Faster and Accurate Detection of Vehicle Registration plate using Hough Transform and Morphological Processing For Real Time Applications

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Abstract - The paper describes a detection method of vehicle registration plates on digital images. The method inputs the RGB image of a vehicle and extracts from it the characters on the plate. The method proposed here makes use of morphological processing, Hough transform and Hough peaks for detection of registration plates on vehicles and their character recognition: Examined on registration plates, of India, Pakistan and other countries of which most of them uses font of UK standard and also now a days the fonts of UK 3D, Indian number plates have ten places for letters and numbers while neighboring countries like Pakistan has six places for letters and numbers respectively. The method can be applied to access control systems supervising the vehicle traffic on the roads, restricted areas etc. The developed system can be trained for any kind of font system and any kind of vehicle registration pates around the world. The technique is tested for Number Plates of few countries. The successful recognition and time for recognition are important parameters fulfilled very well by the technique used here.

Keywords-Anpr, Morphological Processing,hough transform, acess control.

I. INTRODUCTION

Visitor's control and automobile owner identification has become major concern in countries of the world. During the course it becomes tough to determine automobile owner who violates visitor's guidelines at check posts. It is not feasible to capture and punish those types of people because the check post personal might not really be capable to get vehicle registration number from the shifting vehicle because of the velocity of the vehicle. For that reason, there can be a required to develop Automatic Number Plate Recognition (ANPR) program as a one of the solutions to this issue [1][2]. There are several ANPR systems obtainable today [3],[4],[5],[6][7]. These systems are centered on different methodologies but still it can be really difficult job as some of the elements like high velocity of the vehicle, non-uniform vehicle number plate, vocabulary of automobile quantity and different light circumstances can affect a great deal in the general recognition price.

At first a use 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.

II. PRINCIPLE OF THE PROPOSED METHOD

The sophistication of the ANPR system depends on better the algorithms used the highest the quality of the

acknowledgement .An ANPR will generally be determined by :-

The acknowledgement precision it offers

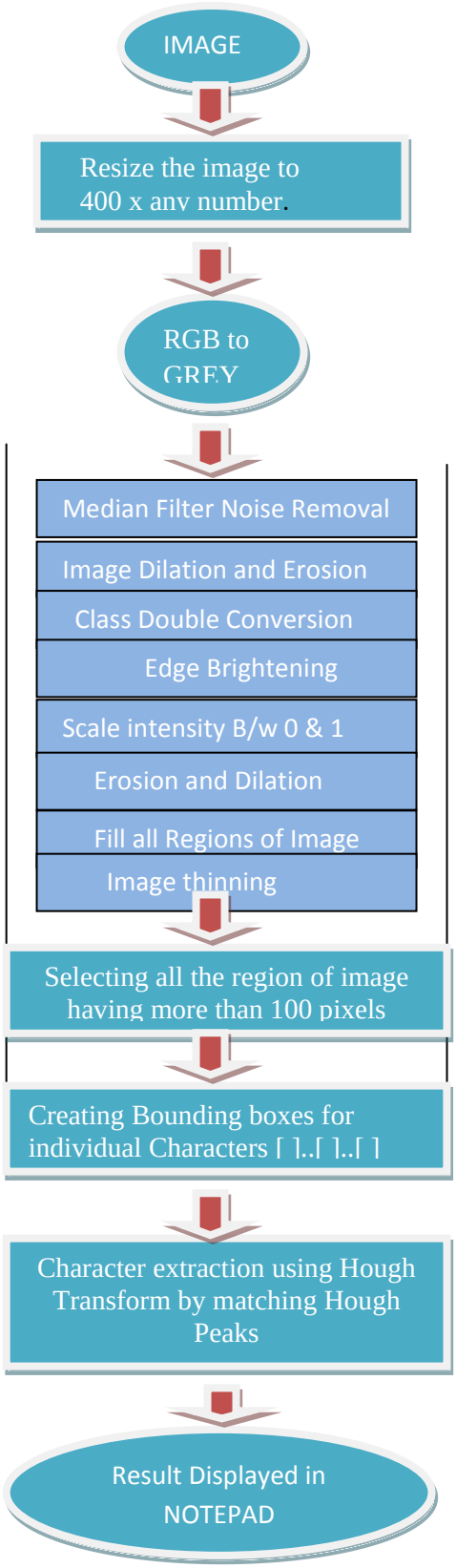
The fastest digesting velocity it offers.

The majority type of plates it can manage.

Tolerance against distortions of insight data

The presented approach satisfies all above major requirements .The most important task in ANPR is the preparation of image for detection purpose Most of the time the vehicle numbers plates are subjected to lot dust , water , old numbers with almost vanished alphanumeric all these conditions are to be duly considered for preparing image ready for character reorganization .Some time the vehicle number plates are also captured by camera looks rotated ones or even we can say that some times the number plates are not perfectly horizontal to the ground .ie rotated images or rotated characters ,so that condition is also to be considered while image is prepared for detection .There are various approach for character recognition one of them is based on matching measures using Hough peak as the matching vector [8][9]. The method gives fair results and produces good results even when RGB image is under consideration. The method involves an input RGB image of the license plate of vehicle. The main contribution of this research is firstly the extraction of the significant parts of image to get various characters of the RGB license plate input image[10]. Secondly, converting the cropped images to binary image then use of the Hough transforms and Hough peaks on the binary images only to make the processing really fast. The proposed algorithm is clearly shown here: in fig-2.

The working of the proposed method follows these steps and each intermediate step has been Clearly explained with its intermediate result image .



2.1 Image Acquisition First the image of vehicle is captured using digital camera which will be an RGB image and is fed into the system .This image may consist of information other than the number plate also the image may be a very big image so first it is converted into an image of 400x any suitable no. of pixels .

(Test image) Image of car number plate
Img-1

2.2. RGB to Grey -Here the captured image will now be converted from RGB image to grey scale image so that boundaries of characters can be defined and it is the preliminary step for image preparation.

(Test image) –RGB to Grey image
Img-2

2.3 Image Preparation –The image preparation will follow a series of steps for improving the quality of the image and making characters properly visible and identifiable for the system.

2.3.1- Median Filter for Noise Removal

The first step in this will be the noise removal of the image using median filter. During image capturing the image may be a noisy image it may be due to dust, rain or any other kind of noisy elements such image is so passed from median filter first for preliminary noise removal from the image. The Median filter is a nonlinear advanced filter method, frequently used to evacuate noise. Such noise decrease is an average preprocessing venture to enhance the aftereffects of later transforming. Median filtering is broadly utilized as a part of computerized picture preparing on the grounds that, under specific conditions, it jelly the edges

While removing noise.

(Test image Result) –Median filter noise removed
Img-3

2.3.2 Image Dilation and Erosion

A series of morphological operations[12] will be performed on image at this step and steps afterwards these all steps are a part of image enhancement process. Dilation and Erosion are most fundamental morphological operations.

(Test image result) –Dilation performed
Img-4

Dilation adds pixels to the boundaries in a picture, while erosion evacuates pixels on item boundaries. The quantity of pixels included or expelled from the boundary in a picture relies on upon the size and state of the organizing component used to process the picture. In the morphological dilation and erosion operations, the condition of any given pixel in the yield picture is dictated by applying a tenet to the comparing

pixel and its neighbors in the information picture. The principle used to.

It is used find or detect edges We could have used edge detector operators but as it a time taking process as we will have to move the operator through the edge. Since dilation and erosion are logical operation that do not incorporate any type of masking.

(Test image Result) –Erosion performed
Img-5

Process the pixels characterizes the operation as an dilation and erosion.

(Test image Result) –Edge Detection using morphological processing
Img-6

2.3.3 Class double conversion

Numeric classes in MATLAB incorporate marked and unsigned numbers, and single-accuracy and twofold exactness coasting point numbers. Of course, MATLAB stores every numeric esteem as twofold accuracy floating point. we can decide to store any number, or array of numbers, as whole numbers or as single-accuracy. Single exactness array offer more memory-effective stockpiling than twofold accuracy.. But as we have to retain actual values of image pixels they are converted to class double.

2.3.3 Edge Brightening

Further for more accurate detection and easily recognizable edge boundaries of characters are brightened.

2.3.4. Scale intensity b/w 0 and 1

All the intensities of the image which is a grey scale image are further reduced only to two values where intensity of the pixels lies between scales of 0 and 1as we have to form character boundaries which require either black or white and no grey scale is required. We are taking 255 will be mapped as 1 and 0 will be mapped as zero.

(Test image Result) –Intensity scaled b/w 0and 1
Img-7

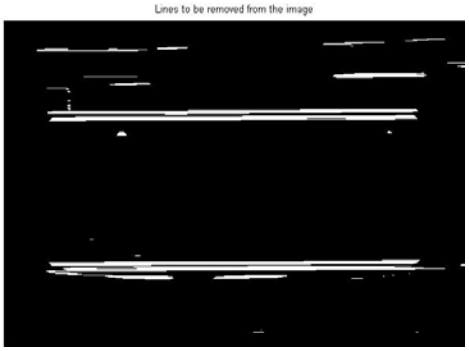
2.3.5 Converting to logical Image

After this the image is converted to a logical image having only two values either 0 or 1. 1 is assigned to brighter pixels and 0 for all pixels which are dark.

(Test image Result) –Converting to logical Image
Img-8

2.3.6 Erosion and Dilation

The process of image erosion and dilation is again performed in order to remove the horizontal and vertical lines which appear in a camera capture of the image[7], as these lines may interfere with the recognizable characters. In this method a line structure is formed of length above 200 connected pixels and further this structure is XOR'ed with the logical image ,this leads to removal of vertical and horizontal lines upto our desired fixed number of pixels.



(Test image Result) –Erosion Process for lines to be removed from image
Img 9

(Test image Result) –Dilation Process for lines to be removed from image
Img-10

2.3.7 Filling all the regions of image

Most of the characters that are encountered during detection example A, B, D, O,P,Q,R or numerical values like 0,4,8,9.. have enclosed or bounding space apart from their boundary .This bounding space is actually filled with pixels .All this space becomes part of reorganization process.

(Test image Result) –For erosion and dilation Xor And lines removed from image
Img-11

(Test image Result) –All the region of the image has been filled with pixels
Img-12

2.3.8 Image thinning operation

The image thinning operation is performed so that if any character is in any kind of overlapping with another character next to it can be easily distinguishable by thinning the characters they are separated out with the other character. This becomes a very important step for character isolation.

(Test image Result) –Thinning operation being performed on the image
Img-13

III. SELECTION OF REGION OF THE CHARACTER IMAGE

The third step lies after the image thinning process the characters in image are almost ready for reorganization. As in previous step we have already filled the image with pixels now we select the region of picture having pixels > 100 and the selection criteria is based on N8 connectivity , by using this criteria portion of character is selected.

IV. BOUNDING BOX CREATION FOR ALL INDIVIDUAL CHARACTERS OF IMAGE

Once the regions of characters are selected then bounding boxes for characters are created which will contain the individual character[13][14].If Bounding boxes have been created so that now further reorganization operation which is to be performed will be performed on the region inside the bounding box. In the next step as we will be performing character recognition using Hough transform where actually Hough peaks of characters inside bounding box are found out and matched with Hough peaks of existing characters, best match will be the characters.

Img-14

(a)

(b)

(Test image Result)-Region having more than 100 pixels are then selected for Hough peak calculations

Img-14

5. Character recognition using Hough Transform

Hough Peaks of the characters inside bounding box are calculated we will be accumulating at least four Hough peaks of the characters inside bounding boxes, these Hough Peaks are then matched to already existing character Hough peak table and then best matched characters are then entertained. The significant hough peaks for UK standard fonts have been obtained and kept for reference as shown in Table - 1.1,1.2,1.3

6. Display of characters on Note Pad

The characters recognized are then displayed as per their actual order in the number plate .So that it is easily identifiable to the user.

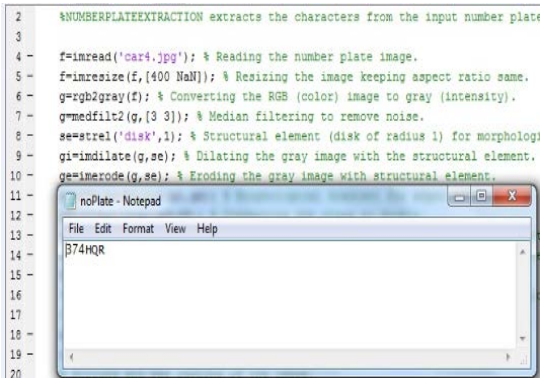


Table 3.1Position of Hough peaks for Alphabets in UK standard fonts

'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

These positions of the hough peaks are significant corresponding to the fact that image detected is horizontal image with no characters rotated or tilted at any angle if any rotation of characters occurs the results may vary.

Table 3.2 Position of Hough peaks for Numerical values [0-9]

‘0’	145,016	251,067	354,131	404,131
'1’	124,135	336,138	454,133	404,131
‘2’	424,132	337,132	554,135	404,135
‘3’	324,133	237,133	754,130	504,131
‘4’	590,132	470,136	470,132	624,133
‘5’	437,135	470,136	547,122	513,131
‘6’	614,136	471,133	546,132	515,131
‘7’	513,132	548,123	392,041	654,031
‘8’	614,133	464,142	395,143	653,131
‘9’	462,167	456,087	654,145	404,121

V. EXPERIMENTAL RESULTS

The effectiveness of the proposed method is tested on various license plate, having fonts of UK standard and UK standard 3-D [6]. The input image taken can be of any size which is an RGB image, further the input image is cropped is 598 x 400 pixels image and then further processing is performed on the image, significant blocks of information in the number plate are extracted. These sub images are resized to a size of 250 x 250 pixels, in order to increase the number of pixel under consideration and avoiding the possibility of getting same peak positions of different characters. First four Hough peaks are taken into account for the recognition purposes. The system has been tested on various images has given accurate results and also significant improvement in time of processing.

VI. SUMMARY

The proposed technique here first uses image cropping and image resizing for image preparation. The image is then further improved by noise removing of the original input RGB image. The edge detection for significant character recognition is performed using morphological processing. Also image thinning is performed so ensure no character overlapping The significant blocks of the input image having characters are created which will be needed for accurate detection. As instead of whole image, significant blocks are used, the database management becomes compact and the technique becomes flexible, can be trained for any font system. Further, conversions of these RGB sub images to binary images is done and then Hough transform algorithm followed by Hough peaks algorithm to give the Hough peak positions on (ρ,θ) plane. Here selection of four Hough peaks gives unique result for almost every alphabet and number used in the license plates.

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