

Automatic License Plate Recognition Using Optical Character Recognition Based on Image Processing

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ABSTRACT

A License plate is a rectangular plate which is alphanumeric. The license plate is fixed on the vehicle and used to identify the vehicle along with honor of that vehicle. There is a huge number of vehicles on the road so that traffic control and vehicle owner identification has become a major problem.

The automatic number plate reorganization (ANPR) is one of the solutions of such kind of problem. There are different methodologies but it is challenging task as some of the factors like high speed of vehicles, languages of number plate & mostly non-uniform letter on number plate effects a lot in recognition. The license plate recognition system mainly has four stages: image acquisition, license plate detection, character segmentation and character recognition. The license plate recognition (LPR) system have many applications like payment of parking fees; toll fee on the highway; traffic monitoring system; border security system; signal system etc.

In this paper, template matching algorithm for character recognition is used. The system presented here mainly focuses on recognition of ambiguous characters based on position of the character. It is observed that the developed system successfully detects & recognizes the vehicle number plate on real images and the problem of recognizing ambiguous character is solved.

Keyword: License plate recognition, character recognition, character segmentation, template matching, optical character recognition.

1. Introduction

Automatic License plate recognition (ALPR) is a form of automatic vehicle identification. It is an image processing technology used to identify vehicle by only their license plate [1]. Automatic License Plate Recognition (ALPR) is one of the fundamental techniques of Intelligent Traffic System (ITS) [2], [3].

The ALPR was invented in 1976 at the Police Scientific Development branch in UK. However, it gained much interest in last decade along with the improvement with the digital camera & the increase in computational activity, it is simply the ability to automatically extract and recognize a vehicle number plate character from an image. In essence it consist of a camera or frame grabber that has capability to grab an image, find the location of the number in the image & extract the character for character recognition tool to translate the picture in to numerical readable character [4]. It could be used to detect and prevent criminal activities and for security control of restricted area like military zones or area around top government office.

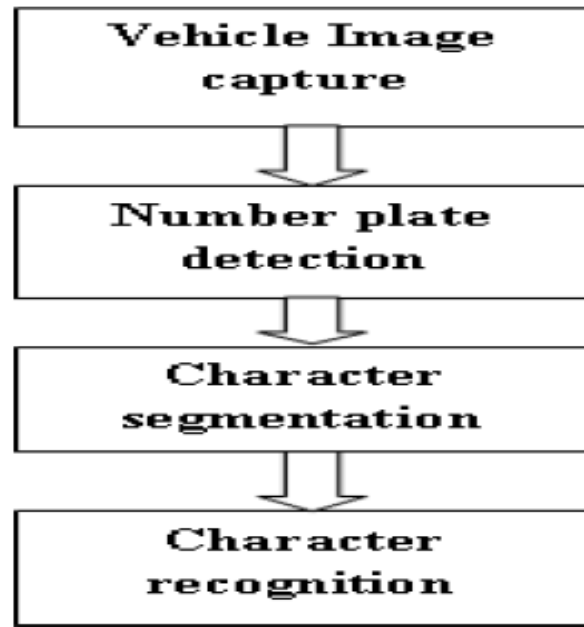


Fig. 1 ALPR System

The automatic license plate recognition system is developed in MATLAB. In this system first a vehicle image is taken as input. Then the plate area is detected and extracted from image. After successfully extracting the number plate character segmentation is performed. Finally the character recognition using template matching algorithm is performed.

The paper organized as follows: Section 2 presents literature survey of license plate recognition system, Section 3 presents the proposed methodology for license plate recognition, Section 4 presents the experimental results, Section 5 shows result analysis and Section 6 presents conclusion.

2. Literature Survey

Chengpu Yu et al. [3] adopted the feature of characters' stroke width and color match of license plate to locate and segment the license plate. In the paper, author used color match feature and stroke width constraint to identify the character edges in the license plate. As the English and digital letter has only one connected region, they use the number of holes to represent the interior structure and peripheral profiles of the character to represent the exterior feature.

Jitendra Sharma et al. [4] proposed a license plate recognition technique that uses Wavelet Transform for the improvement of the recognition rate and time for character recognition. It is proposed a technique of Neural network for vehicle license plate recognition. It has analyzed the performance of the system using Radical Basis Function Network. The proposed methodology provides the better performance in comparison of correlation based method.

M. T. Qadri and M. Asif [5] implemented the Automatic Number Plate Recognition (ANPR) system on the entrance of highly restricted area. In this paper, the ANPR system is implemented in MATLAB, and its performance is tasted on real image.

K. Kaur and V. K. Banga [6] presented an algorithm for vehicle number identification using Optical Character Recognition (OCR) technique. In this paper, the first step is capturing the image approximately 1 meter from the number plate with camera. The purpose is to get a clear image without distortion. The second step is cropping the number plate from captured image. The cropped image is the input for the character recognition. The third step is character recognition. Then OCR technique is used to recognize an optically processed printed character number plate which is based on template matching. The template matching affects the accuracy of the number plate.

Zhao et al. [7] presented an algorithm based on morphology and Least Square Support Vector Machine (LS-SVM) in LPR system. It applies the improved Robert edge operator to detect the edge, dilates and erodes the edge image to

locate the license plate. For segmentation, horizontal and vertical projection is used. Finally, construction of several classifiers applying LS-SVM to carry out the character recognition process is performed.

Kapil Bhosale et al. [8] developed a number plate recognition system for toll collection. This paper mainly focuses on Indian number plate. In this paper high resolution digital camera is used to acquire an image, preprocessing is used to improve contrast of an image and reduce the noise in the image. For binarization of an image, a binary method called Ostu's method is used. Adaptive thresholding filter has been used to process segmentation.

T. D. Duan et al. [9] presented the boundary line-based that optimizes speed and accuracy by combining the Hough transform and Contour algorithm. The Contour algorithm is used to detect closed boundaries of objects. These contour lines are transformed to Hough coordinate to find two intersected parallel lines that are considered as a plate-candidate. Since there are quite few pixels in the contour lines, the transformation of these points to Hough coordinate required much less computation. Therefore, the speed of the algorithm is improved without loss of accuracy.

V. Koval et al. [10] describes the Smart Vehicle Screening System for automated recognition of vehicle license plate information using a photograph of a vehicle. There are considered an approach to identify vehicle through recognizing of its license plate using image fusion, neural networks and threshold techniques. The neural network was used to successful recognition of license plate.

N. Vishwanath et al. [11] proposed a hybrid character segmentation algorithm that involves license plate normalization and object enhancement technique as an image preprocessing step, followed by Hough transformation based horizontal and vertical segmentation steps for Indian license plate character segmentation.

3. Proposed Methodology

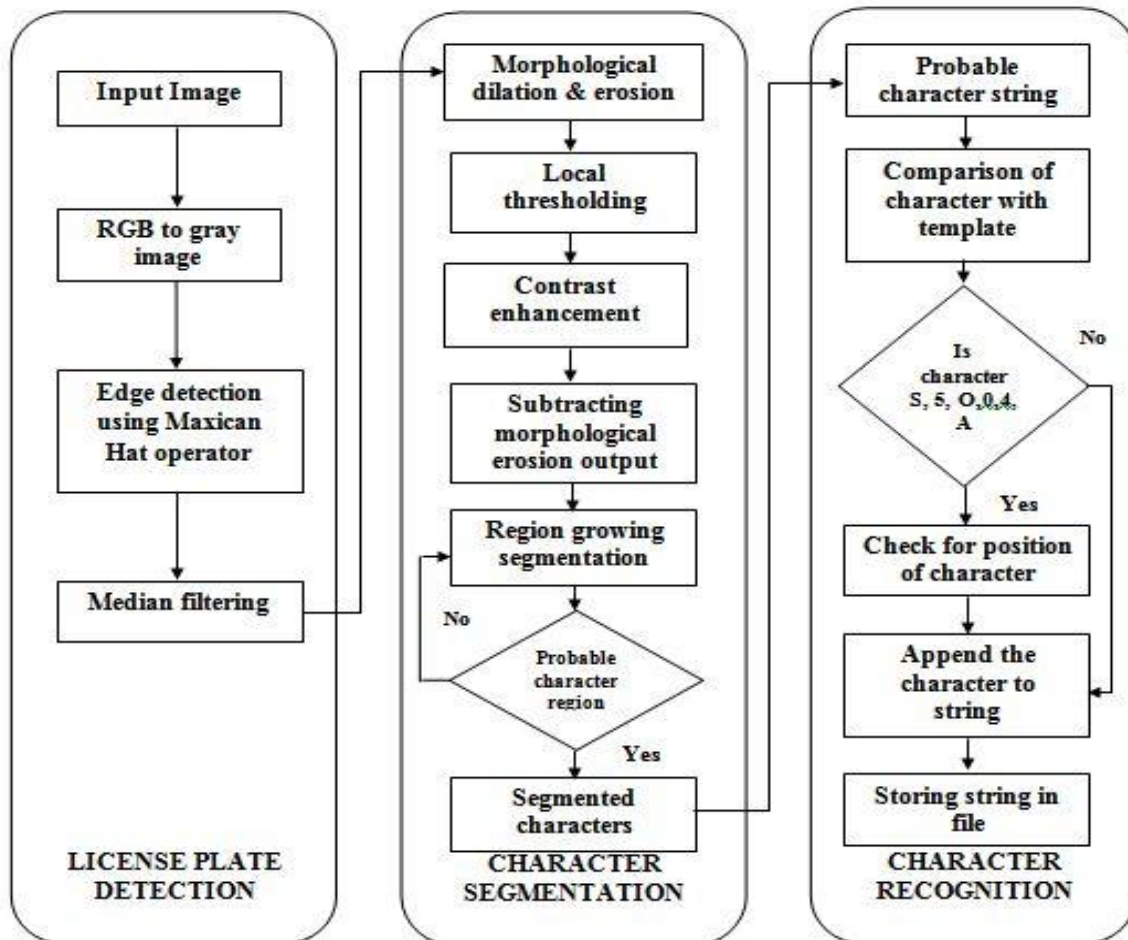


Fig 2. Proposed system Flowchart

The proposed system mainly works in three stages:

- (1) License Plate Detection
- (2) Character Segmentation
- (3) Character Recognition

Stage 1: In this stage image acquisition and license plate detection are performed. For the first, a vehicle image is taken as input. The image taken is in the RGB format. Then the image is converted to gray scale image. After converting the RGB image to gray image, edge detection using Maxican Hat operator is performed. Then median filtering is applied to remove unwanted noise.

Stage 2: In this stage license plate extraction and charcter segmentation is performed. For that morphological dilation and erosion operations are performed to fill holes.

Morphological erosion operation can be defined as:

$$A \oplus B \triangleq \{x: B_x \cap A \neq \varphi\}$$

Morphological erosion operation can be defined as:

$$A \ominus B = \{z: B_z \subseteq A\}$$

After applying morphological operations, local thresholding is applied to covert gray image into binary image. In order to get further contrast enhancement, intensity range of the pixel values are scaled between 0 to 1. In certain situations if some unwanted gaps and holes are present in the plate region. For that erosion operation is repeated for removing such kind of holes or gaps. Then region growing segmentation is performed to segment characters from the plate region.

Stage 3: In this stage character recognition is done using template matching. Each segmented character is matched with character templates stored in database. Finally the string can be stored in a file to display number of vehicle.

4. Experimental Results

The system is simulated in MATLAB. The input image is taken of size 640*480 pixels. Images taken as input are in RGB format. Fig. 3(a) shows input image. The converted gray image is shown in fig. 3(b). Fig. 3(c) shows the output of edge detection. For detecting edges the Maxican Hat operator is used. Then noise is removed using median filtering which is shown in fig. 3(d). Fig. 3(e) shows the result of morphological operations. The output of the thresholding is shown in fig. 3(f). Fig. 3(g) shows the output of region growing segmentation. Fig. 3(h) shows output of segmented characters. After recognizing number the number is stored in a file which is shown in fig. 3(i).

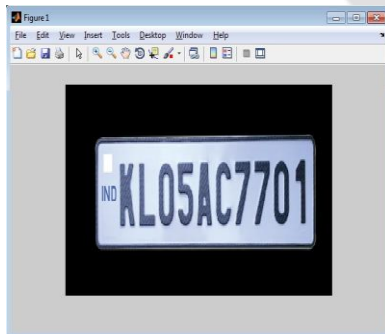


Fig. 3(a)

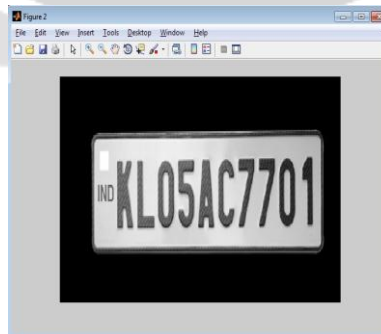


Fig. 3(b)

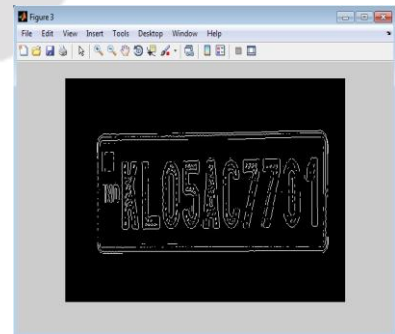


Fig. 3(c)

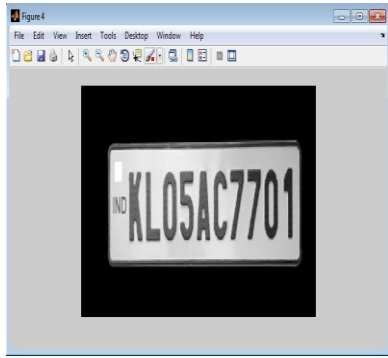


Fig. 3(d)

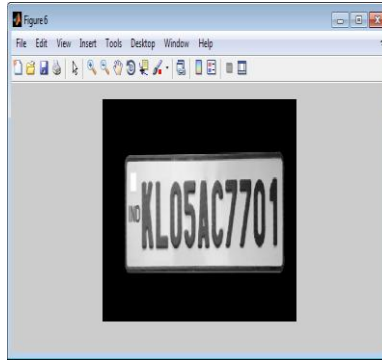


Fig. 3(e)

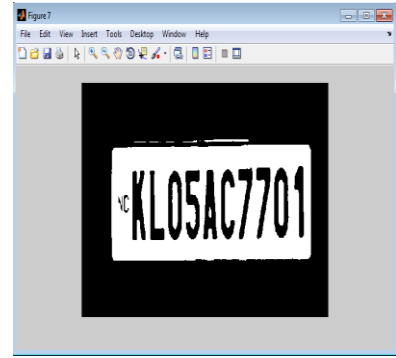


Fig. 3(f)

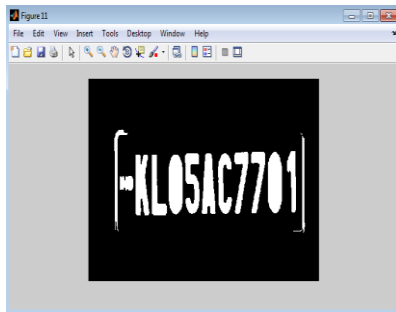


Fig. 3(h)

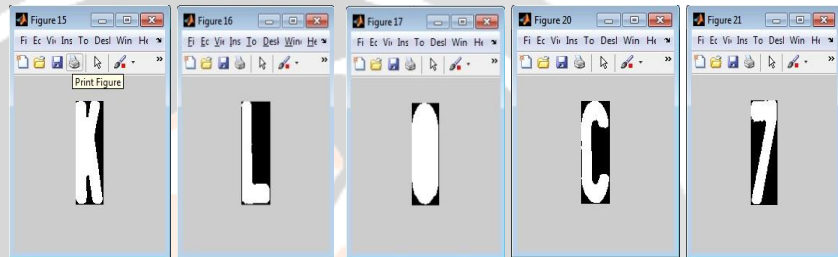


Fig. 3(h)

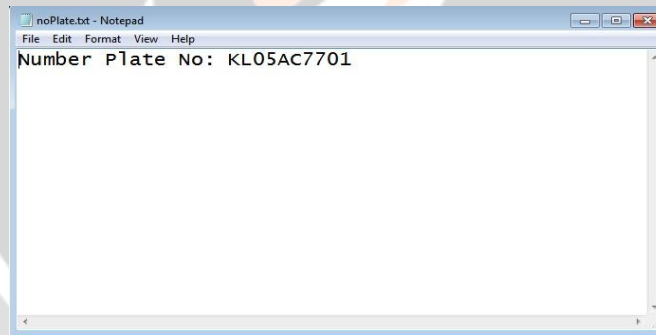


Fig. 3(i)

5. Result Analysis

The license plate recognition system was tested on MS Windows-7 Operating System. The software implementation is done using MATLAB 7.10.0. The images are taken in RGB format. The resolution of image is 640 x 480 pixels.

The result shows that the developed system successfully detects the vehicle license plates when images are taken from fixed distance or from the centre view. There are few problems where system fails to detect the plate region when images are affected by luminance condition or problematic background. If the image is too dark in color then system cannot detect the license plate region correctly.

When the license plate is successfully detected, it is easier to segment and recognize the characters of the license plate. The system works with 98% accuracy when images taken from fixed distance or centre view. The system improves the character recognition performance especially in dealing complex scenes like recognizing (0,O), (5,S), (4,A). The recognition of characters is done using 10 digits and 26 alphabets.

6. Conclusion

The developed proposed system uses series of image processing techniques to detect, segment and recognize the vehicle license plate. The system is implemented in MATLAB. The system focuses on Indian standard number plate. The main focus in developing this system is to improve the character recognition performance while dealing with complex scenes like O,0,S,5,4,A. The system is tested with nearly 40 images. This system gives about 98% of result in license plate recognition.

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