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Automatic localization of license plate region using two dimensional filter in MATLAB

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ABSTRACT

Automatic license plate recognition system is an image processing technology used to identify vehicles by their license plates. Such systems require the localization of number plate area in order to identify the characters present on it. Since number plate standards are not strictly practiced in India, a large amount of variations are obtained in parameters like, size of number plate and characters, location of number plate, type of font used, background and foreground colour, etc. which makes the task of number plate localization all the more difficult. The proposed algorithm consists of two main modules: image splitting and localization of region of interest (ROI).

A two-step approach for localization is presented. In the first step, image is split in two parts. In the second step, a two dimensional digital filter is used to find the probable number plate location. This approach enables the localization of number plates in widely varying illumination conditions with relevance to the commonly found types of car number plates with a success rate of 89%.

KEYWORDS

License plate localization;
2D digital filter.

INTRODUCTION

Nowadays, the development in transportation and growth of vehicle is enormous. In addition, the Intelligent Transportation System (ITS) is emerged to develop the automated transport maintenance systems. Among the intelligent transportation technologies, Automatic license plate recognition (LPR) plays an important role in numerous real time applications. Locating the license plate region from complex scenes is the key component of LPR, which determines the overall performance of the system. The Localization problem is generally sub-divided into 3 parts[1]: (1) image acquisition i.e. capturing the image of the license plate (2) pre-processing the image i.e. normalization, adjusting the brightness, and contrast of the image (3) localizing the license plate.

The region of license plate commonly have some obvious features distinct from the background[2,3]: the characters and bottom surface of car license have the big gray level change; the areas of license plate have obvious frame and the background areas around the license plate mainly include some horizontal edges, and so on.

A guiding parameter in this regard is country-specific traffic norms and standards. This helps to fine

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tune the system i.e. number of characters in the license plate, text luminance level (relative index i.e. dark text on light background or light text on dark background) etc. So the problem can then be narrowed down for application in a particular country. For example, in India the norm is printing the license plate numbers in black colour on a white background for private vehicles and on a yellow background for commercial vehicles.

License Plate Localization (LPL) methods are broadly classified into Morphology based LPL methods, Edge statistics, neural networks, fuzzy, templates based and so on. The aspect ratio, colour, variance, edge density are some of the license plate features used by the above methods. High contrast between characters and background in a license plate is a strong feature which is considered in edge analysis[4].

In this paper, a method is proposed for detecting the license plate form a colour image. For real time application, the system requires a video camera which acquires the image of vehicles from rear or front but for the present work, due to unavailability of the required hardware, we have used mobile camera. The image of various parked vehicle have been acquired manually and from the internet[5], there after fed to the software where they are firstly processed and then the two dimensional digital filter is used to extract out the specific region of same shape.

All processing is done in MATLAB (2011) Version 7.13.0.564.

PROPOSED LOCALIZATION SCHEME

The process of localization involves seven steps as shown in Figure 1. First step involves the image acquisition from a camera or any other source in such a way that plate lies either in lower half or upper half part of the image.

In our method, we acquire images in such a way that plate lies in lower part of the image. An already extracted plate was used as test image in filtering process. Figure 2 shows the test plate used in our system.

Figure 3 & 4 show the example of image with wanted portion.

There were a list of constraints which need to be specified before selecting the image. The constraint is listed as below:

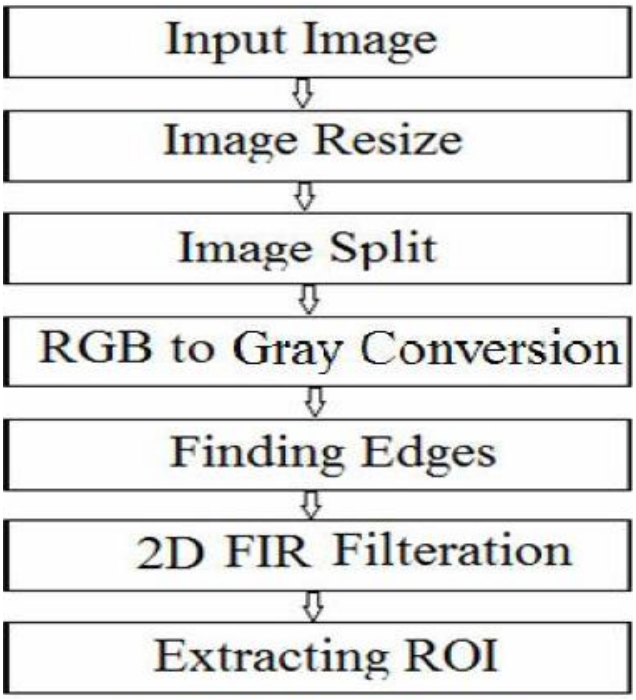

Figure 1 : Proposed work

Figure 2 : Test image in filtration process

Figure 3 : Example of indian number plat

- Image taken only when vehicle is stationary
- Captured image of vehicle at fixed angle
- There will be no motion capture image
- Captured images on location where light is proportional
- Plate lies in lower half part of the image

Resizing the image

In the 2nd step, every acquired image is resized to a fixed size which is similar to size of test image used in

Figure 4 : Example of non-indian number plate

Figure 5 : Clipped portion of the figure 3

Figure 6 : Clipped portion of the figure 4

filtering process. In Our system, we resized each image to 1200 X 1600 resolutions. In MATLAB, resizing is done using 'imresize' function.

{img = imresize(img, [1200 1600]);}

Here img' is the variable which was used to read the image.

Splitting the image

Third step involves the horizontal splitting of image in two parts. In our system, we used lower part of the image for further processing. Figure 5 and 6 shows the split portion of the image.

RGB to gray conversion and finding edges of the image

In any 24-bit colour image, each pixel contains the Red (R), Green (G) and Blue (B) colour components, each consuming 8 bits of information. From these R, G and B components, 8-bit gray value for each pixel position is calculated using the formula written in Equation (1).

$$gray(i, j) = 0.29*R(i, j)+0.59*G(i, j)+0.11*B(i, j) \quad (1)$$

where, (i, j) indicates the position of a pixel in the image, and $gray(i, j)$ (0, 255). Since most of the license plate has two colours, one is background colour and another is text colour, the gray level of pixels is utilized as features to detect ROI.

The segmentation of gray scale image generated by finding edges using sobel filter for smoothing image and is used to reduce the number of connected component. Figure 7 and 8 shows the gray scale and edges of figure 5 and 6.

Test image which is to be used in filtration process is also converted to gray scale and edges were found. Figure 9 shows the edges of test image using sobel filter.

Two dimensional filtration process

This part filters the data in input image with the two-dimensional FIR filter using test image. 2-D filters compute the result using two-dimensional correlation,

Figure 7 : Gray scale and edges of figure 5

Figure 8 : Gray scale and edges of figure 6

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Figure 9 : Edges of Test image

Figure 10 : Masked region of figure 7

Figure 11 : Masked region of figure 8

and return the central part of the correlation that is the same size as test. The test image is correlated with the filter and the resulting correlation output is processed to determine where the region of license plate is. The correlation output will have a strong peak on the region of license plate. In MATLAB, 'filter2' function is used to find the correlation matrix in two images.

{Y = filter2 (t_edge,i_edge);}

Here t_edge is the edges of test image and i_edge is the edges of input image.

After calculating the dimensions of the region, 'roipoly' is used to find out the masked region.

{m = roipoly(i_edge,c,r) ;}

Figure 10 & 11 shows the masked region of Figure 7 and 8.

Extracting the roi

As Masked region contains only one component and whose dimensions can be found by labelling the component. Then masked region is multiplied with the input gray scale image.

{out = mask.* i_gray;}

Here out is final image which can be cropped out to

Figure 12 : Plate location region of figure 3

Figure 13 : Plate location region of figure 4

Figure 14a : Example of successfully located license plate region

Figure 14b : Extracted regions

license plate region using 'imcrop' function in Matlab.

{LP=imcrop(out,[cmin rmin … (cmax-cmin) (rmax-rmin)]);}

Figure 12 and 13 shows the extracted regions of figure 3 and 4.

EXPERIMENTATION AND RESULTS

The proposed work is simulated using the

MATLAB software on the Intel processor of 2.67 GHz frequency and 3GB RAM. The required images for the proposed work are acquired with the help of digital Mobile camera. The images acquired have the resolution of 1600×1200. In order to check the efficiency of the proposed algorithm, the experiment is performed repeatedly with many car images and the results of the experiment are shown below.

The technique is extensively tested with 150 image samples and gives satisfactory performance. For all the images, the corresponding license plate regions are correctly located, and most of the results are accurate. The rate of success is 89%. The average execution time of license plate localization is 1.65 sec. Overall, it shows the proposed method achieves good performance, and is influenced little by external condition.

But we have to point out there were some cases failing to locate the plates. The reasons are different, for example, the images are taken at some angle or in caliginous surroundings, and the images are fuzzy. These problems could be solved if further efforts will be concentrated on better pre-processing methods to remove the bad influences.

CONCLUSION AND FUTURE WORK

In this paper, we presented a new method of locating license plate from a vehicle image. Our algorithm accurately localizes the license plate in one vehicle image. What's important, during the whole it doesn't place any specific limits on the images. The algorithm can be found to work well, robustly and in real time even when applied to complex vehicle images in noisy conditions and poor illuminations. The system works satisfactorily for wide variations in illumination conditions and different types of number plates commonly found in India. It is definitely a better alternative to the existing manual systems in India. Currently there are certain restrictions on parameters like speed of the vehicle, script on the number plate, skew in the image which can be aptly removed by enhancing the algorithms further.

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