Localization & Segmentation of Indian Car Number Plate system: A Projection based Multistage Approach

Ms. Sonali Sonavane
Department of computer
TEC, Nerul, Navi Mumbai.
sonali_28387@yahoo.co.in

Prof. Alka Khade
Assistant Professor, Dept. of Comp
TEC, Nerul, Navi Mumbai.
khadealka@gmail.com

Prof. V. B. Gaikwad
Associate Professor, Dept. of Comp
TEC, Nerul, Navi Mumbai.
vb_2k@rediffmail.com

Abstract- Enormous incorporation of information technologies into all aspects of recent life caused demand for processing vehicles as conceptual resources in information systems. This can be achieved by a human agent, or by special intelligent equipment which is be able to recognize vehicles by their number plates in a real environment and reflect it into conceptual resources. Because of this, various recognition techniques have been developed and number plate recognition systems are today used in various traffic and security applications, such as parking, access and border control, or tracking of stolen cars. This work deals with problematic from field of artificial intelligence, machine vision and neural networks in construction of an automatic car number plate Recognition (ACNPR). This techniques deals with enhanced shadow removal algorithm, along with horizontal and vertical projection method for number plate localization & segmentation..Work comparatively deals with methods achieving invariance of systems towards image illumination, translations and various light conditions during the capture.

Index terms- Artificial Intelligence, machine vision, neural network, segmentation, Horizontal & Vertical Projection, Illumination

I. INTRODUCTION

Number plate Recognition technique aims to identify number plate character in real images. Number plate recognition (NPR) is one of the most practical applications of image processing and classification techniques. Generally Number Plate Recognition (NPR) technology has been used for automobile law enforcement purposes. This task is quite challenging due to the different of plate formats and the no uniform outdoor illumination conditions during image acquisition, such as backgrounds illumination, vehicle speeds and distance ranges between the camera and the vehicle. Therefore, most approaches work only under restricted conditions such as fixed illumination, limited vehicle speed, and stationary backgrounds.

The initial objective of the study is to improve a quality in number plate recognition with respect to identification of characters. The successful deployment of such a measure can also potentially lead to improved highway safety, efficiency, and national security.

To Design a Car Number Plate Recognition of system, in developed countries the attributes of the number plate are strictly maintained. For example size of the plate, font size, spacing between each character etc are maintained very distinctively. However in India, number plates are not standardized across different states making localization and recognition of plates efficiently difficult. Number Plate Recognition applied to the intelligent transportation system is implemented based on the following aspects: Ambiguous characters recognition such as (B-8), (O-0), (I-1), (A-4), (D-O) and broken characters, Reduction of Illumination problem, Try to identify plates ones with stickers and unofficial stamps affixed on their surface, Work with Inclination: Plates may be tilted, Variable plate size.

An algorithm for number plate recognition (NPR) applied to the intelligent transportation system is proposed on the basis of a novel shadow removal technique i.e., improved Bernsen algorithm combined with the Gaussian filter [3][10]. In paper [4], algorithm is based on a combination of morphological operation with area criteria tests for number plate localization. Segmentation of the plate characters was achieved by edge detectors, labeling and fill hole approach. The character recognition was accomplished by the process of Template matching. To make number plate numbers more legible, a generalized discontinuity-adaptive Markov random field (DAMRF) model is proposed [8].

Observing that characters in different number plates are duplicates of each other, paper proposed the idea of bag-of-words (BoW) model popularly applied in partial-duplicate image search[9]. A novel scheme to automatically locate number plate by principal visual word discovery and local feature matching.[11] .

A typical system for NPR consists of four parts:

1) Obtaining an image of the vehicle
2) Number Plate Localization
3) Character segmentation and standardization

4) Feature Extraction and Character recognition.

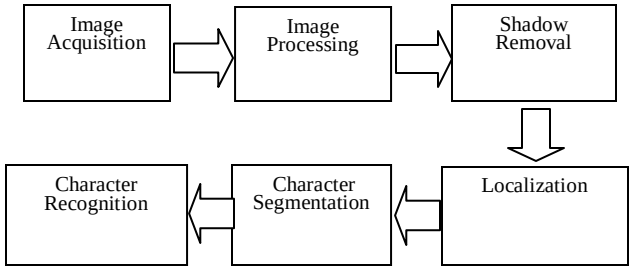

Figure 1: Car Number Plate Recognition System

II. NUMBER PLATE PREPROCESSING AND SHADOW REMOVAL ALGORITHM

Localization of potential license plate regions(s) from vehicle images is a challenging task due to huge variations in size, shape, color, texture and spatial orientations of license plate regions in such images. Here we captured the vehicle images and stores them in a centralized data server for further processing.

Preprocessing Applied:

1.RGB to Gray Scale Conversion:

From the 24-bit color value of each pixel (x,y) the R, G and B components are separated and the 8-bit gray value is calculated using the formula:

$$gray(x, y) = 0.59 * R(x,y) + 0.30 * G(x,yj) + 0.11 * B(x,y)$$

2. Median Filtering:

Median filtering is a useful in reducing impulsive, or salt-and-pepper noise. In median filtering, the neighboring pixels are ranked according to brightness (intensity) and the median value becomes the new value for the central pixel. Here we used 3X3 mask for filtering.

Enhanced Shadow Removal algorithm:

The brightness distribution of various positions on a license plate image may vary due to the condition of the plate and the effect of the lighting environment. During the number plate recognition procedure, the global threshold value method provides better computation efficiency if the vehicle images are obtained under uniform illumination and without noise, but in most cases, the environment around the number plate is complex and the illumination is un even, so the performance of a single binary threshold is poor. When the headlights are turned on at night, the illumination around the number plate is uneven. Therefore methods using global or local threshold values do not produce ideal results, whereas the Gaussian Laplace operator can achieve better results by using a dynamic binary.

In this study the Gaussian Laplace operator is combined with an iterative method. When illumination is even, the iterative method is adopted; when illumination is uneven, the Gaussian Laplace operator is adopted. Suppose that $f(x, y)$ denotes a gray value of point (x, y). Consider a block whose center is a point (x, y).

Steps:

1. Apply the Gaussian filter on the image.
2. The threshold $T(x, y)$ of $f(x, y)$ is computed by
   $T(x,y)=(\max(f(x,y)) + \min(f(x,y)))/2.$
3. Find difference as:
   $Diff=(\max(f(x,y) - \min(f(x,y)));$
4. Now fine final threshold as
   If diff>= constant_th then final_th=T(x, y)
   Else final_th=128;
5. Obtain a binary image by
   f(x, y)= 255 if f(x,y)>final_th;
   0 otherwise

Fig1:Processing task of simple image
(a) a sample RGB car image
(b)RGB to Gray conversion of image
(c)Image after applying median filter
(d)Image after applying Enhanced shadow removal image

III. NUMBER PLATE LOCALIZATION

In general, objective of any Number Plate Recognition (NPR) system is to localize potential license plate region(s) from the vehicle images captured through a road-side camera and interpret them using an Optical Character Recognition (OCR) system to get the license number of the vehicle.

In our paper we used Sobel operator for edge detection of license plate, after tha. Horizontal projection and vertical projection method is used to locate license plate on car image.

Edge detection method:
the Sobel method uses the derivative approximation to find edges. Therefore, it returns edges at those points where the gradient of the considered image is maximum. The horizontal and vertical gradient matrices whose dimensions are 3×3 for the Sobel method has been used in the edge detection operations.

$$G_x = \begin{pmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{pmatrix} \qquad G_y = \begin{pmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{pmatrix}$$

$$G = G_x + G_y;$$

Fig 2: Sobel operator mask for edge detection

Vertical and horizontal image projection:
The vertical projection of the image is a graph, which represents an overall magnitude of the image according to the axis y. If we compute the vertical projection of the image after the application of the vertical edge detection filter, the magnitude of certain point represents the occurrence of vertical edges at that point. Then, the vertical projection of so transformed image can be used for a vertical localization of the number plate. The horizontal projection represents an overall magnitude of the image mapped to the axis x.
We can mathematically define the horizontal and vertical projection as:

$Px(x) = \sum_{j=0}^{h-1} f(x, j)$ $Py(y) = \sum_{i=0}^{w-1} f(i, y)$

Where w and h are dimensions of the image.

Vertical detection – band clipping:
The band clipping is a vertical selection of the snapshot according to the analysis of a graph of vertical projection. If h is the height of the analyzed image, the corresponding vertical projection Py (y) contains h values, such as y (0; h -1). The height of band in pixels. We use aspect ratio of number plate i.e. Bands with a lower height will be preferred.

Horizontal detection – plate clipping:
The horizontal band clipping a horizontal selection of the snapshot according to the analysis of a graph of horizontal projection, w is the width of the analyzed image same like vertical detection.

Connected components labeling scans an image and groups its pixels into components based on pixel connectivity, *i.e.* all pixels in a connected component share similar pixel intensity values and are in some way connected with each other. Once all groups have been determined, each pixel is labeled with a gray level or a color (color labeling) according to the component it was assigned to.

Fig 3: Car image after localization of number plate

IV. NUMBER PLATE SEGMENTATION

Image segmentation plays an important and critical step that lead to the analysis of the processed image data. In order to extract and analyzed the object characteristic, the process need to partition the image into different parts that will have a strong correlation with the objects.

Here first we resize the plate image to fix size as 100*200 and then apply the adaptive thresholding filter to enhance an area of the plate before segmentation. The adaptive thresholding is used to separate dark foreground from light background with non-uniform illumination. After the thresholding, we compute a horizontal and vertical projection of the number plate. We use this projection to determine horizontal boundaries between segmented characters. These boundaries correspond to peaks in the graph of the horizontal projection. The segmentation algorithm is to find high peaks, which correspond to the spaces between characters.

The goal of the segmentation algorithm is to find high peaks, which correspond to the spaces between characters.

Fig 4: Segmented car image

V. RESULTS AND CONCLUSION

Above system aims to identify Indian number plate with minimum restriction. To achieve required result different algorithms are used for shadow removal, plate localization, plate segmentation. Preprocessing of detected number plate is done to improve plate results. As per literature review, there are different noise removal methods; in this project median filter is used. For the Localization of the Number plate region, there should be a proper edge in between the number plate boundary and the car in the background for the vertical edge detection to detect the edges.

For the process of number plate segmentation, we should first apply shadow removal technique; Image can have different lighting effect, to remove this Laplacian of Gaussian with adaptive thresholding method suggested. Image segmentation is done using vertical and horizontal projection which takes minimum processing speed and highly accurate. Principal Component analysis or Blob coloring is proposed for generation of feature vector. This feature vector is used by Support Vector Machine for character recognition. It is an algorithm for the classification of both linear and nonlinear data. It is a very highly accurate, and having less over fitting problem.

REFERENCES:

[1] Christos Nikolaos E. Anagnostopoulos, Ioannis E. Anagnostopoulos, Vassili Loumos, and Eleftherios Kayafas, "A Number Plate Recognition Algorithm for Intelligent Transportation System Applications", IEEE Trans. On Intelligent Transportation System, vol. 7, No. 3, Sept. 2006.

[2] Jaiwei Han and Micheline Kamber, 2006, "Data Mining: Concept and Techniques", Second Edition, ELSEVIER

[3] Kumar Parasuraman, and Subin P.S, "SVM Based Number Plate Recognition system" IEEE International Conference on Computational Intelligence and Computing research,2010.

[4] Lihong Zheng, Xiangjian He, Qiang Wu and Tom Hintz, "Number Plate Recognition without Segmentation", Proceedings of Image and Vision Computing New Zealand 2007, pp. 164–168, Hamilton, New Zealand, December 2007.

[5] P.ANISHIYA 1, PROF. S. MARY JOANS,"Number Plate Recognition for Indian Cars Using Morphological Dilation and Erosion with the Aid Of Ocrs", International Conference on Information and Network Technology IACSIT Press, vol.4 (2011).

[6] Shan Du, Member, Mahmoud Ibrahim, Mohamed Shehata, and Wael Badawy, "Automatic Number Plate Recognition (ALPR): A State of the Art Review, IEEE Journal 2011.

[7] Tom Mitchell, 1997, "Machine Learning", Second Edition, McGraw-Hill Publication.

[8] Weili Zeng and Xiaobo Lu., "A Generalized DAMRF Image Modeling for Super resolution of Number Plates", IEEE TRANSACTIONS ON INTELLIGENT TRANSPORTATION SYSTEMS, VOL. 13, NO. 2, JUNE 2012.

[9] Wengang Zhou, Houqiang Li, Yijuan Lu, and Qi Tian, "Principal Visual Word Discovery for Automatic Number Plate Detection", IEEE, 2012.

[10] Ying Wen, Yue Lu, Jingqi Yan, Zhenyu Zhou, Karen M. von Deneen, and Pengfei Shi, "An Algorithm for Number Plate Recognition Applied to Intelligent Transportation System", IEEE trans. On Intelligent Transportation System, vol. 12. , No. 3. Sept.2011.

[11] Zhen-Xue Chen, Cheng-Yun Liu, Fa-Liang Chang, and Guo-You Wang, "Automatic Number-Plate Location and Recognition Based on Feature Salience", IEEE RANSACTIONS ON VEHICULAR TECHNOLOGY, VOL. 58, NO. 7, SEPTEMBER 2009.