Detection of Car Registration Number using Segmentation

1. Introduction

The past few years have been extremely challenging for researchers interested in detection of car registration number. This can be explained, as many of the knowledge domains from nowadays need to recognize these registration numbers. The security of humans and military bases being at stake. The applications of detecting car registration numbers, without human interaction, is very difficult, and they have a wide area of appliance, from surveillance systems used by family owners to the monitoring of traffic or the security of the military projects.

There are several ways in which the researchers are approaching this, but in my experiment, I wanted to implement a system that uses some simple operations, such as the morphological operation and Sobel edge detection method. In order to get to the second step, the segmentation of characters from the registration number, the bounding box method was used to simplify the process.

The project was developed using *Matlab R2016a*.

2. Description of the method

The contrast features from an input images are an essential problem that needs to be addressed, because it's becoming very hard to identify the exact location of the plate that contains the registration number, if the background of the registration plate is highly indistinguishable, related to the plate itself. The reflection of any tiny source of light when the image is taken, can compromise the accuracy of the work the system is doing. To resolve this problem, morphological operations were used. In the next figure, is named every step we need to make in order to divide our work in small phases.

1. Input raw image.
2. Image binarization.
3. Reduce noise using mid-filtering method.
4. Enhance contrast using histogram equalizer.
5. Plate localization.
6. Character segmentation.

Fig. 1

Related to the binarization, it can be said that the 8 bits gray value is computed together with the conversion of the input RGB image, into gray scale.

The technique of median filtering is used to handle the noise data. To obtain the related gray values of every eight pixels located in the proximity of a studied pixel, a mask has been used, with the size of three by three.

With the purpose of adjusting the contrast of the images fed to the system, a method known as the histogram equalization is being exploited, a method which uses the image histogram. See the *Fig. 5.* In this regard, the function that does this thing is `histeq`.

The things tend to follow the lead of basic logic when it comes to the phase of detecting the place of the registration number plate. One of the important aspects, is to figure out the size of the plate. The problem is reduced to find out the edges of a shape being rectangular, because almost every plate has this geometric particularity. The place of the plate is discovered using mathematical morphology. The Sobel edge detector has the goal of highlighting the areas that are characterized by a higher edge magnitude, while it identifies the areas with a higher edge variance. See the *Fig. 6.*

After the detector has removed the related components possessing a smaller than `p` considered pixels, another binary image is produced. We need to remark the fact that our method has a selected number of eight pixels for `p`. The next figure contains an inside on the algorithm.

The next step would be to fill the holes from the binary image. As a hole, are interpreted the pixels from the background of the binarized image, which are failed to be reached by the edge detection method. The `imfill(BL,'holes')`would be the function responsible for that, where BL was considered the binary image resulted from the previous steps. See the *Fig. 7.*

1. Determine the connected components.

```
L= bwlabeln(BW,conn);
```

2. Compute the area of each component.

```
S= regionprops(L,"Area");
```

3. Remove small objects.

```
Bw2 = ismember(L,find([S.Area] >= p));
```

Fig. 2

```
for m=2:p-1
  for n=2:q-1
    if(In(m,n)>0)
      c=Connectivity(H3,m,n);
      if(c>2)
        In(m,n)=1;
      else
        In(m,n)=0;
      end
    end
  end
end
```

Fig. 3

In order to find out the area location of the registration plate, thing possible after the holes are filled with the help of the flood fill algorithm, we omit the pixels which are characterized by lower components, to extract information about the actual location of the registration plate. The side *Fig. 3* shows the algorithm used.

To achieve the final goal, we are removing the pixel components with a smaller connectivity. Here was considered the connectivity threshold of one thousand pixels. This morphological filtering concludes with the detection of actual car registration plate area. See the *Fig. 9.* Then, by outputting the

coordinates of the vertices of the rectangular registration plate, it is possible to draw out the car registration number exact area.

The last step, is the segmentation of the characters, which consist of measuring a range of characteristics contained by the labeled area from the matrix of labels. The `regionprops()` function is used in that regard. The area related to the registration plate is extracted in the end. See *Fig. 10.*

3. Details about the dataset

The dataset consists of 60 images with two attributes, in total. There are character images and car registration plate images. From them, 50 are from the set of characters, while the remaining 10 images are car images. Various random images with cars have been selected from the internet with the desire of challenging the system.

4. Results

I have run the method on *Matlab R2016a* on a computer with Intel Core i3-2330M, 2.2 GHz with 4GB of RAM. The goal was identifying the area in which the plate can be found out, with as much accuracy as possible. As a bonus, the system was able in special cases to recognize the characters from the plate.

Fig. 4 – The original image

Fig. 5 – The image after contrast adjustments


Fig. 6 – The image after the Sobel edge detector was applied


Fig. 7 – The image after the lower pixels were removed

Fig. 8 – The image after the "holes" were filled

Fig. 9 – The registration area was located, following the use of the morphological filtering

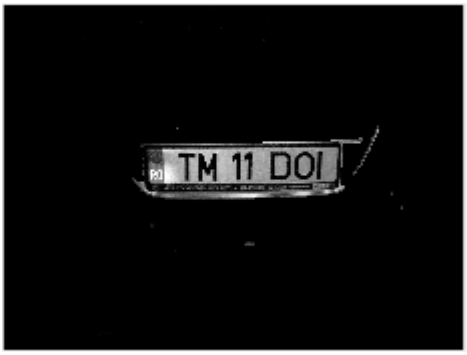

Fig. 10 – The image containing the area of the car registration plate

5. Final remarks. Further Work

It's now much easier for me to understand the fact that the field of extracting numbers and letters from a car registration plate is more difficult than I could have imagined. Experts are having trouble with the light, the contrast, the poor quality of images together with other characteristics that made the work sometimes impossible. The method implemented by me still have some issues that need to be addressed in the future. The accuracy of the results can be increased in the next versions of this proposed method, by acknowledging new ways of handling the noise of the dataset, or by simply changing the algorithms being used.