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Automatic Number Plate Localization and Optical Character Recognition

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Abstract:
In areas with high traffic, toll booths with manual paper based billing process tend to create bottleneck which slows down the traffic even more. In those places atomization of tolling process is required. Automatic Number Plate Recognition system will provide a solution for such problem wherein toll will be deducted automatically from user's account using his license plate number which will recognized by a camera based sensor installed at toll booth. It is a mass surveillance method that uses optical character recognition on images to read vehicle registration plates. Automatic Number Plate Recognition technology may also help detects criminality at different levels by tracking criminals, Organised Crime Groups and terrorists. This technology may also be used for overspeed detection. We have proposed simplified method for plate localization and have efficiently used template matching for character extraction.

Keywords: *Plate recognition, histogram equalization, image processing, template matching, character extraction*

1. Introduction

With the ever increasing need for technology in daily life activities the process of number plate detection can be accomplished by a vast number of digital image processing techniques. The applications of such techniques is not just limited to detect and record keeping but spans across the fields of security, toll collection and automated toll processing. This paper focuses on the application we have created with the objective of number plate recognition using template matching. The image is captured from a capturing device and is sent to the application. The application will apply pre-processing techniques described below and apply recognition to obtain string format of the number plate.

2. Proposed Method

Successful implementation of this system lies in efficiently locating and extracting plate region from the image and then applying template matching algorithm for character extraction.

2.1. The Process Involves Following Steps

- Image pre-processing
- Plate Localization
- Character Segmentation
- Optical Character Recognition

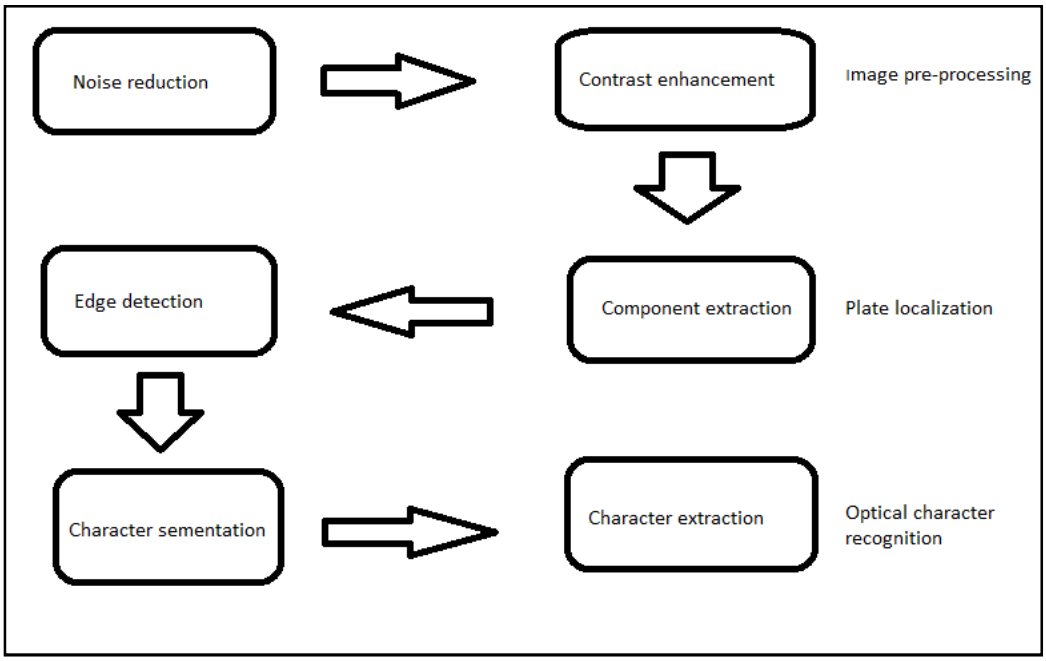

Figure 1: Block diagram of vehicle number plate recognition system.

2.2. Image Pre-Processing

Input raw image requires pre-processing so as to increase performance of the system. Pre-processing is done in following steps [11] [3] [10]

- Input image is converted to grayscale by calculating its 8 bit gray scale value.
  The function used for grayscale conversion is
  b=rgb2gray(a)
  this function calculates 8 bit gray scale value for every pixel.

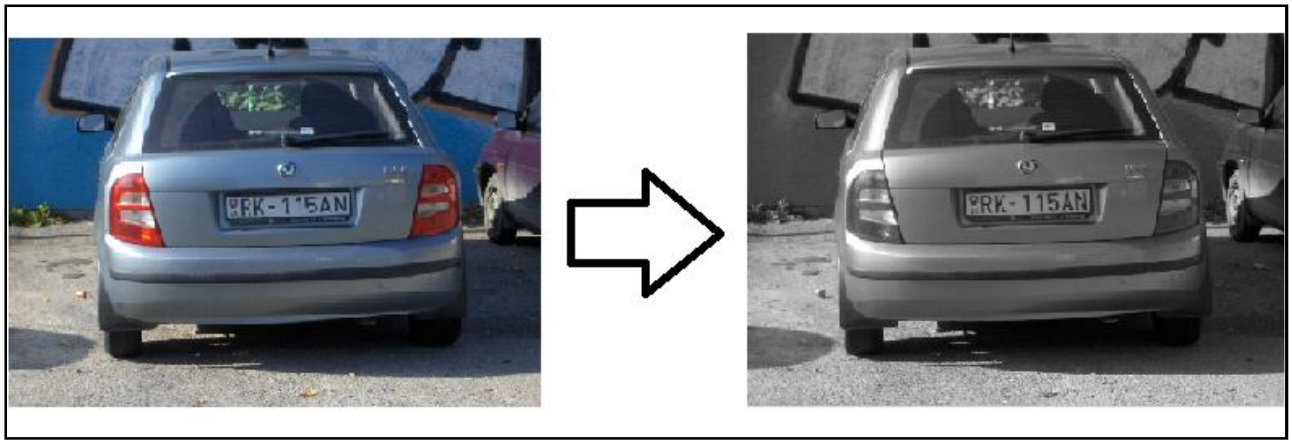

Figure 2: Grayscale conversion

- Noise reduction using median filtering
  Median filtering is a neighbourhood processing technique which is used to reduce salt and paper noise.
  Function used is fil=medfilt2 (bw)

Figure 3: Image after median filtering is applied.

- Using histogram equalization technique the contrast of the image is enhanced.
  Contrast of the image is enhanced by using histogram equalization [10].
  Function used is b=histeq(a)

Figure 4: Histogram equilized image

Graphical representation of above image before and after histogram equalization is shown in Figure 3

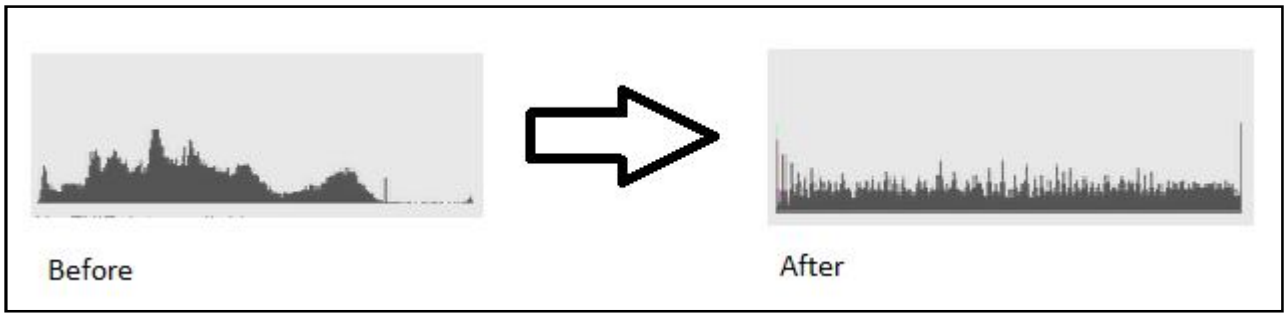

Figure 5: Histogram graph before and after equalization

2.3. Plate Localization

Plate localization [11] is an important step in ANPR system, wherein the plate component is extracted from the entire image.

- Sobel edge detection method is applied to the pre-processed image which highlights all the edges in the image[10]. Output of sobel edge detection is a binary image with edges highlighted. Matlab has a inbuilt method
  b=a(hist, 'sobel');
  where,
  a is the image on which edge detection has to be applied
  b is the edge detected image

Figure 6: Image after sobel edge detection

- Using flood fill algorithm extracts all the connected components in the image.
  We apply flood fill algorithm to fill all the holes in the images. A hole is a connected component in an image which cannot be reached by filling the image with background color. All holes in the image are filled by white color.

Figure 7: Image after applying sobel edge detection.

- Use connectivity ptoperty to get actual location of number plate [11].
  Matlab has a function bwareaopen() using which components of the image with desired connectivity (say 1500 pixels) can be extracted.

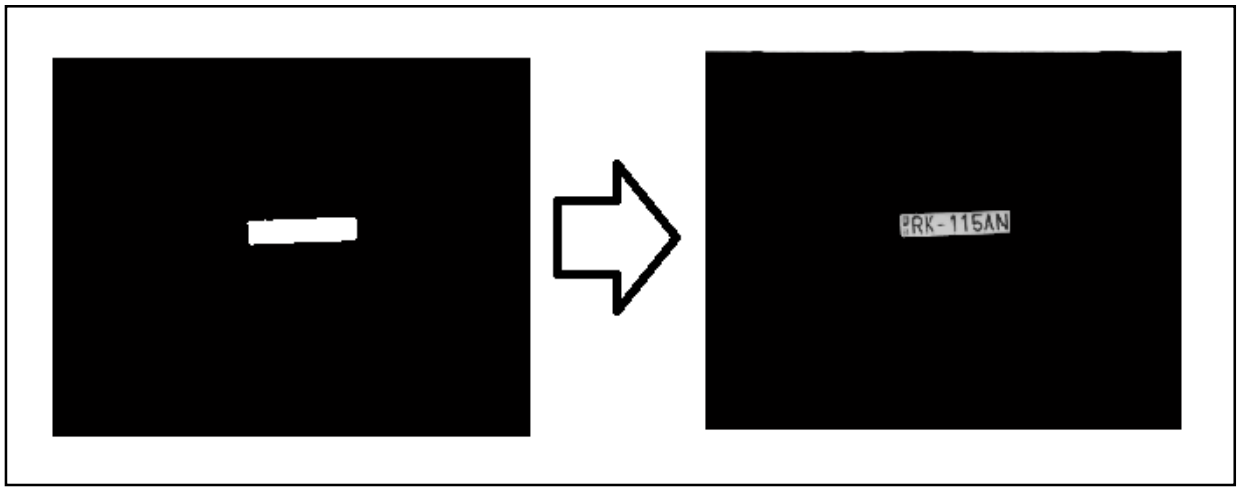

Figure 8: Image after specifying connectivity 1500 pixels

Bounding box property of regionprops() function can be used to crop plate region.
Algorithm is as follows

```
L = bwlabel(lp);
s = regionprops(L, 'BoundingBox');
subImage = imcrop(hist, s(1).BoundingBox);
```

Figure 9: Localized number palte

2.4. Character Segmentation & Optical Character Recognition

For perfoming optical character recognition (OCR) we first have to perform character segmentation. This is done by cropping each character after applying bounding box [6]. Bounding box is a one of the property calculated by applying region props () function on the image.

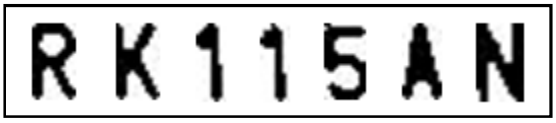

Figure 10: Segmented characters

Once characters are segmented each character is compared with predefined templates [4], this process is known as template matching. In template matching each segmented character is correlated with all the templates. Result depends on maximum match found after template matching.

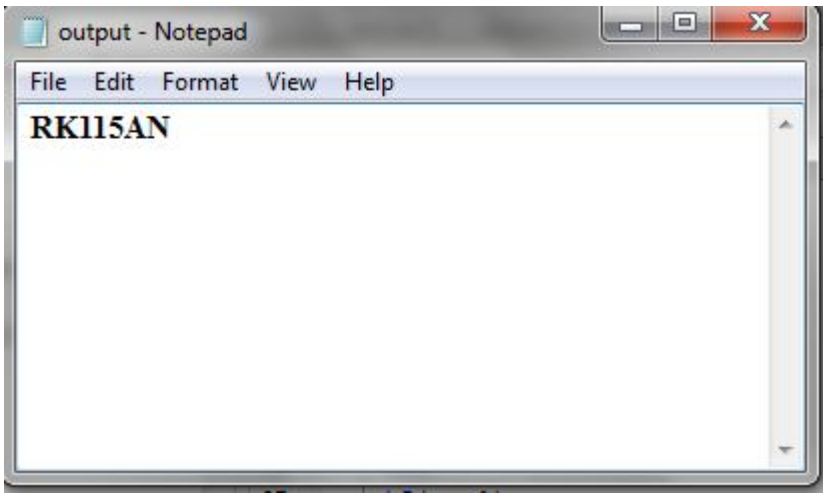

Figure 11: Final output text

3. Experimental Results

We implemented our proposed method on MATLAB R2014a which was installed on a machine with windows 7 operating system, 4GB RAM and Intel i5 processor.

Plate was located accurately and OCR results were around 90% accurate.

4. Conclusion

In this paper, a fast and efficient method for plate localization and optical character recognition is proposed. Pattern matching was used to recognize characters. Accuracy of this method can be increased by using a high resolution camera.

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