License Plate Detection and Character Recognition System

M. Sornam
Department of Computer Science
University of Madras
Chepauk, Chennai

Santhi Manimozhi
Department of Computer Science
University of Madras
Chepauk, Chennai

ABSTRACT
Vehicle License Plate Recognition is an image-processing technology and an important field of research that identifies vehicles by their number plates in which the number plate information is extracted from vehicle's image. In this paper, a new algorithm for vehicle license plate identification is proposed, sliding concentric windows (SCW) on the basis of a novel adaptive image segmentation technique. Also Localization algorithm is used in detecting the candidate region. Tilt correction by the Hough transform is used and implemented for estimating rotation angle of the License Plate region. Character Segmentation has been done by extraction bounding of connected component. Optical Character Recognition (OCR) is used to recognize an optically processed printed character number plate which is based on template matching. This algorithm is tested on different ambient illuminated vehicle images. OCR is the last stage in vehicle number plate recognition. In recognition stage, the extracted characters in the number plate are normalized, and the characters are then recognized using the template matching algorithm. This algorithm was tested with 10 vehicle images. The License Plate was successfully located and segmented. The Recognition rate of character using template matching method is 98% accuracy.

General Terms
Sliding Concentric Windows (SCW), License Plate Localization, segmentation, Hough transform, connected component analysis, template matching algorithm.

1. INTRODUCTION
During the past few years, Vehicle License Plate Recognition System have had a wide impact in people's life as their scope is to improve transportation safety and mobility and to enhance productivity through the use of advanced technologies. A novel segmentation technique named sliding concentric windows (SCWs) is used for faster detection of regions of interest (ROI). Recognition algorithms reported in previous research were generally composed of several processing steps, such as extraction of a license plate region, segmentation of characters from the plate, and recognition of each character. J.S. Chittode et al. [2] proposed an algorithm which is applied on the car park systems to access parking services. Another approach [1] was based on morphological operations and area criteria test used for number plate recognition. Recognition of characters [2] in number plate was done with optical character. H. Peng et al. [7] presented an algorithm for Document Image Recognition (DIR) found most matched template for input document image in a database. The algorithm was based on the global matching of Component Block Projections. The character is recognized with the help of image pre-processing, edge extraction and segmentation of characters. C.N. Paunwala et al. [6] proposed a method which aimed to identify Region Of Interest (ROI) by allowing morphological processing and sequence of directional segmentation. The ROI contains the number plate from which characters were recognized. V. Ganapathy et al. [4] proposed a methodology which is helpful in the number plate recognition for vehicles in Malaysia. Their proposed methodology was the combination of morphological process and Hough transform. Divya Gilly [3] proposed an efficient method for License Plate Recognition (LPR). LPR system mainly consists of three main phases 1) plate detection 2) character segmentation 3) character recognition. This method utilizes a template matching technique for character recognition. The main feature of the method is that it is suitable for both Indian number plates and foreign license plates. Yuang et al. [10] has developed a new algorithm for character segmentation.

In the proposed work, character segmentation method has been used to perform the segmentation of characters followed by Character Recognition (CR) [7]. Character Recognition is to recognize the segmented characters. A type of similarity measure is performed between the test character and the templates [9] to extract and recognize the license plate characters.

This paper is organized as five sections, second section explains about existing work, third section is about the current work, forth section gives the experimental results and conclusion has been drawn in fifth section.

2. EXISTING METHODOLOGY
The steps used by Anish et al. [1] for the detection and recognition of number plate were the segmentation technique which localized (locate) the possible number plate and then extracted from the image for further processing and the next step was the character segmentation after which the extracted number plate image is normalized, the individual characters have to be distinguished (segmented) from each other. Segmentation becomes difficult when the plate is not clear, when the characters were touching each other or there were screws or strong light-effects (like shadows) on the plate, etc. When the characters were properly segmented (separated from each other and precisely localized) there was time to invoke the character recognition algorithm for each individual segmented character image by recognizing all characters after each other, the entire plate text was read. This system must guarantee robust detection and recognition under various weather and lighting conditions, independent of orientation and scale of the plate. As far as detection, tilt correction and recognition of the license plate region were concerned, researchers have found various methods of correcting tilt, locating and recognizing license plate. Hough Transform method has been introduced [5] for correcting a Vehicle License Plate tilt with different angles and varied distances.

3. PROPOSED METHODOLOGY

The methodology proposed in this paper is to detect a license plate from an image provided by a camera. An efficient algorithm has been developed to detect a license plate in various luminance conditions. This algorithm extracts the license plate data from an image and provides it as an input to the stage of Car License Plate Recognition (CLPR) as shown by the flowchart in the Figure. 2.

The three main phases are:

3.1 License plate detection,

3.2 Character segmentation,

3.3 Character recognition.

3.1 License Plate Detection

3.1.1 Localization

1. Input image from camera.

2. Convert an image into gray.

3. Dilate an image to remove noise.

4. Process edges in horizontal and vertical direction.

5. Smoothen the horizontal and vertical histogram by applying low pass filter.

6. Filter out horizontal and vertical histogram values by applying Dynamic Threshold.

7. Apply Region of Interest (ROI) extraction to detect the number plate area as shown in the Figure. 3.

3.1.2 Hough Transform

1. Mapping between coordinates and parameter space.

2. Calculate the threshold value by generated histogram of the intensity values of all pixels and plot the License Plate Regions.

3. Detect the up skew point and low skew point.

4. Detect the license plate area from different angles, short viewpoint and long viewpoint.

3.2 Character Segmentation

3.2.1 Extraction Bounding

1. Convert the detected image into binary.

2. Remove all the objects containing fewer than 30 pixels.

3. Label connected components.

4. Measure properties of image regions.

5. Plot Bounding Box.

6. Finally, the Bounding Boxed objects are extracted.

3.3 Character Recognition

Template Matching method is used for classifying objects. Templates are most often used to identify printed characters, numbers and small other objects. Template Matching is a technique that compares portions of images against one another. The matching process moves the template image to all possible positions in a larger source image and computes a numerical index that indicates how well the template matches the image in that position. Matching has been done on a pixel by pixel basis. In this method templates are correlated with the source image. Since the template size is fixed, it leads to inaccurate recognition. The optical character recognition is a recognition method in which the input is an image and the output is string of character. Template matching is one of the approaches of OCR. The cropped image is compared with the template shown in the Figure 1. OCR automatically identifies and recognizes the characters without any indirect input.

3.3.1 Template Matching

1. Initialize templates.

2. Resize the segmented character to the same size as the images in the template. (i.e. 24×42).

3. Find the correlation coefficient value of segmented character with each template image and store that value in the array.

4. Find out the index position of maximum value in the array.

5. Find the letter which is linked by that index value.

6. Store the letter in the array.

7. Display the recognized characters.

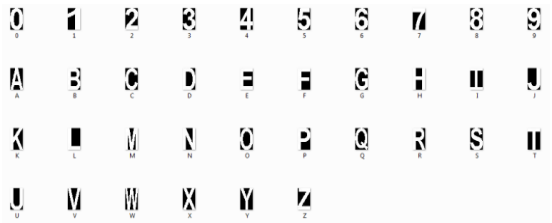

Figure 1. Template database

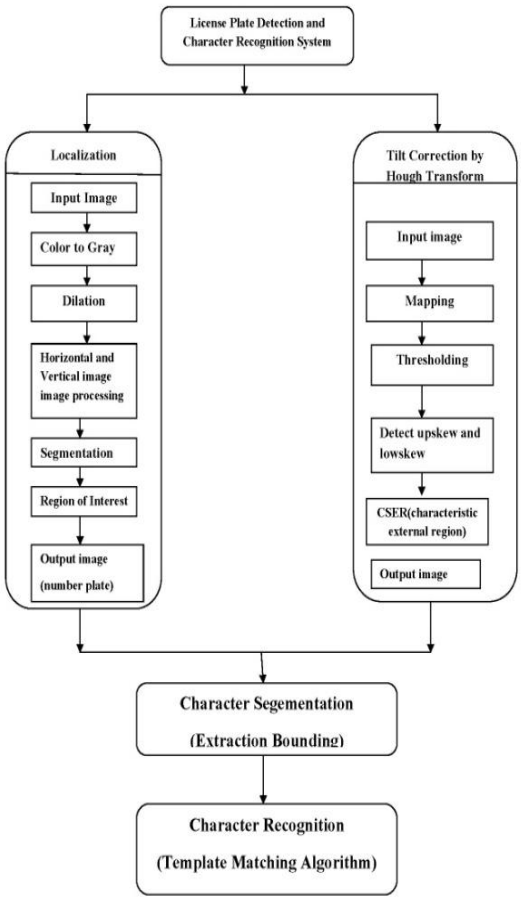

Figure 2. System flow diagram

4. EXPERIMENTAL RESULTS

All experiments were done on Pentium-IV with MATLAB 2009 version. In the experiments, 10 images were employed and the size of each image is 640*480 pixels. For these images, all of them were taken by digital camera (canon 570 power shot A570 IS) from various scenes and under different lighting conditions of the real world, varied distances from the vehicle and varied weather.

The Localization algorithm described here is to convert the color image into gray image for preprocessing and extracting the required information of an image. So, if the input image is a colored image represented by 3-dimensional array it is converted to a 2-dimensional gray image before processing**.** Dilation is a process of improving given image by filling holes in an image, sharpen the edges of objects in an image, and join the broken lines and increase the brightness of an image. Using dilation, the noise within an image can be removed.

Figure 3. Process of localization

The histogram is passed through a low-pass digital filter. While performing this step, each histogram value is averaged out considering the values on it right-hand side and left-hand side. This step is performed on both the horizontal histogram as well as the vertical histogram as shown in the Figure. 4 and Figure. 5.

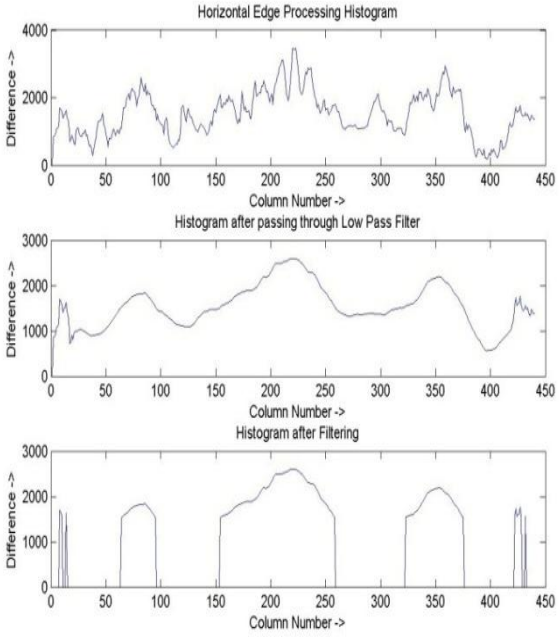

Figure 4. Horizontal histogram

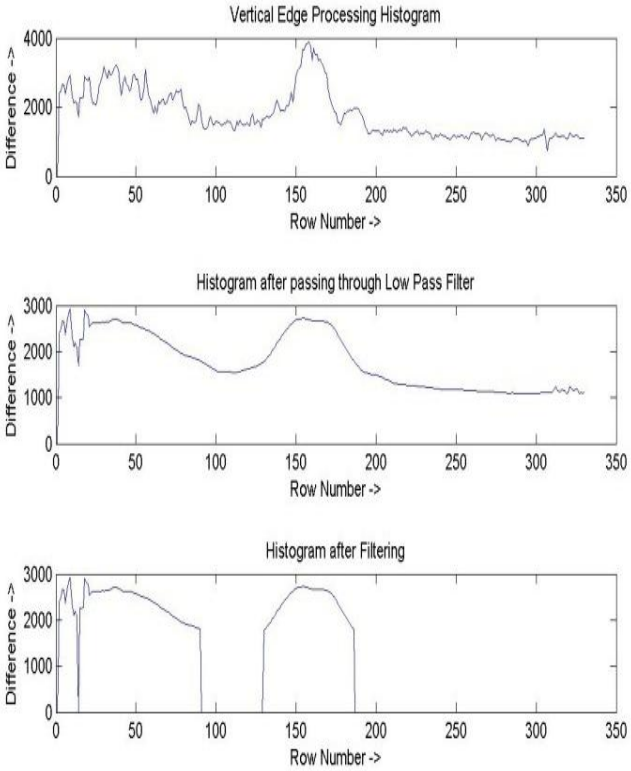

Figure 5. Vertical histogram

The threshold values and the intensity values of all pixels are plotted in the histogram for finding the License Plate Regions which are shown in the Figure. 6.

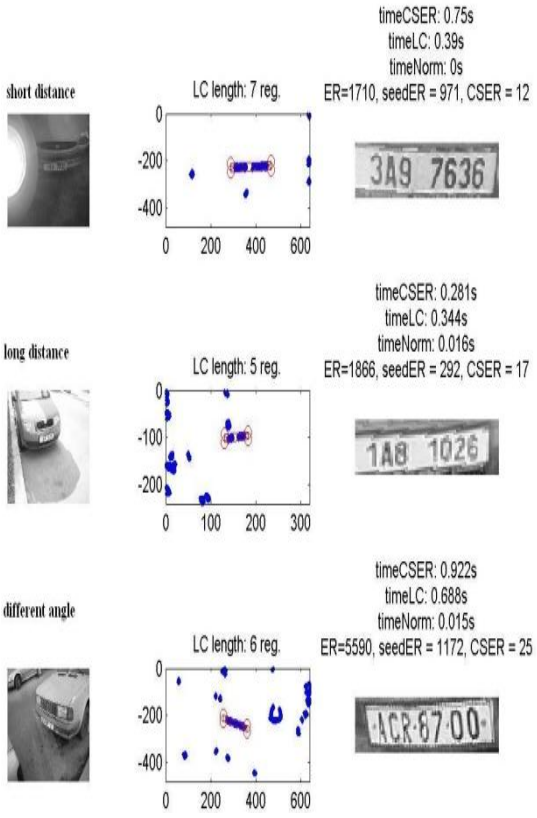

Figure 6. Tilt correction in varied distances

Table. 1 shows the license plate length, detection and time for normalization from varied distances:

Table 1. Detection of license plate in varied distances

IMAGES	VARIED DISTANCES	LICENSE PLATE LENGTH	TIME FOR CSER	TIME FOR LICENSE PLATE DETECTION	TIME FOR NORMALIZATION
	LONG DISTANCE	5 region	0.281s	0.344s	0.015s
	SHORT DISTANCE	7region	0.75s	0.39s	0.016s
	DIFFERENT ANGLE	6 region	0.922s	0.688s	0.01s

Segmentation is the next step to find all the regions in an image that has high probability of containing a license plate. Bounding boxes are placed on the characters to extract the bounded characters. Co-ordinates of all such probable regions are stored in an array and extracted each character in the license plate as shown in the Figure.7 and finally, each character is recognized by template matching algorithm.

Figure 7. Extracted characters of license plate

5. CONCLUSION

In this paper, proposed algorithm detected the number plate region based on character segmentation and recognition. An efficient License Plate Detection method is proposed and performed on some real images that have been captured with the different imaging conditions. The appropriate experimental results show that proposed method is nearly independent to environmental conditions such as camera angles and camera distance from the vehicle, and license plate rotation. The template matching algorithm is applied on many images and found that it was successfully recognized

6. FUTURE SCOPE

The work can be extended to detect the license plate in video sequences. Also other methods like Support Vector Machine (SVM) or feed forward neural network methods can be applied in recognizing the license plate.

7. REFERENCES

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