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Automatic Vehicle Number Plate Recognition Using MATLAB

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ABSTRACT: Video surveillance systems are used for security purposes. But the detection of moving object is difficult for video surveillance. Video surveillance systems are used in many applications like Banking security, Military applications, Traffic monitoring etc. Automated systems have been designed for numerous detection tasks, but the task of detecting illegally parked vehicles has been left largely to the human operators of surveillance systems. The detection Indian vehicles by their number plates are the most interesting and challenging research topic from past few years. It is observed that the number plates of vehicles are in different shape and size and also have different colour in various countries. This work proposes a method for the detection and identification of vehicle number plate that will help in the detection of number plates of authorized and unauthorized vehicles. This paper presents an approach based on simple but efficient morphological operation and Sobel edge detection method. This approach is simplified to segmented all the letters and numbers used in the number plate by using bounding box method. After segmentation of numbers and characters present on number plate, template matching approach is used to recognition of numbers and characters. The concentrate is given to locate the number plate region properly to segment all the number and letters to identify each number separately.

KEYWORDS: Number Plate Recognition (NPR), Support Vector Machine (SVM), Automated Teller Machine (ATM)

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 (NPR) 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 licence plate. The identification task is challenging because of the nature of the light. Experimentation of number plate detection has been conducted from many years, it is still a challenging task .Number plate detection system investigates an input image to identify some local patches containing license plates. Since a plate can exist anywhere in an image with various sizes, it is infeasible to check every pixel of the image to locate it. In parking, number plates are used to calculate duration of the parking. When a vehicle enters an input gate, number plate is automatically recognized and stored in database. In NPR system spectral analysis approach is used were acquiring the image, extract the region of interest, character segmentation using SVM feature extraction techniques. The advantage of this approach is success full recognition of a moving vehicle[1].It is difficult to detect the boundary of the Number plate from the input car images in outdoors scene due to colour of characters of the number plate and Background of the Number plate the gradients of the original image is adopted to detect candidate number plate regions. There are also algorithms which are based on a combination of morphological operation, segmentation and canny edge detector License plate location algorithm consist of steps like as Edge Detection, Morphological operation like dilation and erosion, Smoothing, segmentation of characters and recognition of plate characters.

II. BLOCK DIAGRAM OF NPR SYSTEM

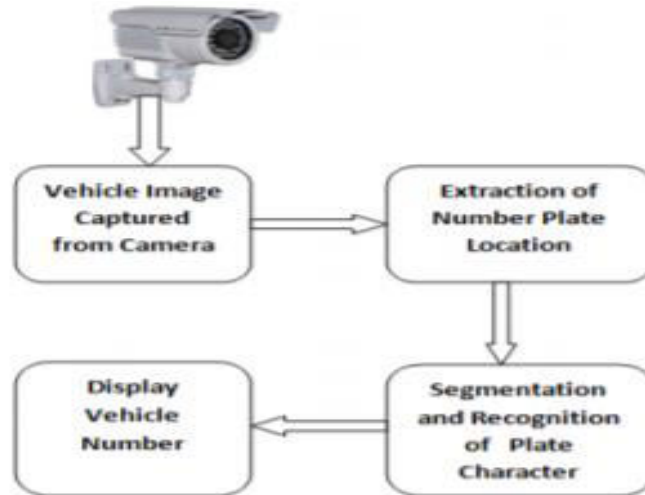


Fig: 1 Block diagram

Blocks of general NPR system are discussed below:

A. Vehicle image captured by camera:

The image of the vehicle whose number plate is to be identified is captured using digital camera.



Fig: 2 Captured image from the vehicle

B. Extraction of number plate location:

In this step the number plate is extracted by firstly converting RGB Image i.e., the captured image to Gray Scale Image. Here mathematical morphology is used to detect the region and Sobel operator is used to calculate the threshold value. After this we get a dilated image. Then infill function is used to fill the holes so that we get a clear binary image.

C. Segmentation and Recognition of Plate Character:

Here bounding box technique is used for segmentation. The bounding box is used to measure the properties of the image region. The basic step in recognition of vehicle number plate is to detect the plate size. Here the segmented image is multiplied with gray scale image so that we only get the number plate of the vehicle.

D. Display vehicle number :

After undergoing the above steps the number plate is displayed in MATLAB window

III. NPR IMPLEMENTATION USING MATLAB

The entire working process of NPR implementation using MATLAB:

A. INPUT IMAGE :

This is the first phase deals with acquiring an image. In the proposed system, digital camera of 3.2 megapixel camera is used. The input image is 120 x 160 or 1200 x 1600 pixels



Fig: 3 Original Image

B. EXTRACTION OF NUMBER PLATE LOCATION :

The inputs to the system were the images of vehicles captured by a camera. RGB to gray-scale conversion is adopted, in order to facilitate the plate extraction, and increase the processing speed. Colour image (RGB) acquired by a digital camera is converted to gray-scale image using $I_{gray} = 0.114 * R + 0.587 * G + 0.299 * B$(1)

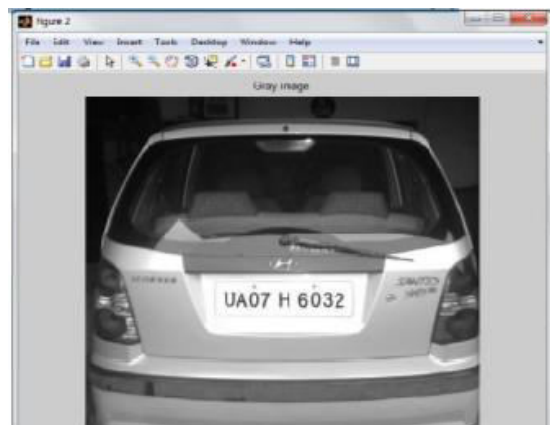


Fig: 4 Gray Scale Image

The basic step in recognition of vehicle number plate is to detect the plate size. In general number plates are in rectangular shape, hence it is necessary to detect the edges of the rectangular plate. Mathematical morphology is used to detect the region of interest and Sobel operator is used to calculate the threshold value, that detect high light regions with high edge magnitude and high edge variance

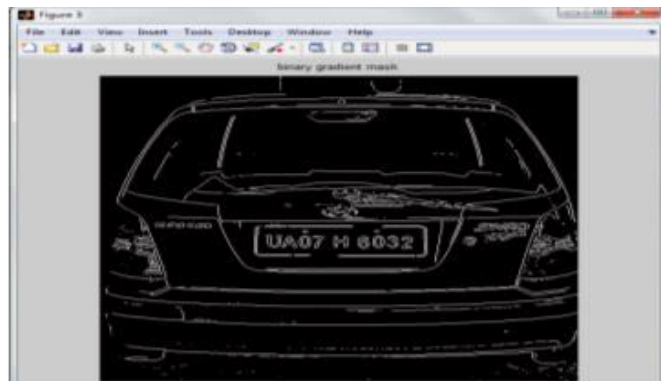


Fig: 5 Binary gradient image with sobel edge detector

The binary gradient mask shows lines of high contrast in the image. These lines do not quite delineate the outline of the object of interest. Compared to the original image, gaps in the lines are observed that surrounds the object in the gradient mask. This linear gap disappears if the Sobel image is dilated using linear structuring elements. Structuring element is represented as matrices, which is a characteristic of certain structure and features to measure the shape of an image which is used to carry out other image processing operations. The binary gradient mask is dilated using the vertical structuring element followed by the horizontal structuring element.

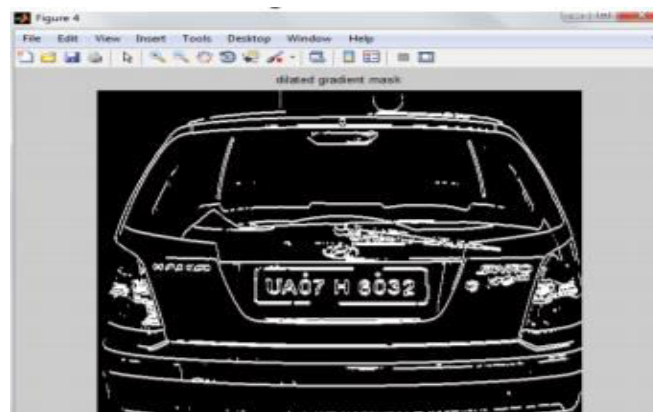


Fig: 6 dilated image

MATLAB toolbox provides a function `infill` (BW, "holes") that fills holes in the binarized image. The dilated gradient mask shows the outline of the cell quite nicely, but there are still holes in the interior of the cell. The set of background pixels are known as hole that have not removed by filling the background from the edge of the image. Figure 7 shows after removal of lower than 100 connected pixels. The dilated gradient mask shows the outline of the region quite nicely, but there are still holes in the interior of the region, to fill these holes `infill` function in MATLAB is used.

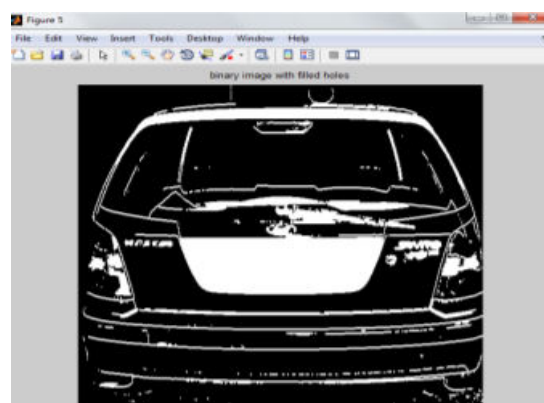


Fig: 7 Binary image with filled holes

C. REMOVE CONNECTED OBJECTS ON BORDER:

The region of interest has been successfully segmented, but it is not the only object that has been found. Any objects that are connected to the border of the image can be removed using the `imclearborder` MATLAB function. The connectivity in the function was set to 4 or 8 to remove diagonal connections and fill the hole to locate the plate region. After removing the lower pixel components actual plate region is detected.

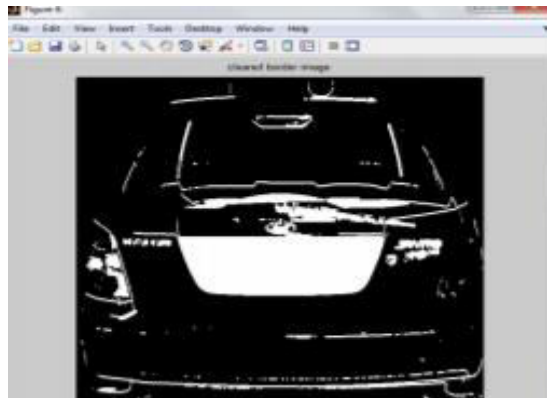


Fig: 8 Removed connected objective image

Finally, in order to make the segmented object look natural, the image is eroded twice with one of the diamond, disk and line structuring element. This helps in extraction of number plate area of the vehicle.

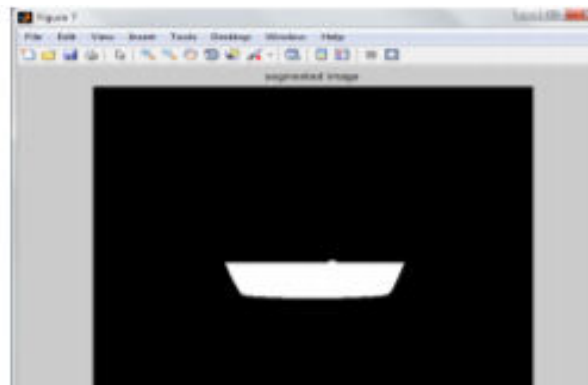


Fig: 9 Extraction of Number plate area

To get the only number plate area in a vehicle image with characters and numbers present on it, the segmented image is multiplied with gray scale image.

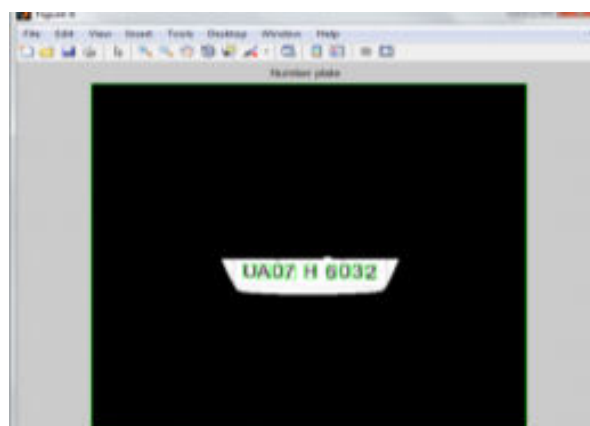


Fig: 10 Number plate of vehicle image

D. CHARACTER SEGMENTATION:

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.



Fig: 11 Number plate with bounding box image



Fig: 12 Image of each character

The above figure shows the image of each character that is present in the number plate of the vehicle sequentially.

E. CHARACTER RECOGNITION AND DISPLAY THE RESULT:

It is employed for the purpose of conversion of images of text into characters. Number plate recognition is now used to compare the each individual character against the complete alphanumeric database using template matching. The matching process moves the template image to all possible positions in a larger source image and computes a numerical index that indicates how well the template matches the image in that position. Matching is done on a pixel by pixel basis.



Fig: 13 Templates used for template matching

IV. MATLAB RESULT

The final result of NPR system is shown in Fig. 14 below

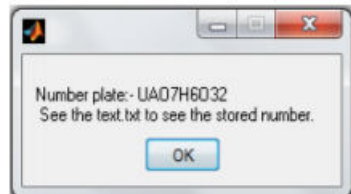


Fig: 14 Image of result

It displays number plate of the desired vehicle.

The number plate as text file is displayed as shown below

Number Plate:-UA07H6032

Fig: 15 Image of result stored at text file

The above Fig shows the number plate of the vehicle from the captured image.

V. APPLICATIONS OF NPR SYSTEM

- **Parking:** - The NPR is used to automatically enter prepaid members and calculate parking fee for non-members.
- **Access control:** - A gate automatically opens for authorized members in a secured area, thus replacing or assisting the security guard.
- **Airport Parking** :- In order to reduce ticket frauds or mistakes, the NPR unit is used to capture the number plate and image of the car

VI. CONCLUSION

In this system, 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

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