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Tracking and segmentation of number plates of Indian vehicles using matlab

Sakhshe Peer, Anoop Mishra

Dronacharya Group of Institutions, Greater Noida, India

Abstract
Usually video surveillance system is used for security purpose as well as monitoring systems. But Detection of moving object is a challenging part of video surveillance. Video surveillance system is used for Home security, Military applications, Banking /ATM security, Traffic monitoring etc. Now a day's due to decreasing costs of high quality video surveillance systems, human activity detection and tracking has become increasingly in practical. Accordingly, 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 of Indian vehicles by their number plates is 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 color 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 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 concentration is given to locate the number plate region properly to segment all the number and letters to identify each number separately. In the end the extracted information is mailed to the responsible authorities for further verification.

Keywords: matlab

Introduction

Vehicle number plate tracking and segmentation is a vital part of digital image processing which is broadly used in vehicles transportation system to identify a vehicle. Automatic number plate recognition system is an image processing technology [1, 2] that identifies vehicles by tracking their number plate without direct human intervention. It is also known by various other terms as automatic license plate recognition, automatic license plate reader, number plate tracking, car plate recognition, vehicle number plate recognition, automatic vehicle identification etc. Number plate detection system investigates an input image to identify some local patches containing license plates [2]. 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. The attributes of the number plates are maintained strictly in all almost all developed and developing countries. The attributes of number plates are background color of number plate, character color, character size, aspect ratio of number plate, font style, script etc. are maintained strictly [3]. The aspect ratio is very important factor and in all developed and developing countries, vehicles number plate has same aspect ratio. There are number of applications of automatic number plate recognition system such as automatic toll collection at toll plaza, traffic monitoring and control, border control, stolen vehicle detection, automatic ticketing of vehicles, access control etc. The number plate start with two digit letter "state code" followed by two digit numeral followed by single letter after those four consecutive digits as the below figure1.1.

From the figure 1, 1 indicates the Country code, 2 indicates the state code, and 3 indicates the district and type of vehicle and 4 indicates the actual registration number.

Fig 1: Sample 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. The location error will increase if the color of the number plate is very similar to the background. Noises in the number plate sometimes cause errors and difficulties in extraction of correct number plate. There are some limitation that led to failure in most practical application due to the diversity of the number plate characteristics and the complexity of the natural environment like rain, snow, less light etc.
In this paper, we have proposed a method mainly based on edge detection and reduction of noise using mid-filtering noise removal method.

Methodology Adopted

The proposed approach for number plate extraction is represented in this section. Input to this system is vehicle image that is acquired through digital camera and output is the actual number plate portion. Images are acquired in different illumination conditions and in different background [3]. The flowchart of proposed method is shown in Fig. 2 consists of following main steps:

- Load RGB Image From File
- Resize the Image
- Convert RGB Image Into Grayscale
- Filter to Remove Noise
- Eroding and Dilating Image
- Edge Enhancement
- Converting into Binary(BW)
- Filling All Regions of the Image
- Character Segmentation
- Character Recognition
- Display Number Plate
- Mail the Extracted Information

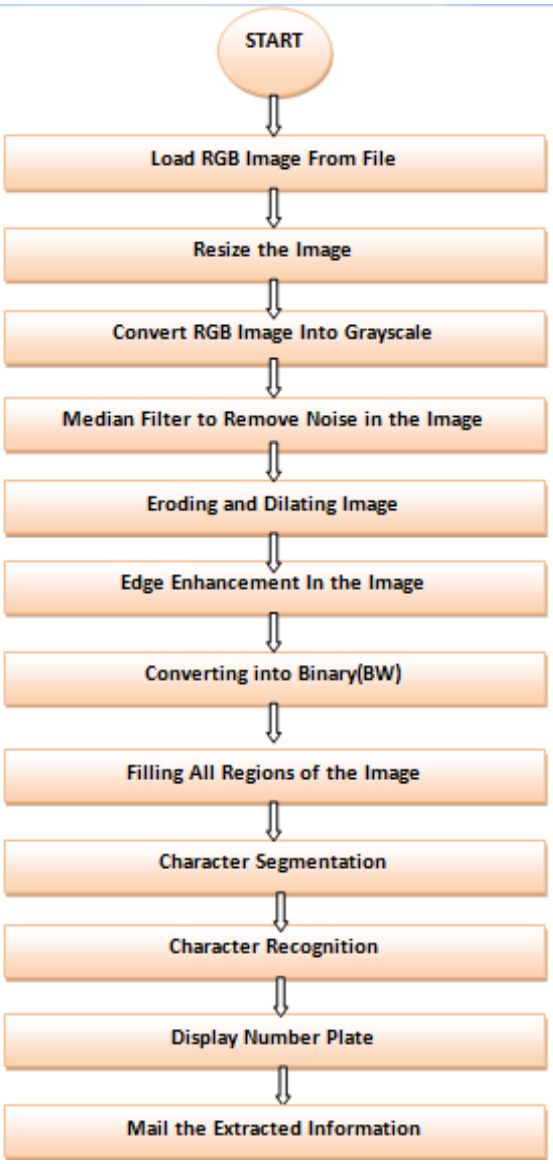

Fig 2: System Block Diagram

A. Load RGB Image from the File

Fig 3: Input Vehicle Image (RGB)

The first step is to acquire the input image of vehicle. Image is acquired by digital camera and resized in MATLAB. Images are taken in different illumination conditions and at various distances from the camera. Fig. 3 shows the input vehicle image.

B. Conversion in Grayscale

Fig 4: Grayscale Image

The captured input image is RGB format. The first step of preprocessing is to convert RGB image into grayscale. The basic purpose of applying color conversion is to reduce the number of colors. The R, G and B components are separated from 24-bit color value of each pixel (i, j) and 8-bit gray value is calculated. Fig. 4 shows the gray scale image.

C. Noise Removal by Iterative Bilateral Filter

The basic aim of filtering is to remove noise and distortion from the image. The noise can occur during camera capturing and due to weather conditions. In the proposed method iterative bilateral filter is used for noise removal. Iterative bilateral filter is non-linear filter. It provides the mechanism for noise reduction while preserving edges more effectively than median filter. The result of applying iterative bilateral filter on gray scale image is shown in Fig. 5.

Fig 5: Bilateral Filter

D. Image Erosion and Dilation

Erosion is one of the two basic operators in the area of mathematical morphology, the other being dilation [4, 5]. It is typically applied to binary images, but there are versions that work on grayscale images. The basic effect of the operator on an image is to erode away the boundaries of regions of foreground pixels (*i.e.* white pixels, typically). Thus areas of foreground pixels shrink in size, and holes within those areas become larger. Fig 6 shows an eroded image.

Fig 6: Image Erosion

In figure7, image has been dilated. Dilation is a process for filling holes in an image, sharpen edges of an object maximize brightness and connect the broken lines. Dilation can remove unwanted noise from image.

Fig 7: Image Dilation

E. Conversion into Binary

In this operation the subtracted gray scale image is converted into binary image. Firstly threshold level is calculated. In MATLAB graythesh function is used to find the threshold level of image and then according to the calculated threshold the subtracted gray scale image is converted into black and white image by using function im2bw. Fig. 8 shows binary image

Fig 8: Binarization

F. Binary Image with Filled Holes

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 9 shows after removal of lower than 100 connected pixels.

Fig 9: Binary Image with Filled Holes

Using Mat lab toolbox function bw area open () that specifies the desired connectivity. All components connectivity lower than 1000 pixel are removed to get the actual location of the number plate. It is shown in figure10.

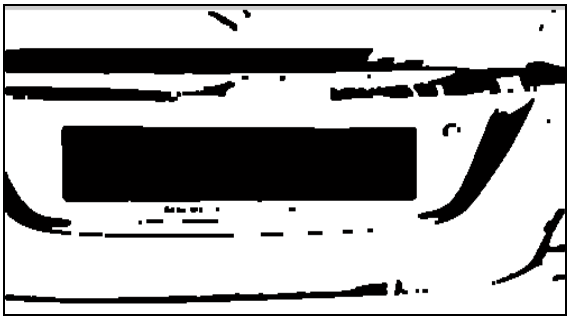

Fig 10: Removed Connected Object Image

Finally to get the only number plate area in a vehicle image with characters and numbers present on it, the segmented image is multiplied with grayscale image which is shown in figure11 below:

Fig 11: Extracted Plate

G. 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 [6]. 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 the result of operation is shown in Fig.12.

Fig 12: Number Plate with bounding box image

Now, it is preferable to divide extracted plate into individual image, each containing one isolated character. There are some widely used methods for character isolation like static bounds, vertical projection, and connected component. In our system, we have used the connected component technique. We have detected the number of connected components and labeled them. After it we measured a set of properties for each labeled region. Bounded box is used to separate individual character from the number plate. Figure 13: shows the segmented plate and individual character.

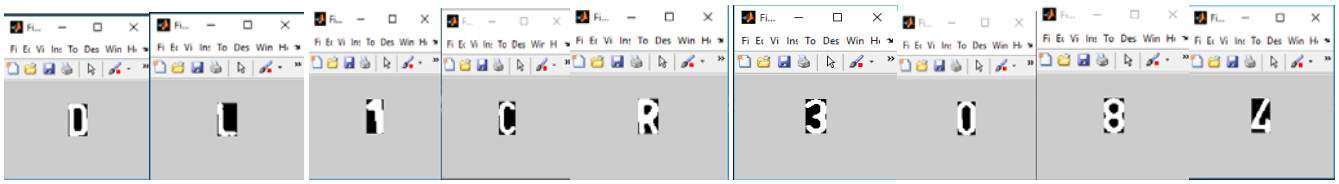

Fig 13: Extracted Characters

H. Character Recognition:

For Recognization of individual alphanumeric character, template based Recognization method is used. In template based algorithm, segmented image is compared with one image which is stored in database named as template image. In both images best matched similarity is compared [6, 7]. This similarity is matched with statistical method correlation. The image for which the correlation coefficient for template image is maximum that image is best matched. These template images are shown in figure 14.

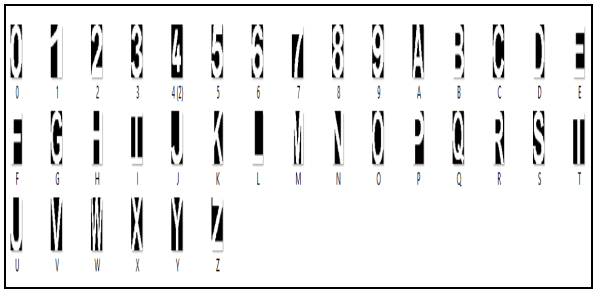

Fig 14: Templates Used for Template Matching

I. MATLAB Results

The final result of the system as a text file is displayed as in figure15 shown below:

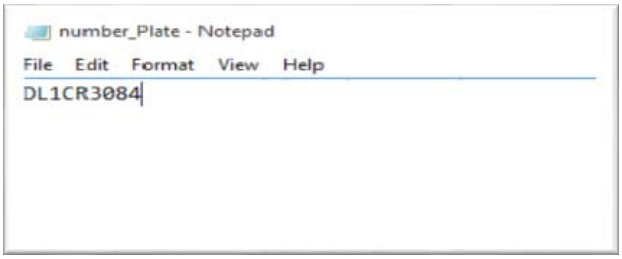

Fig 15: Extracted plate is stored in file

It displays number plate of the desired vehicle.
In the end the. txt file is mailed to the responsible authorities.

Conclusion

Number plate extraction needs extremely high accuracy when working on images of busy roads or parking areas. This system gives about 90% of efficiency and has been tested with nearly 50 vehicles.

Some of possible difficulties:

1. Broken number plate.
2. Blur images.
3. Number plate not as per the legal specification.
4. Low resolution of the characters.
5. Poor maintenance of the vehicle plate.
6. Similarity between certain characters, namely, O and D; 5 and S; 8 and B, E; O and 0, etc.

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