Detection of Vehicle Registration plate using Hough Transform and Hough Peaks For Real Time Applications

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Abstract - The international method associated with recognition belonging to the features is Hough transform utilized in processing the images, computer perspective and exploring information from images. The attempts here is to use Hough transform as attribute vector, examined on Indian Vehicle number plates that have fonts of standard followed by UK in2D and3D, having ten spots for letters and numbers. A port image taken is an RGB image, further the entered image is cropped as well as the significant blocks of data within the number plate therefore are obtained. The ten sub images thus extracted from the input image will also be RGB and among those 4 are alphabets while rest are numbers. These sub images are fed to Hough transform and Hough highs to extract the Hough highs information. First couples of Hough highs are matched for recognition purposes. Also the Hough Highs to standard alphabets of UK fonts at angles of 0,35,65 degree are considered ,so if number plated is a rotaed one.

Keywords - avrpr, edge detection segmentation, Hough transform.

I. INTRODUCTION

Automatic Vehicle Registration Plate Recognition (AVRPR) is definitely a mass surveillance technique that will use character recognition, in order to analyze vehicle registration number plate's images .The application of existing CCTVs or traffic cameras, or task specific devices are done. The utilization of AVRPR is performed by various police department in numerous areas around the world, also utilized for various toll tax collections being a method named electronic toll collection, furthermore handling of traffic on busy highways as well as for implementation of traffic rules upon them. Storage the photographs of one's site captured by equipment and verification of the text on the license plates may also be carried out by AVRPR system. As a result of registration plate variation from location to location the AVRPR is developed like a region particular modern technology. Encroachment of level of privacy act i.e., following the movement of one's citizens, high error rates, misidentifications while increasing spending of tax payer money could be the center of concerns in this technology .The Standard desktop computer hardware can even implement the facet of this technology and it can also link to other applications and database can be done. At first a uses of series of image manipulation processes to detect, normalize and boost the image of the registration plate, then the character recognition to extract the alphanumeric and numerals of the license plate. There are actually six primary algorithms that this software requires for identifying a vehicle registration plate:

1. Plate localization - locating the position of plate and separating out of your image.
2. Plate orientation and sizing - compensates for your skew of one's plate and adjusts the size towards the required specifications.
3. Normalization - adjustment of contrast and brightness is carried out.
4. Character segmentation - Extraction of individual characters within the registration plate.
5. Character recognition.
6. Syntactical/Geometrical analysis - study of character based on the format adopted in the region.

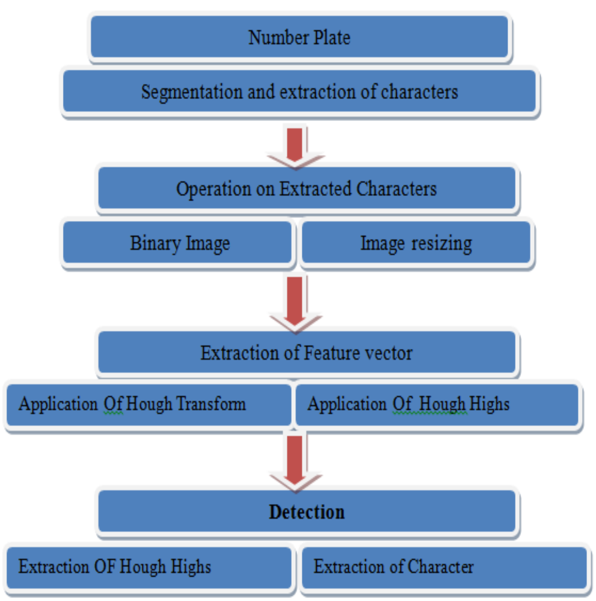
The complexness of each one of the above subsections of the program determines the precision of one's system. Usually in the step # 3 of normalization, great deal of pre-processing of image such as the application of edge detection techniques, using various filters is needed, as an example for lowering of noise in images application of median filter can be achieved[4].

II. PRINCIPLE OF THE PROPOSED METHOD

A new approach for character recognition based on matching measures using Hough peak as the matching vector has been proposed [5]. The method gives fair results and produces good results even when about 4-5% of original RGB image is under consideration. The method involves an input RGB image of the license plate of vehicle. There are three main contributions of these studies.

- First exploration of substantial elements of image to get various characters of the RGB license plate input image by using image cropping.
- Secondly, converting the cropped images to binary image up to bit depth 8, anything above bit depth 8 is not favorable.
- Third use of the Hough transforms and Hough peaks on the binary images only to make the processing really fast.
- Following that the placement on the first couple of Hough peaks are taken under consideration while ignoring all others.

A database for similar dimension binary images is maintained and the comparison leads to the recognition of the characters on the RGB license plate. The proposed algorithm is shown inFig-1.



2.1 Acquisition of License Plate Images.

Acquisition of License Plate Images. Since the quality of detection result dominantly depend on the quality of the acquisition process, the choice of acquisition system must be done carefully. Normally image acquisition by means of 2-D sensors needs image processing technique. In this experimental work, online facility of generation of any license plate of standard font and size is used. The font used is standard UK style, with actual plate sized 520 x 111mmsqr .The dimensions of the image used is 2018x503 pi. The actual segmentation undergone RGBpictures with the figures. The segmented RGB images of the characters are sized as 160 x 325 pixels and the binary images which are fed to Hough Transform and Hough Peaks operations are resized to 250 x 250 pixels. The Indian license plates are shown in Figure 2.1

(a)

(b)

Figure 2.1 Indian license plates (a) Standard UK font (b) standard UK 3D font

2.2 Extraction of Characters by Segmentation

The input License plate according to the Indian convention has 10 slots to convey the information regarding the details of the registration mark. The current arrangement within the registration marks list has three parts.

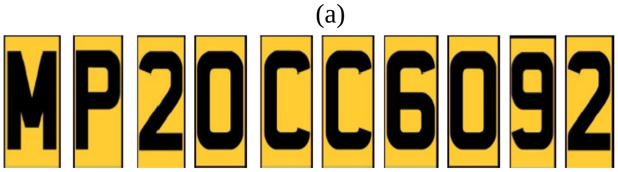
a) The 1st two letters alphabets provide details about their state where vehicle is registered.

b) Another two slots are numbers and so is sequential number associated with a region. As a result of progress within the vehicle registration mark the, numbers taken in to RTO branches of registration mark.

c) The 3rd part is digit number unique to each plate. Correspondence is prefixed each time four digit numbers has no sequence. The input image is a RGB image, with ten slots for the numbers and alphabets. At this point the particular source image will be clipped to obtain these characters and numbers which are considered to be significant blocks within the picture. The structure within the alphanumeric used in license plate are standard UK, repository is preserved consequently. Seeing that, the proposed method is basically attribute centered, identical repository for various font isn't acceptable, therefore with regard to different data formats the repository need to be updated as necessary. Therefore, the vehicle registration plate source picture is clipped to extract the alphanumeric. Image cropping technique is utilized to meet theintend. 10 sub images possessing details of vehicle registration plate are clipped .As required, 4 sub pictures of alphabets and 6 sub images of numbers are obtained. Those sub images are clipped into dimensions of 160mm x 325mm; the cropping pattern should be uniform for all sub images as non-uniformity has bad effects on the last result.

Figure 2.2 segmentation and clipping operations.

(a)



(b)

Fig 2.2 (a) Segmented image (b) Cropped images

2.3 Image Re-Dimensioning and Conversion to Binary value

The scaling of the image is termed Image re-dimensioning. It's a non-trivial method and compromise between efficiency smoothness and sharpness is performed with bitmap images, if the length and widths for this image is decreased or increased, these pixels that has image turn into progressively visible, that produces image be seen "dull" when average pixels are taken. Along with vector graphics the particular trade-off may in processing power for cause of an image, which can be identifiable as sluggish processing with static images or sluggish rate of frames or skipping up of frames in computer animation. Additionally to sizing a lower screen area, image size is generally lessened to generate pictures. Enhancing pictures is usually common for producing smaller imagery fit a larger screen in 100 % display screen mode, to give an example, in "magnifying" a bitmap image, it isn't really very easy to discover any more, information within the image that previously exists, superiority of the picture suffers.Irrespective of this particular, there are several methods to boosting the amount of pixels that image contains, which balance the appearance of the original pixels. The application of image resizing in proposed technique is to boost the quantity of pixels into account. In case the dimensions of image are considerably low than variation in position of Hough peaks of varied input is considerably low also in certain cases exactly identical. So an ideal image dimension is chosen, so that image size on disk doesn't increase abnormal and variations within the results are also achieved. A bitmap binary image, like for example a monochrome bitmap is generated in a manner that assigns an array of distinct bits of data to every pixel within the image; this is actually labeled as the "bits each pixel" (BEP) The actual number of colors which could be shown on a bitmap image is the same as two to the power of the BEP number for this particular file. An image which really can be displayed in "256 colors," is an 8-bit image; eight bits are to determine color of each pixel. Just one single bit of data is utilized for each pixel of bitmap that means these images only have 1 BEP. These types of images can acquire 21 colors, or couple of colors available. It can also be possible to set these colors differently; a monochrome bitmap is often made up of one color being darkish, and another translucent.

Figure. 2.3 Resized and converted binary image (bit depth 1 and monochrome bmp format)

For the reason that translucent area normally shows up on computer displays and paper as vivid white, such images are viewed as black and white. Each bit utilized to develop a monochrome bitmap is definitely a piece of binary information, which means that it can be represented in binary 0 and 1.Pixel having a value of "0" is normally displayed as translucent or white, on the other hand pixels having value "1" are black colored. This type of images don't have probability of other colors , so a gray scale bitmap exhibits sharp, smooth vertical lines and horizontal lines, curves and diagonal lines can be shown spectacular. Finally the cropped images were resized to 250 X 250 and additional changed into monochrome bitmap format to get the bit depth of "1". The images are shown is

2.4Application of Hough Transform

Now the resized binary images are ready to be applied to the Hough transform. Before for the Hough transform application the image are fed to edge detector. Various edge detectors are used for serving this particular objective. Mainly, the goal is to locate edges out of binary images. Some primary edge detectors are:

2.4.1Canny operator based edge detection

Good detection, good localization, and minimum response time localization, and minimal response would be the three requirements by Cannyedge detection. The procedure it's essentially referred to as attribute synthesis. Using Gaussian convolution accompanied by 2-D first derivative operator the image smoothening operation is performed. Using a couple of value of thresholds the procedure of non-maximal technique is performed. Value of uppr threshold is placed as high as possible and for lower threshold as low as possible to ensure good results. A wide Gaussian kernel reduces detector's sensitivity. High smoothness and more tolerance to noise made canny operator for edge detection.

2.4.2 Sobel operator based edge detector

Another edge detection operation performed in image processing is Sobel edge detector. Here the gradient value of the image intensity function is computed. It's a discrete differentiation operator, The result of the Sobel edge detection operation is either the normal or gradient value of the vector at each point in the image. The Sobel operator involves convolution of the image with a small and integer valued filter in both horizontal and vertical direction and that's why, the there are more number of calculations for Sobel operation. For high frequency variation of intensity in the image particularly gives relatively crude output.

2.4.3Prewitt operator based edge detector

Another edge detection operation performed in image processing is Prewitt edge detector. Here the gradient value of the image intensity function is computed. It's also discrete differentiation operator, The result of the Prewitt edge detection operation is either the normal or gradient value of the vector at each point in the image. The Prewitt operator involves convolution of the image with a small and integer valued filter in both horizontal and vertical direction and that's why, three are more number of calculations for Prewitt operation. For high frequency variation of intensity in the image particularly gives relatively crude output.

2.4.4Laplacian of Gaussian operator based edge detector

In Laplacian function of Gaussian function, firstly a Gaussian function is utilized which is convolved around the image, which blurs the image. The degree of blurring depends on the standard deviation of the function Gaussian. Then Laplacian function is applied over this smoothened image. Because Laplacian is a linear operator it convolves with the Gaussian function, which is same as convolving the image with smoothing function first and followed by computation of the Laplacian result.

III. EXPERIMENTAL RESULTS

The effectiveness of the proposed method is tested on Indian license plate system, having fonts of UK standard and UK standard 3-D [6], which has ten slots for characters and numbers. The size of the input image taken is 2018 x 503 pixels, which is an RGB image, further the input image is cropped and the significant blocks of information in the number plate are obtained. Ten sub images thus extracted from the input image are also RGB and among which 4 are alphabets while the rest are numbers. The size of the sub images obtained is (162 x 325 pi). The sub images are changed to a size of (250 x 250 pi), in order to increase the number of pixel under consideration and avoiding the possibility of getting same peak positions of different characters. First two Hough peaks will be considered for the recognizing alphabets. The operation of edge detection and with image rotation operation is also used prior to the implementation of Hough transform in order to obtain the binary imageedges. The particular neighborhood maximum for that intensity gradient of image is looked upon by the canny edge detector. The d/dx of a Gaussian filter is utilized to calculate the gradient of intensity for that image. The technique utilizes two thresholds, to identify strong and weak edges, and only if the weaker edges are connected to the strong edges, the detection of weak edges is conducted. This technique thus remains more unlikely than the others to be misled by noises, plus much more probably going to discover accurate fragile edges. Additionally, image rotation angle is assorted to 0, 35 and 65 degrees. The functionality pertaining to image rotation angle 35 degree is found out to be differentiating all the alphanumeric. Table 3.A, 3.B and 3.C consists of position of first four peaks all alphabets within the matrix of Hough Transform. Angles have been taken at these 35 and 65 to cover all possibilities of images being rotated enough between those vaues for detaection.

Table 3.1Position of Hough peaks for Alphabets for rotation angle 0 degree

‘Specimen’	1st Peak	2nd Peak	3rdPeak	4th Peak
‘A’	133,000	493,066	455,114	164,002
‘B’	322,002	134,000	384,092	600,093
‘C’	321,003	357,090	134,000	423,092
‘D’	321,002	134,002	591,093	443,092
‘E’	321,001	134,001	360,092	168,000
‘F’	321,000	357,092	288,003	244,000
‘G’	365,092	321,000	134,000	430,092
‘H’	360,090	598,090	533,092	321,003
‘J’	601,090	536,092	134,003	
‘K’	366,092	318,000	431,092	138,003
‘L’	138,003	366,092	169,002	431,093
‘M’	362,090	592,093	317,004	138,002
‘N’	362,092	592,092	318,003	138,003
‘O’	318,000	363,093	592,092	138,002
‘P’	318,002	363,094	212,000	428,093
‘Q’	318,000	363,095	144,002	531,092
‘R’	317,000	363,092	138,002	429,093
‘T’	317,002	285,000	443,092	507,093
‘U’	595,090	360,092	426,090	530,092
‘V’	321,002	589,118	345,065	406,067
‘W’	321,000	134,000	600.98	354,087
‘X’	322,000	134,002	379,047	505,138
‘Y’	321,002	446,093	511,090	559,135
‘Z’	321,000	134,002	168,002	288,002

Table 3.2 Position of Hough peaks for Alphabets for rotation angle 35 degree

‘Specimen’	1st peak	2nd peak	3rd Peak	4th Peak
‘A’	345,016	351,067	654,131	404,131
'B’	624,135	436,138	654,133	404,131
‘C’	624,132	437,132	654,135	404,131
‘D’	624,133	437,133	654,130	404,131
‘E’	590,132	470,134	470,131	624,131
‘F’	437,133	470,132	547,132	514,131
‘G’	624,136	470,133	547,132	514,131
‘H’	514,132	548,133	392,041	654,131
‘J’	624,133	464,042	395,043	654,131
‘K’	462,177	456,097	654,135	404,131
‘L’	620,132	589,132	654,131	404,131
‘M’	251,011	654,133	404,134	452,041
‘N’	462,176	515,178	654,132	404,131
‘O’	620,132	440,132	654,131	404,131
‘P’	440,132	546,133	654,131	404,131
‘Q’	440,130	654,132	404,130	614,131
‘R’	441,132	654,130	404,135	473,131
‘T’	441,132	473,130	654,131	367,041
‘U’	624,133	654,132	404,131	389,041
‘V’	196,017	484,067	422,068	654,131
‘W’	654,132	404,133	209,035	624,131
‘X’	443,088	515,177	494,089	463,176
‘Y’	514,176	654,132	404,131	491,084
‘Z’	437,138	624,132	457,091	470,131

Table 3.3 Position of Hough peaks for Alphabets for rotation angle 65 degree

‘Specimen’	1st peak	2nd peak	3rd Peak	‘Peak 4’
‘A’	426,097	433,048	303,070	553,072
‘B’	608,163	420,160	333,072	303,070
‘C’	303,072	608,163	553,072	373,073
‘D’	608,162	393,073	541,072	421,160
‘E’	421,162	608,160	454,163	309,070
‘F’	421,162	303,073	454,160	373,070
‘G’	314,073	380,070	303,072	608,160
‘H’	482,072	548,073	309,070	376,070
‘J’	485,072	554,073	608,160	303,073
‘K’	315,072	381,070	265,024	321,027
‘L’	604,160	381,070	315,070	573,162
‘M’	542,073	311,072	553,070	496,103
‘N’	321,028	542,070	269,026	311,070
‘O’	542,070	477,072	312,070	303,072
‘P’	312,073	424,163	378,072	303,070

‘Q’	303,070	553,072	542,071	597,164
‘R’	314,073	425,160	379,072	285,073
‘T’	425,163	457,070	392,073	457,160
‘U’	376,072	479,070	545,070	608,162
‘V’	558,098	497,094	284,047	303,072
‘W’	553,078	300,067	303,072	553,070
‘X’	495,117	267,025	547,117	319,028
‘Y’	546,113	303,074	553,078	268,027
‘Z’	549,123	421,162	608,164	499,122

IV. SUMMARY

The proposed technique hereby uses image cropping and image resizing on the original input RGB image and thus, obtaining the significant blocks of the input image needed for detection. As instead of whole image, significant blocks are used, the database management becomes compact and the technique becomes flexible, until same font is used. Further, conversions of these RGB sub images to binary images is done and then are fed to the Hough transform algorithm followed by Hough peaks algorithm to give the Hough peak positions on (ρ,θ) plane.

Here selection of first two Hough peaks gives unique result for almost every alphabet and number used in the license plates. Non uniform cropping and resizing of image has catastrophic effects on the detection, thus uniform cropping and resizing algorithm should be followed to ensure proper and efficient detection.

V. FUTURE WORK

Some other Hough transform approaches like fast Hough transform and circular Hough transform can be used to further improve the processing. One major shortcoming of the proposed method is that the variation in results is drastic if the orientation of the image is changed. Tilting and non-uniform position of image affects the result. Hence, further work is required to modify these shortcomings.

One approach can be normalization of the rho theta plan after the position of Hough peaks are located, this will allow us to use different size images for the purpose. But even by this the problem of orientation is not rectified. Further research is needed to rectify this problem. The images with high noise are not incorporated but since Hough transform is used, the handling of noise is not supposed to be a problem.

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