Vehicle Number Plate Detection Using Machine Learning Techniques

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Abstract: Vehicle number plate recognition is the most exciting and challenging research topic from past few years. Number plates are of different shape, size and also have different color in different countries. In India the most common vehicle number plate used have yellow or while as background and black as foreground color. In this paper we proposed a system for localization of number plate for vehicles in India and segmented the numbers as to identify each number separately. We generally focus on two steps; one is to locate the number plate and second is to segment all the number and letters to identify each number separately.

Index Terms **– Number plate localization, Morphological operation, Character segmentation, Thresholding, Edge detection.**

I. INTRODUCTION

Vehicle Number Plate Identification (VNPI) is a part of digital image processing which is generally used in vehicle transportation system to categorize the vehicle. Number plate recognition systems are having varieties of application such as traffic maintenances, tracing stolen cars, automatic electronic Toll collection system etc. But the main aim is to control the traffic management system. In India the traffic management system is developing day by day. In India, the number plate containing white background with black foreground color is used for private cars and for the commercial vehicles yellow is used as background and black as foreground color. The number plate starts with two digit letter "state code" followed by two digit numeral, followed by single letter after those four following digits as the below figure1.1.

Figure 1.1-sample of number plate

In figure 1.1, 1 indicates the Country code, 2 indicates the state code, and 3 indicates the district code, 4 indicates the type of vehicle and 5 indicates the actual registration number. Locating the number plate is very stimulating work in the field of image processing. The whole system mainly consists of two stages. First to identify the position of the number plate from the particular vehicle and second segmentation of all the numbers and letters of the number plate. The identification task is interesting because of the nature of the light. The position error will increase if the color of the number plate is related to the background. Noise on the number plate can sometimes cause error and low accuracy. There are some limitations that lead to failure in most practical applications due to the diversity of the number plate characteristics and the intricacy of the natural environment like rain, snow, for etc. we anticipated a method mainly based on edge detection and morphological operation and decrease the noise using mid-filtering noise removal method.

2. RELATED WORK

Many plate detection, segmentation algorithm have been proposed to implement VNPI system. Number plate detection algorithm is mainly categorized into three classes: edge-based, color based and texture based. License plate location algorithm based on edge Detection and morphology are describe to locate the number plate, first identify whether any noise is present in the plate. Several segmentation and recognition methods are used for number plate segmentation. More correct and effective segmentation of number plate will produce virtuous and more efficient recognition. Based on the above mentioned technique, many number plate localization algorithms have been established.an upgraded and efficient approach is recognized with high detection rate based on sobel edge detection and morphological operation.

3. PROPOSED METHOD

Number plate is a pattern with very high disparities of contrast. If the number plate is very similar to background it's challenging to identify the location. Illumination and contrast is changes as light fall changes to it.the morphological operations are used to eliminate the contrast feature within the plate.

The work is distributed into several parts:

II. Input raw image

III. Image binarization

3.Reduce noise using mid-filtering method

4.Enhance contrast using histogram equalizer

1 Plate localization

2 Character segmentation

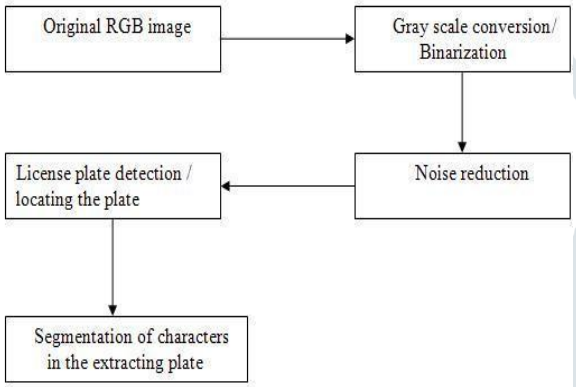

Figure 3.1 shows the basic step diagram of our proposed method.

The proposed method is designed for Vehicle Number Plate Detection for Indian vehicles. In Fig. 1 the method for proposed VNPD System is depicted. VNPD System consists of the following modules:

A. *Pre-processing* In this module firstly an input image is taken from an external source such as database or camera which is converted to gray scale. segmentation is performed using local Otsu's method. The initial threshold is set to zero. By calculating the size of input image, *n* window frames of equal size were found representing the overall image. A window frame moves on the input image and its local threshold is being calculated, the task is carried out for *n* window frames. Finally the average of *n* threshold values is calculated. This weighted threshold value is used to convert the image to binary scale.

B. Candidate Area Extraction

In this module the number plate area of Indian vehicles is located and extracted. The exact number plate area is being located and cropped from the original image Then the components are detected. Detection of components is done by starting with the top-left corner, the pixels are scanned from left to right in a topdown fashion for any lower intensity pixels. If a lower intensity pixel is found, all the connected pixels of similar intensity are found and their information is stored in a set. Traversing along, if a pixel of higher intensity is encountered, the pixels are again scanned till a pixel of lower intensity is found. If the currently discovered pixel has already been recorded in the set, the scanning is continued without storing its information. The process is again continued until all the connected pixels forming different components have been recorded. The image is depicted.

C. Character Recognition

In this module the labeled characters are retrieved and recognized. The templates loaded are resized to the size of recognized characters. Normalized cross correlation template matching is used to find the best match. Templates from an existing template set are selected and resized according to the size of the components discovered in the process. Resizing is done in such a way that the scale variance is minimized. In the proposed algorithm, the height and width of the template image is resized to the height and width of the characters of the processed image. Normalized Cross Correlation is performed between the components and the template image to find the degree of similarity between them. The value is obtained is compared to a given threshold. If the value of cross correlation is greater than the proposed threshold then the original threshold value is updated to the new one. If more than one correlation values exceed the previous threshold then threshold is updated to the highest among these values for the best match. The matched characters are retrieved and the result is stored in a text file.

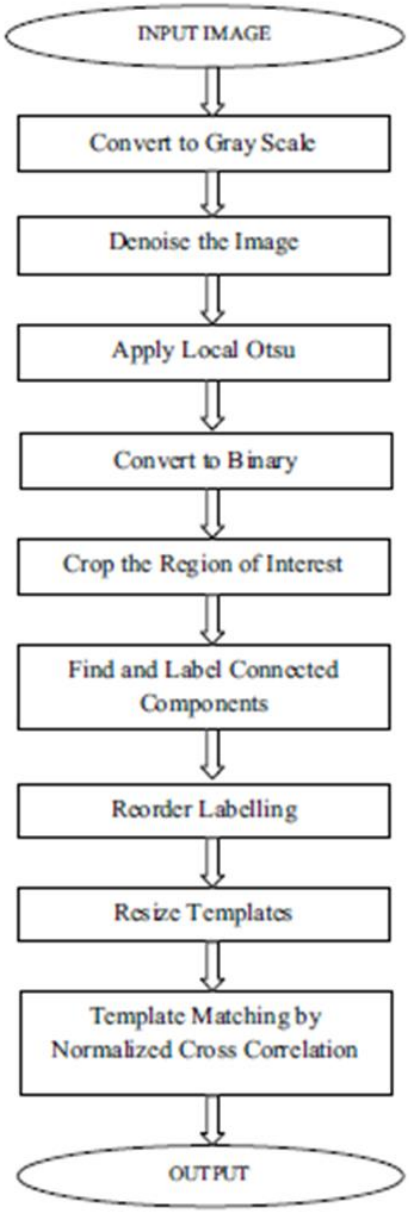

Fig. 1 Schematic flow of proposed method

Generally, the image obtained contains some irrelevant information or impurities such as holes, dirt particles and the background which must be removed. The noise is removed using median filter.

3.1. Input raw image

Input the image that is taken from the car

Figure:3.1.1- input car image

3.2. Gray scale conversion

From the input RGB image it has to be convert to gray scale and the 8-bit gray value is intended.

3.3.Noise reduction

We used median filtering method to reduce the paper and salt noise. We have used 3x 3 masks to get eight neighbors of a pixel and their consistent gray value.

3.4. Contrast enhancement using histogram equalization.

Using histogram equalization method the difference of each image is being enhanced. The function used to improvement that is J=histeq(k); histeq enhances the contrast of the images by converting the values in an intensity image. When image pixel intensity of 8-neibourgh connectivity, we supply a preferred histogram, histeq chooses the grayscale conversion T to minimize
$\left| c_1 (T (k))-c_0 (k) \right|$

In below we state the change of histogram from original image and after smearing the contrast enhancement using histogram equalization.

3.5. Plate localization

The basic step in recognition of vehicle number plate is to detect the plate size. In general number plates are rectangular in shape. Hence we have to identify the edges of the rectangular plate. Mathematical morphology will be used to detect that region.Sobel edge detector we used to high light regions with a high edge magnitude and high edge alteration are identified. Depending upon the threshold value edge will be detected from the input image. Figure 2.3 shows the input image before applying Sobel edge detection algorithm and figure 2.4 shows after applying the Sobel edge detection method.

Figure: 3.5.1- Grayscale image after image enhancing.

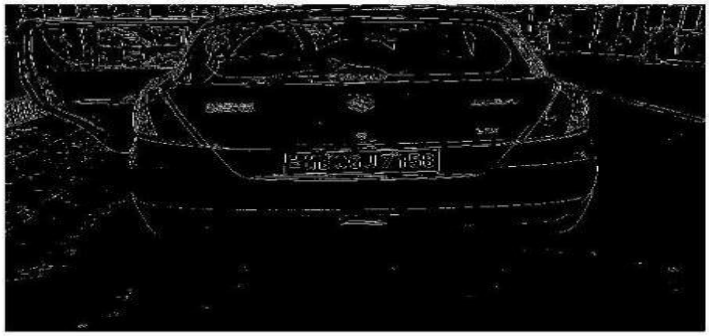

Figure: 3.5.2-After applying Sobel edge detection method

After edge detection eliminates all connected components that have lower than (eight pixel in our method) pixels.
Thus it will produce another binary image.

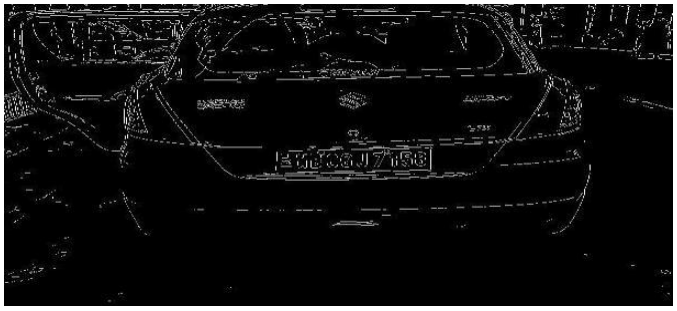

Figure:3.5.3-After removing lower pixels.

Python function deliver a functionimfill(BW,"holes") that fills holes in the binarized image called BW. The set of background pixels are known as hole that cannot be reached by filling the background from the edge of the image. Figure 2.5 shows after remove lower pixels connected components fills the holes

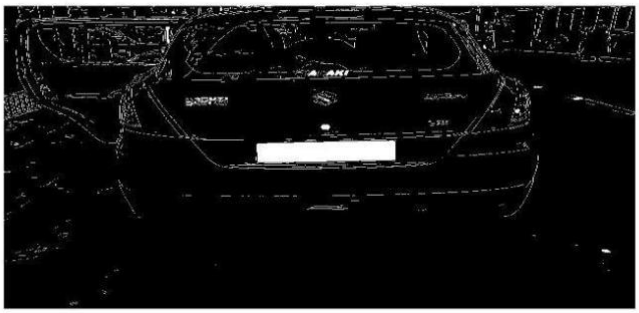

Figure: 3.5.4-After filling the holes

Using flood fill algorithm we fill the hole to trace the plate region. Now neglecting the lower pixel components to gets the actual plate.

Figure:3.5.5-image after removing components with connectivity less than 1000 pixel.

Using Python function bwareaopen() that stipulates the expected connectivity. All components connectivity lower than 1000 pixel are removed to get the actual location of the number plate. We output the four vertexes coordinates of the last selected region after morphological filtering and extract the number plate .

Figure: 3.5.6- License plate before crop

The final positioning of the number plate after cropping.

Figure: 3.5.7- The final number plate after the croping.

3.6. Character Segmentation

Python function delivers a function called regionprops(). It measures a set of properties for each labeled region in the label matrix. We use boundingbox to measure the properties of the image region. After labeling the connecting components, the region will be removing from the input image.

Figure 3.6.1- Segmentation of characters

4. EXPERIMENTAL RESULTS

We have run our proposed method on desktop computer Several vehicle images are taken using 1.3 mega pixel camera as well as 12 mega pixel cameras. In the experiments, we test our proposed method on the different type car image to identify the location exactly.

Fig: 4.1-Proper light on cropping

Fig 4.2-Successful number plate.

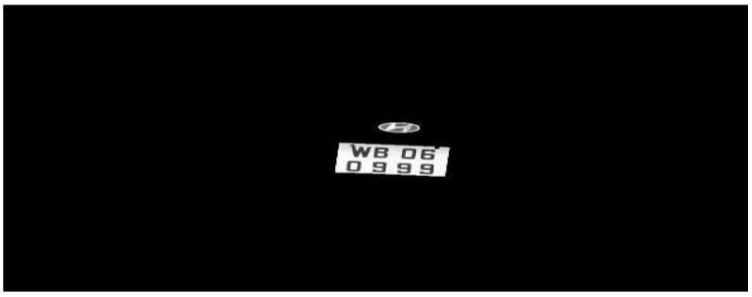

Figure: 4.3-Problem in distinguishing the actual plate position due to light.

5. CONCLUSION AND FUTURE WORKS

An efficient less time consuming vehicle number plate detection method is projected which performed on multifaceted image. By using, Sobel edge detection method here detects edges and fills the holes less than 8 pixels only. To removing the license plate we remove connected components less than 1000 pixels. Our anticipated algorithm is mainly based on Indian automobile number plate system. Extraction of number plate accuracy may be increased for low ambient light image.

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