Automatic Number Plate Recognition System for Vehicle Identification Using Improved Segmentation

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Abstract— An exponential increase in number of vehicles demands the use of automated systems to retain vehicle information. The information is highly required for both control of traffic as well as cutback of crime. Automatic Number plate recognition is an image processing technology and can be successfully used for automatic vehicle identification. The objective is to design a robust method for automatic detection of authorized vehicle number plate. The system can be implemented for safe parking management in Parliament, Supreme Court, buildings and other parking lots etc. This System used captured vehicle images and extracts the number from license plate. The system is based on a combination of thresholding, labeling, filling up the holes approach method and region props technique with area criteria test for the number plate localization. The characteristic recognition was accomplished with the help of optical characters by the process of Template matching. We mainly concrete on four steps: one is to locate the number plate, second is to segment all the number and to identify each number separately, third is distinguish each character and the resulting data is then used to compare with the records on a database so as to come up with the precise information of the owner such as place of registration and owner name etc which is used to check the authenticity.

Key words: Vehicle Plate Recognition, Plate Extraction, Segmentation, Optical Character Recognition

I. INTRODUCTION

Automatic number plate recognition (ANPR) word was introduced in 1976 at the Police Scientific Development Branch in the UK. However, taking into account its advantages it gained much popularity in the various regions in the world. From the last decade, there has been great research has been carried out with use of digital camera with increased in processing speed. ANPR is an image processing technology which enables to take out vehicle license plate number form digital images. It consists of a camera that has the potential to capture an image, finds the position of the number plate in the image and then extracts the characters using character recognition tool that interpret the pixels into alphanumerically readable character or string.

ANPR consist of three main stages namely Number plate localization (NPL) character segmentation (CS) and optical character recognition (OCR). Each stages having different image processing and different pattern recognition algorithms. The implementation of ANPR system can be done by software and hardware based solutions. In the last several years software based solutions have been intensively research, however, there are few hardware completion has been done.

A. Related works

So many researches of car detection have been approached by car license plate extracting and recognition, some of the related work is as follows. Ozbay and co-workers [1] demonstrated use of edge based algorithms for extracting number plate from Turkey regions. In segmentation part, smearing algorithms, filtering and several morphological algorithms are used. And at end statistical based template identical is used for recognition of plate characters. The performance of the proposed algorithm has been tested on true images. Gokman and co-workers [2] utilized Gabor transform and vector quantization for NP finding. Duan and co-workers [3] extracted edging image and use contour algorithm to detect closed boundaries of objects. These contour lines are transformed to Hough coordinate to find two interacted parallel lines (one of two parallel lines hold back the other 2-parallel lines and establishes an parallelogram form object) that are considered as a plate-candidate. Since there are quite few (black) pixels in the contour lines, the transformation these points to Hough coordinate required much less computation. Zakaria and co-workers [4] used color processing based algorithm. This method utilizes template matching technique to approximate the location of the number plate region.—Badr and co-workers [5] introduced an Automatic Number Plate Recognition System (ANPR) with Morphological operations, Histogram treatment and Edge detection Techniques for plate localization and characters segmentation. Artificial Neural Networks are used for character classification and recognition. Rasheed and co-workers [6] described a well method of license plate detection and recognition based on Hough lines using Hough transformation and template matching for Islamabad standardized number plates cars. Khare and co-worker [7] recognized the use neural network for number plate detection. First the image of number plate is captured by camera. License plate is segmented by using horizontal and vertical projection. After that characteristic extraction techniques are used to take out the characters from segmented data. Neural Network algorithms are used to identify the characters which get better the color and brightness.

II. PROPOSED SYSTEM

The ANPR system is divided into following parts. The overall ANPR method can be subdivided into the software model and hardware model. The section will discuss essentially the software model.

A. Software Model

The main and the most vital portion of this system is the software model. The software model use sequence of image
processing techniques which are implemented in MATLAB. The ANPR algorithm is usually divided into following parts:

- Capture image.
- Pre-processing.
- Plate region extraction.
- Segmentation of character in the extracted number plate.
- Character recognition.
- Comparison with database.
- Indicate result.

The flow chart of license plate recognition system completion in this work is shown in the following figure 1. There are different steps in this approach and these are implemented in MATLAB.

![Flow chart of developed ANPR system](image)

**III. IMPLEMENTATION WORK**

**A. Capture Image (Image Acquisition)**

The initial step is the capturing of an image using a digital camera or a usual camera or a mobile camera or using a video camera attached to the PC. The images are stored in color JPEG format so it can be further processed for the number plate taking out. Input image was captured by a camera located at a distance of 1-2 metres away from the vehicle as shown in following figure 2.

![Original image](image)

**B. Pre-Processing**

After the acquisition of image, pre-processing of image is done. When an image is acquired, there may be noises there in an image. These noises influence the recognition rate to a great extent. So these noises should be distant from the images. For that purpose pre-processing is done as follows.

1) **Gray Processing**

It involves translation of color image into a gray image. The method is based on dissimilar color transform. According to the R, G, B value in the image, it calculates the rate of gray value, and obtains the gray image at the same time.

![Grey scale image](image)

2) **Median Filtering:**

When images are acquired there is lot of noises are there in image. The noise cannot be removed in gray processing. To abolish noise from the image median filters are used so that image becomes noise less. Noise removal is essential step in License plate recognition system because it really affects the recognition rate of the system. Filtered gray scale image is shown in figure 4.

![Filtered Image](image)

**C. Plate Region Extraction**

After image acquisition and pre-processing it will be given to the segmentation part. First the image was reborn to grey scale image once that thresholding algorithm is applied on this grey level image to represent it as a black and white image. Binary image is shown in figure 5(a). Then black white fill is applied to the binary pictures. BWFILL differs from numerous alternative binary image operations in this it operates on background pixels, as an alternative of foreground pixels. If the foreground is 8-connected the background is 4-connected, and vice versa, this is called segmentation image is shown in figure 5 (b).

The segmental image is filtered by Median filter methodology. Median filter is then enforced for the effective removal of speckle noise, salt and pepper noise. After that, we have to look for space of the actual plate. For this region properties have to be verified. The region consists of a number of properties, in that ‘area, orientation and the bounding box’ square measure some essential properties. REGIONPROPS doesn't admit a binary image as its first
input. Therefore we convert binary image to label matrix using

\[ L = \text{bwlabel}(BW) \]

which returns the label matrix \( L \) that contains labels for the 8-connected items found in \( BW \). The label matrix, \( L \), is the same size as \( BW \). After getting label matrix, \( \text{REGIONPRPS} \) function is used to calculate the properties of image such as area, bounding box, orientation etc, to remove the useless part in image we used area property.

![Binary Image](image1)

**Fig. 5(a): Binary Image**

![Bwfill Image](image2)

**Fig. 5(b): Bwfill Image**

Once finding the 3 properties the segmental image was obtained as shown in figure 6 by using following equation:

Find the area number using following equations:

\[ B = \text{STASTS.BoundingBox}; \]
\[ X_{\text{min}} = B(2); \]
\[ X_{\text{max}} = B(2) + B(4); \]
\[ Y_{\text{min}} = B(1); \]
\[ Y_{\text{max}} = B(1) + B(3); \]
\[ LP = \{\}; \]
\[ LP = b \left( X_{\text{min}} + 25: X_{\text{max}} - 20, Y_{\text{min}} + 10: Y_{\text{max}} - 10; \right) \]

![Extracted Number Plate](image3)

**Fig. 6: Extracted Number Plate**

D. Character Segmentation

The character segmentation process takes the extracted license plate region from the preceding module as the input. The input is a colored JPEG image, and separate the each character from license plate. Here for character segmentation we use the split function of Matlab. The segmented characters are shown in Figure

![Segmented characters Database](image4)

**Fig. 7: Segmented characters Database**

Database is assortment information of knowledge or data that it's being orderly organized; consequently it will be accessed simply and updated. Database can be in the type of text, contents and pictures. Info is required to generate certain that the image area will be contained enough characters that have been extracted and the vehicle license plated range grip on in the pad for the purpose of comparison. For the character recognition we use the template matching method. We have database for 0-9 number and A-Z alphabet. We have 15 different types of database for each number and alphabet. Total we have 540 images in data base. Database of alphabet and numerical characters are shown in Figure 8.

![Database of Alphabet and Numerical Characters](image5)

**Fig. 8: Database of Alphabet and Numerical Characters**

E. Recognition

The OCR is currently accustomed compare the each individual character against the alphanumerical information. The OCR use correlation coefficients system to match individual character of number and at last the number is converted into string. The string is compared with the keep information in the vehicle owner information database file. If the database file contain the same number as recognized vehicle number then display owner information along the recognition of number plate. Following figure 9 shows the example of owner information

![Owner information of car comparision.](image6)

**Fig. 9: Owner information of car comparision.**

The recognized number string is compared with the kept information for the vehicle authentication and if the each appeal is same means that it will show the authorize message window otherwise it will show the unauthorized. The output string and authentication result are shown in figure 10(a) and figure 10(b).
IV. EXPERIMENTAL RESULTS

Experiments have been performed to test the algorithm for license plate extraction, segmentation, recognition and measure its accuracy. Color image were used for testing the algorithm with size of 2048×1536. This work is implemented using MATLAB, and result shown in GUI. The results of simulation are reported here step by step as follows. Fig 11(a) shows GUI for system, fig 11(b) selected image along with grey conversion and black and white image. Fig 11(c) shows segmented number plate, fig 11(d) segmented characters, fig 11(e) shows the recognized number along with user information, fig 11(f) comparison result.
V. CONCLUSION

In this work, we presented a convenient and efficient method for license plate recognition based on improved segmentation and template matching. The system implemented in MATLAB and its performance is tested on test database samples of extracted license plate images with different background, various light and atmospheric conditions (sunny, cloudy, daytime etc). The simulation results show that the system robustly identify and recognize the vehicle using license plate. The performance of the system is robust in its tolerance of difference of illumination conditions. The system also capable to reducing confusing pair effect of license plate characters and able to differentiate number ‘1’ and ‘7’, ‘5’ and ‘S’, etc. The method has a low computational complexity and results achieved have shown marvelous detection rate compare to existing methods.

REFERENCES


