Implementation of Vehicle License Plate Detection Algorithm in MATLAB

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***Abstract*— Each vehicle has unique identification number on its license plate. It is possible to identify this by means of vehicle license plate identification system. This helps to monitor weight- and speed-limit prosecution, traffic data collection, and automatic payment of highway toll fee, handling parking lot traffic and tracking of specific vehicle. The consistency of the vehicle license plate identification system depends upon this type of application. License plate recognition has limitations due to different conditions, such as mist, shower, glooms, uneven illumination conditions, variable distances, cars' velocity, plate angle on frame, plate skew, number of vehicles in the frame, etc. These things makes plate recognition very complicated and hard than the traditional systems. So we have discussed about how to implement an algorithm using the MATLAB for the License Plate Localization system.**

Key Words—Algorithm, Dilation, Histogram, Threshold, Segmentation

I. INTRODUCTION

MATLAB is better choice for the execution of algorithms which requires heavy computation, especially in image processing. MATLAB provides easy and quicker implementation of algorithms compared to C and C++. The considerable feature in MATLAB is that it contains a rich library functions for image processing and data analysis. Implementation and verification any algorithm with MATLAB is fast and reliable before actually employing it on real hardware. Recognition and rectification of errors, modifications in any algorithm on actual hardware system becomes a very difficult. MATLAB offers an easy methodology for debugging, correction and modifications in any algorithm. MATLAB contains many for data analysis and image processing, so it is a better choice over other software languages like C and C++.

Considering all the above benefits, I have used MATLAB to implement my algorithm for License Plate Detection. This algorithm uses some inherent functions and some user defined routines associated to image processing. The algorithm was tested for many samples of car images. Once the algorithm was fully confirmed, the inherent functions of MATLAB were replaced by user-defined functions. A flow chart in figure 1 shows steps of implementation of algorithm.

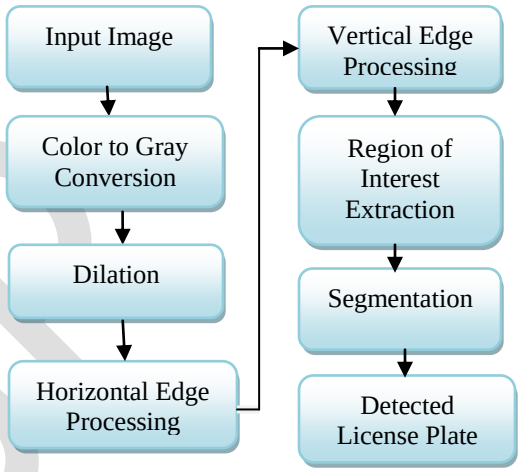

Fig. 1: Flowchart of license plate detection algorithm in MATLAB.

II. CONVERT A COLOURED IMAGE INTO GRAY IMAGE

The algorithm described here is independent of the type of colours in image and relies mainly on the gray level of an image for handling and mining the required information. Colour components like Red, Green and Blue value are not used throughout this algorithm. The input image is normally RGB. Before advance processing it is converted to a gray image [1]. Figure 1 shows RGB input image and figure 2 shows a gray image.

Fig 2: Original color image

Fig. 3: Gray image

III. DILATE AN IMAGE

The improvisation in given car number plate image is done by filling holes, making the edges of objects sharp, joining the broken lines and increasing the brightness. Any noise in an image may also be removed using dilation [2]. The variance of gray value within adjacent pixels at the edge of an object can be increased by sharpening the edges. This enhances the edge detection. The image of a car number plate may not always have the equal intensity and shades. Hence, the given image has to be transformed from RGB to gray form [6][7]. However, during this conversion, certain important parameters like difference in colour, lighter edges of object, etc. may get lost. The dilation process will support to abolish such losses. The figure 4 shows image after Dilation.

Fig. 4: Dilated image.

IV. HORIZONTAL AND VERTICAL EDGE PROCESSING OF AN IMAGE

Histogram is a graph signifying the values of a variable magnitude over a given range. In this algorithm, to detect exact position of number plate in car image, I have used the column and row wise histogram [3]. These histograms signify the summation of variances of gray values amongst neighboring column and row wise pixels of the number plate image.

The histogram in horizontal direction is calculated within first stage [7]. To get a horizontal histogram, the algorithm navigates through each column of an image. It begins calculating from the second pixel from the uppermost, within each column. The difference amongst second and first pixel is calculated. If the difference goes above certain threshold, it is added to total sum of differences. The algorithm goes down and computes the difference amongst the 3rd and 2nd pixel. It moves towards the last pixel of a column and compute total sum of differences between neighbouring pixels. Finally, an array is created which contains the column wise sum [4]. The similar process is used to get the vertical histogram by processing rows instead of columns.

V. PASSING HISTOGRAMS THROUGH A LOW PASS DIGITAL FILTER

It is seen from the figures 5 & 6 shown below, that the histogram values changes significantly between successive columns and rows. Hence, to avoid loss of vital information in forthcoming steps, it is worthwhile to smooth out such drastic changes in values of histogram. Therefore a digital low-pass filter is used through which the histogram is passed. While execution of this step, each value of histogram is averaged taking in account the values on its right hand and left hand side. This step is performed on both the horizontal histogram as well as the vertical histogram. Figures 5 & 6 shows these histograms with the effect of a low-pass digital filter on them.

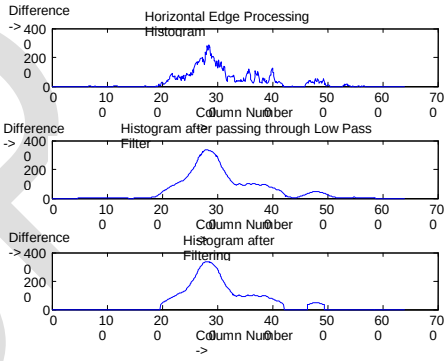

Fig. 5: Histogram of horizontal edge processing.

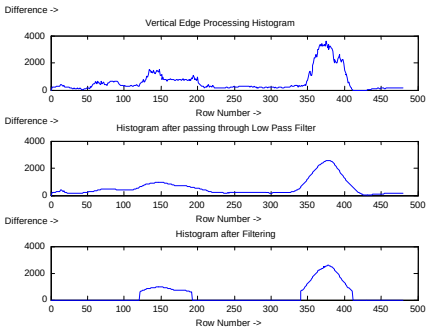

Fig. 6: Vertical edge processing histogram.

VI. FILTERATION OF UNWANTED REGIONS IN AN IMAGE

These histograms are filtered using a low-pass digital filter to discard unwanted regions from the captured image. The rows & columns having low histogram values are the unwanted regions. A low histogram value specifies that the region of image contains very minute deviations amongst neighbouring pixels. Since a area on a license plate contains

bare background with alphanumeric characters in it, the difference in the neighbouring pixels, especially at the edges of typescripts on number plate, will be very high. This results in a high histogram value for such portion of an image. Therefore, a region that has a large horizontal and vertical histogram values, likely have license plate. Regions with less values are not required. Such areas are discarded from an image by applying a dynamic threshold [10].

The dynamic threshold, in this algorithm, is the average value of a histogram. The vertical and horizontal histograms are filtered through a digital filter with this dynamic threshold. The outcome of this procedure is the histogram which shows most probable regions which might have number plate.

VII. REGION OF INTEREST EXTRACTION

In the next stage, we detect all the areas within the image which has better probability of having a license plate [5]. Coordinates of all such likely areas are kept in an array. Figure 7 displays the output image with the most likely license plate areas.

VIII. SEGMENTATION

Amongst all these regions, one of these with the largest histogram value is almost certainly candidate for license plate [9]. The outcome of segmentation is all the regions that have highest possibility of having a license plate. to search area having largest vertical and horizontal histogram values, each region is processed row wise and column wise . This is the region having largest possibility of having a license plate [8]. Figure 8 shows image in which license plate is detected.

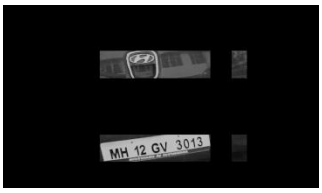

Fig. 7: Output of segmentation.

Fig. 8 Image in which license plate is detected

IX. RESULTS

The algorithm was tried on number of sample images having resolutions from 680 × 480 to 1600 ×1200 pixels. The vehicle images of diverse colours and changing intensity of light, the algorithm properly identified the number plate.

X. FUTURE WORK

After successfully extracting license plate from vehicle image, the following algorithms are to be developed.

i. The recognized license plate must be made noise free.
ii. Unwanted image components from the recognized license plate must be detected and erased.
iii. The recognized license plate must be normalized in rotational angle, if any.
iv. Every character is to be separated.
v. A suitable character recognition technique is to be developed.
vi. Performance of the developed techniques is to be compared with existing system.
vii. To customized and suggest this system for any practical application.

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