. It reduces the clustered pixel values in an image. It also helps in even distribution of images with the light and dark areas.

d) Thinning

Thinning is a pre-process which results in single pixel width image to recognize the character easily. It is applied repeatedly leaving only pixel-wide linear representations of the image characters.

e) Filling Holes

`imfill(BW,'holes')` fills holes in the input binary image BW. In this syntax, a hole is a set of background pixels that cannot be reached by filling in the background from the edge of the image.

f) Morphological Operations

They are generally used to remove noise from the imperfect segmentation. Morphological operations are especially suited for binary images. So they are performed on output image of thresholding. Here Dilation and erosion are performed. Dilation and erosion are used to remove holes in the detected foreground. In the process of dilation the size and shape determination of structuring element is very important.

V. SEGMENTATION

A) Edge Detection

Edge detection is main method of feature detection or number plate detection. In common cases the result of applying this algorithm is an object boundary with connected curves. This method is difficult to apply in complex images. In such

cases it sometimes result with object boundary only, not connected curves. There are many edge detection algorithms or operators like Canny, Laplacian, Differential, Canny, Sobel, Prewitt and Roberts Cross. The prewitt and sobel edge detectors are better for delineating edges than the Robert edge detector. The prewitt masks are easier to implement than the sobel masks as they are simple. But sobel masks have superior noise-suppression characteristics. To detect wide range of edges in image we use canny edge.

B) Hough Transform

This is a technique for feature detection. Initially it was used for line detection. Now it has been extended to find position of different shapes like circle, square, oval etc. Therefore we can use it to detect number plates from the image based on their rectangular shape.

C) Bounding Box

Segmentation is one of the most important processes in the number plate recognition, because all further steps rely on it. If the segmentation fails, a character can be improperly divided into two pieces, or two characters. The ultimate solution on this problem is to use bounding box technique. The bounding box is used to measure the properties of the image region. Once a bounding box created over each character and numbers presented on number plate, each character & number is separate out for recognition of number plate.

VI. CLASSIFICATION

Classification is used to identify and converting image text into editable and readable text. To perform character recognition we should first perform character segmentation with high accuracy. Otherwise character recognition will have errors.

A) Character recognition using Template matching

It is useful when we have characters of fixed size. It have numerous other applications like face detection, medical image processing etc. It is further classified in two parts: template based matching and feature based matching. Feature based approach is used if template image has strong features otherwise we can use template based approach. To adjust all characters with uniform size we can use linear normalization algorithm. In matching process we move the template image to all possible regions of source image and compute a numerical index which indicates the accuracy of template match with the position. Then a correlation coefficient is calculated between the input character matrix and template character matrix. Character with the maximum value of correlation coefficient are considered to match the most and produced as output.

B) Character recognition using optical character recognition

Optical Character Recognition algorithm can also be used to recognize the vehicle number. We invert the image obtained after the number plate extraction that is convert all the white pixels to black and vice versa. This results in white text and black background. Before applying this we separate the individual lines in the text by using line separation process. This adds the each pixels value in a row. When the resultant sum of row is zero we assume that no text pixel is present in a row and if greater than zero it means the text is present in row. The first resultant sum which is greater than zero indicates the start of the line and the end of line is represented by

the resultant sum zero after it. These values- start and end of the line are used to crop the initial line in the text. The process continues to separate all the lines of text. Once the lines are separated, the same process is applied column wise to separate individual characters. These are then stored in variables. By using OCR we can now compare the each individual character with the complete alphanumeric database.

C) Support Vector Machine (SVM)

SVMs have become more and more important in the field of pattern recognition. SVM is forcefully competing with many methods for classification. An SVM is a supervised learning technique. SVM takes Statistical Learning Theory (SLT) as its theoretical foundation, and the structural risk minimization as its optimal object to realize the best generalization. They are based on some simple ideas and provide a clear intuition of what learning from examples is all about. More importantly, they possess the feature of high performance in practical applications. The SVMs use hyper planes to separate the different classes. Many hyper planes are fitted to separate the classes, but there is only one optimal separating hyper plane. The optimal one is expected to generalize well in comparison to the others. A new data sample is classified by the SVM according to the decision boundary defined by the hyper plane. Among many classification methods, SVM has demonstrated superior performance.

VII. CONCLUSION

Number plate extraction has different phases and accuracy of each phase dependent on previous phase. Presently, the techniques are not general. Different style and formats of number plate as well as the environment conditions under

which the systems are designed to operate are the main challenges. From this survey it can be concluded that for pre-processing median filter, morphological operation like erosion and dilation used to enhance the image, for segmentation there are so many approaches like bounding box, canny and sobel edge detection techniques work very well. The classification can be improved by neural network and SVM.

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