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Automatic Indian Licenses Plate Recognition System

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Abstract: An Automatic Indian license plate recognition system is one kind of an intelligent transport system and has great importance because of its potential applications in highway electronic toll collection and traffic monitoring systems. It is shown that the number plates are different shape and size and also have different color in different countries. In India the most common vehicle license plate used yellow or white as background and black used as foreground color. This paper presents an approach based on simple and efficient morphological operation and template matching. The proposed model consists of four main parts pre-processing of image, localization of license plate, character segmentation and character recognition. In this paper, our main focus is on license plate detection and character recognition. The project develops by using MATLAB R2013a.

Keyword: Morphological operation, template matching, license plate localization, character recognition.

I. INTRODUCTION

Automatic License Plate Recognition (ALPR) system is an important technique, used in Intelligent Transportation System. ALPR is an advanced machine vision technology used to identify vehicles by their license plates without direct human intervention. There are many applications for license plate recognition for example automated parking attendant, petrol station forecourt surveillance, speed enforcement, security, customer identification enabling personalized service, highway electronic toll collection and traffic monitoring systems.

It is shown that the license plates are different shape and size and also have different color in different countries. In India the most common license plate color used for commercial vehicle is yellow and private cars is white as background and black used as foreground color. Though in Indian there is standard format for license plate, as described in fig. 1, which is not followed which makes the license plate recognition system quite difficult. The Indian license plate start with two digit letter "state code" followed by two digit numeral followed by single letter after those four consecutive digits as the described below in fig.1.

Figure 1: Standard Indian License Plate format

In fig.1, 1 indicates the country code, 2 indicate the state code, and 3 indicate the district code, 4 indicate the type of vehicle and 5 indicates the actual registration number. The identification task is challenging because of the nature of the light. The location error will increase if the color of the number plate is very similar to the background. Noise on the number plates some time cause of error and low accuracy. There are some limitation that led to failure in most practical application due to the diversity of the number plate characteristics and the complexity of the natural environment like rain, snow, dust for etc. So, a flexible algorithm required for solved this task.

This paper will explore and elaborate the proposed algorithm for ALPR for Indian license plate. ALPR process consists of four stages: 1) Preprocessing 2) License plates localization 3) Character segmentation and 4) Character recognition. In first stage, acquired image is enhanced by converting RGB image to gray image, thresolding, median filtering etc. In the second stage, license plate localization which is difficult but most important stage is obtained, based on the features of license plates. Features commonly employed have been derived from the license plate format. The features of license plate format include shape, symmetry, height-to-width ratio, area in comparison to image size. In third stage, characters are segmented using bounding box analysis. Fourth stage, character recognition is achieved using template matching.

II. PROPOSED SYSTEM

The block diagram of license plate recognition system implementation is shown in the Fig. 2. There are various steps in this approach and these are implementation using MATLAB R2013a software.

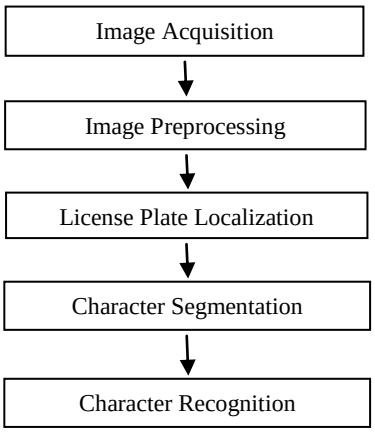

Figure 2. Block diagram of proposed system

2.1 Image acquisition

The first stage of any vision system is the image acquisition. The input image is taken either from low resolution camera or from database as per the application. Fig 3. shows the acquired image of car below which is consider as original or raw image of car.

Figure 3. Original image

2.2.1 Image pre-processing

When an image is acquired, there may be noises, low contrast, unwanted object etc present in an image. These noises affect the recognition rate greatly. So, these unwanted noises should be removed from the images. To get enhanced image the original image preprocessing with various operation and these are described below.

2.2.1 Gray scale conversion

It involves conversion of RGB image into a gray scale image. It is more convenient and easier to deal with one component (intensity) in gray scale images than three color components (red, green, blue) in color images

$$G(x,y) = 0.3R + 0.59G + 0.11B$$

Fig 4. shows conversion of RGB image into gray scale image, noise reduction and contrast enhanced image. The method is based on different color transform. According to the RGB value, gray value is obtained.

2.2.2 Noise reduction

We used median filtering technique to reduce the paper and salt noise. We have used 3 x 3 masks to get eight neighbors of a pixel and their corresponding gray value. If f(x, y) represents the dealt image and g(x,y) represents the result image, noise removal using median filtering is shown as:

$$g(x,y)= f(x,y)*h(x,y)$$

Where h(x, y) is filter transfer . Noise removal is necessary step for license plate recognition because it greatly affects the recognition rate of the system.

2.2.3 Contrast enhancement

Using histogram equalization technique the contrast of each image is being enhanced. The function used to enhancement that is I_Adst = imadjust(I_Gray,[0.3 0.7],[]). The pixel with value below 0.3 is 0 and value above 0.7 is 1 and in between is kept same.

Figure 4. Grayscale, noise reduced & contrast enhanced image

2.2.2 License plate localization

The plate localization is the most important phase of the license plate recognition system. License plate localization consists of number of step. We will see each step in detail. License plate region are localized based on the features of license plates.

2.2.3 Opening and closing of image

Opening is nothing but erosion followed by dilation and closing is inverse of opening. Opening of image is processes of adding pixel to boundary & closing is removing of pixel from boundary. Firstly, enhanced image is opened and then closed using imopen and imclose function respectively. Fig. 5. shows (a) opening image & (b) closing image. Once we get this two image take different of them. We get difference result as show in fig.5 (c). In which we can see that license plate region as highlighting.

(a) (b) (c)

Figure 5. (a) Opening (b) Closing of gray scale image & (c) Difference of opening and closing image

2.3.2 Image binarization

In image processing, Otsu's thresolding method (1979) is used for automatic binarization level decision, based on the shape of histogram [54]. The algorithms consider that image composed of two basic classes: foreground and background. It then computes an optimal threshold value that minimizes weighted within the class variance of two classes.

Fig.6 shows binary image. For a given gray scale image, examine the intensity value of each pixel. If it is above a threshold, we mark it as white; otherwise we mark it as black. The threshold chosen for the candidate selection process is 102 (given intensity values ranging from 0 to 255). This threshold is chosen based on examining. Having only black and white pixels makes the image much easier to work.

Figure 6. Binarized image

2.3.3 Elimination of unwanted region

The binary image show in fig.6 consist of many unwanted region. This unwanted is eliminated in following way and thus produce another binary image.

1. Determine the connected components.

```
[L num]=bwlabel(bw);
```

Compute the area of each component.

```
STATS=regionprops(L,'area');
```

3. Remove small objects on the base of area

```
idx = find([STATS.Area] > 500);
bw2 = ismember(L, idx);
```

Figure 7. Binary image with unwanted region eliminated.

2.3.4 Mapping of candidate region

After unwanted region is eliminated a bounding box is obtained from the binary image and mapped on original image. In following way dimension for mapping we get:

```
Iprops = regionprops(Ilabel);
Ibox = [Iprops.BoundingBox];
```

Bounding box is dimension of rectangle box created around the connected object within an image. Fig. 8 shows a bounding box mapped image.

Figure 8. Mapped candidate region

2.3.5 License Plate Extraction

The mapped candidate region are check for certain parameter if all the parameter are satisfied the candidate region is consider as license plate and is segmented from whole image . The parameter of license plate includes shape, symmetry, height-to width ratio, area and number of connected component. Fig.9 show license plate which extracted is from the whole image and binarized.

Figure 9. Extracted License Plate

2.4 Character Segmentation

Character segmentation is important step for recognition of character. Again the unwanted object like dots or some noise needs to be removed. After removing the unwanted object we get the license plate as shown in fig. 10.

Figure 10. License plate free of unwanted object

After removing unwanted objects dilation is performed. Dilation is adding of pixel to boundary of an object. The need for dilation is, in case of broken or disjoints character. As we will use connected component analysis for segmentation, a single character may be treated as two connected component due to broken. Once the character is dilated connected component analysis is done and bounding box is obtained from the dilated image. And this bounding box is mapped on the license plate free of unwanted object. Fig.11 show mapping of character in license plate. Mapped character are cropped and bordered by black pixel. Fig.12 show segmented character.

Figure 11. Mapped Character

Figure 12. Segmented Character

2.5 Character Recognition

The final step of the license plate recognition system is character recognition. Two essential components in a character recognition algorithm are the feature extractor and the classifier. Feature analysis determines the descriptors, or feature set, used to describe all characters. Given a character image, the feature extractor derives the features that the character possesses. The derived features are then used as input to the character classifier.

Template matching, or matrix matching, is one of the most common classification methods. In template matching, individual image pixels are used as features. Classification is performed by comparing an input character image with a set of templates from each character class. Each comparison results in a similarity measure between the input character and the template. One measure increases the amount of similarity when a pixel in the observed character is identical to the same pixel in the template image. If the pixels differ the measure of similarity may be decreased. After all templates have been compared with the observed character image, the character's identity is assigned as the identity of the most similar template.

The character recognition method consists of the following steps:

1. Skeletonization of segmented character.
2. Inverted input image.
3. Normalization of Individual characters.
4. Recognition using Template Matching.
5. Convert the recognized character images to text.

GUI model constructed as show in fig.13. As seen in fig13. there are two radio button namely online and offline for acquiring car image. By selecting online radio button car image will be captured by laptop camera and by selecting offline button camera image will be selected from database.

Axes 1 (Input) shows the original image and candidate region mapping on original image. Axes 2 shows the mapping of character to be segmented. Axes3 shows the segmented character image and axes 4 show the skeleton of each segmented character. Two push button are provided namely refresh and exit. A graphical user interface provides the user with a familiar environment in which to work.

Figure 13. GUI model for license plate recognition system

III. EXPERIMENTAL RESULT

The algorithm was tested using different car images with license plate having various background conditions, light condition and image quality. Some of the output results for offline and online snap shot and performance result is show below:

Table 1. Performance result

Algorithm	No. of inputs	No. of output	Percentage of success rate
License plate extraction	58	56	96.56%
Character Segmentation	58	56	96.56%
Character recognition	58	49	84.48%

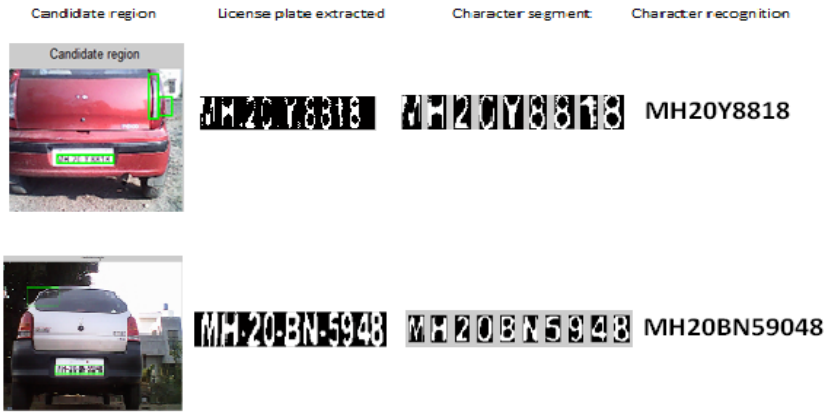

Figure 14. Result obtain after execution of code

IV. CONCLUSION & FUTURE WORK

The process of vehicle number plate recognition requires a very high degree of accuracy when we are working on a very busy road or parking which may not be possible manually as a human being tends to get fatigued due to monotonous nature of the job and they cannot keep track of the vehicles when there are multiple vehicles are passing in a very short time.To overcome this problem, many efforts have been made by the researchers across the globe for last many years. A similar effort has been made in this work to develop an accurate and automatic number plate recognition system.

In this paper, an efficient less time consuming license plate recognition method is proposed which has been tested on complex image. The system has been also tested on images of various lighting conditions, angle etc but still there are some restriction. This system improves different and simple algorithms among the neural network, support vector and the other systems.

In future scope the License Plate Recognition System is to be design for real time stand alone by using the DSP processors. Expand the system to work with real time video· Expand the system to work with Non- Standard License Plates.

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