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Automatics Vehicle License Plate Recognition using MATLAB

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Abstract - The objective of this paper is to be able to detect the area of a car license in a photograph. Using computer vision and digital image processing techniques. The different processes to which a photograph of a car is subjected will be explained in order to detect its registration. It will be indicated under what conditions the presented algorithm is effective and correctly detects the registration and under what conditions it can produce false positives. Indicate that the algorithm will only detect the area where the license plate is located, adjusting as much as possible the size of this zone to the size of the license plate.

Keywords - *Median filter , canny edge detection, image convolution , image binarization.*

1. Introduction

The ANPR (Automatic Number Plate Recognition or ANPR in English) is a method of mass surveillance which uses optical character recognition on images to read the license plates of vehicles. In 2005, systems can scan license plates with an approximate frequency of one per second in vehicles with speeds of up to 160 km / h. They can use the existing closed circuit television or radars, or ones designed specifically for this task. They are used by the various police forces and as a method of electronic toll collection on the payment highways, and to monitor traffic activity as a red light at an intersection.

The ANPR can be used to store the images captured by the cameras, as well as the license plate text, and some can be configured to store a photograph of the driver. These systems often use infrared illumination to make it possible for the camera to take pictures at any time of the day. At least one camera version for intersection monitoring includes a powerful flash, which serves to illuminate the scene and make the offender aware of his error. The ANPR technology tends to be region-specific, due to the variation between license plates from one place to another.

The system software runs on a standard PC hardware and can be linked with other applications or databases. First, it uses a series of image manipulation techniques to detect, normalize and enhance the image of the license plate number, and finally, optical character recognition to extract the alphanumeric from the license plate. The ANPR / ALPR systems can be used in two ways; one allows the process to be performed in its entirety in the place of the shot in real time, while the other transmits all images from many cameras to a remote computer where the OCR process is performed later. When done in situ, the information captured from the alphanumeric registration, date and time, identification of the place and any other information that is required is completed in about 250 milliseconds. This information, now converted into small data packets, can be easily transferred to a remote computer for further processing if necessary or stored in the place to be retrieved later.

In the other arrangement, there is typically a large number of PCs used in a server farm to handle high workloads, such as those found in the London Congestion Charge project. Often in such systems, there is a need to send images to the remote server and this may require high bandwidth transmission means. The drawbacks of these systems are centered on the fear regarding the privacy of citizens' movements and media reports about misidentification and high error rates. However, as they have been developed, these systems have been much more accurate and reliable.

1.1. Methodology

The proposed algorithm is designed to recognize license plates of cars currently used in Europe , both those located at the front and at the rear. This algorithm will take as input an image of a vehicle, perform a pre-processing process to adjust the quality of the image, then mark the area of the image where the license plate is located, be making segmentation, and finally proceed to the location and extraction of the license plate. In summary, the steps of the algorithm are:

1-Pre-processed image
2-Segmentation of the image.
3-Location and extraction of the license plate

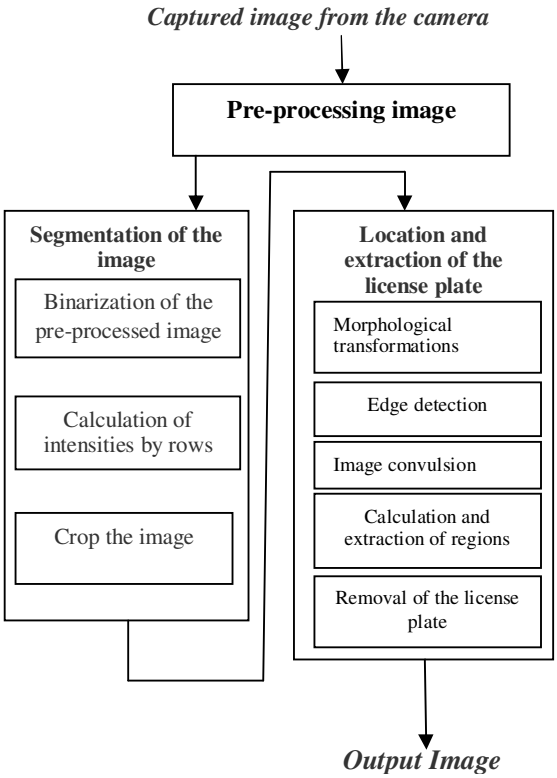

Fig.1 License Plate Recognition diagram

1.2-Pre-processed image

The input image will consist, as a general rule, of a color RGB image. The first step will be to scale the image to a suitable size for further treatment. In this case, the image is scaled to a size of 480 × 640. Then, we proceed to the conversion of the image to a grayscale, eliminating the information of tone and saturation but maintaining the luminance. The result of these two processes is the following:

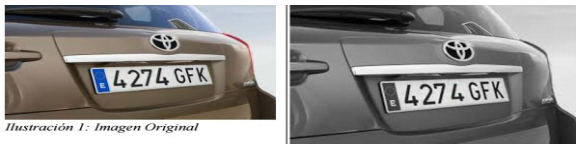

Fig. 2 scale the image to a suitable size

Once the image is converted, it is subjected to a smoothing process in order to eliminate the noise. For this purpose, an order filter is applied, in this case, the median filtering has been used. Order filters are based on methods that use image statistics, known as order statistics. In the case of filtering the median for each pixel, the intensities are ordered by their neighboring pixels, the median is determined and this value is assigned to the pixel. The size of the neighborhood that has been used is 5 × 5. The result of this process is an image with less noise and greater smoothing.

Fig. 3 using median filter to smooth the image

2. Segmentation of the image

The next step is to segment the image to locate the possible area where the license plate is located. This step does not pretend to detect the registration, but only to segment the image to stay with the best area of the image where the registration is possible.
The steps to be taken in this process are:

1- Binarization of the pre-processed image.
2- Calculation of intensities by rows.
3- Crop the image.

2.1 Binarization of the pre-processed image

A process of binarization is applied to the resulting image of the pre-processing in order to detect its edges. In this case, the image is processed using the Canny algorithm. This algorithm is based on the theory of first derivative operators and is especially useful since, in addition to extracting edges, it closes the contours avoiding possible ruptures. The threshold used for this algorithm was 50.

The result of this process is the following:

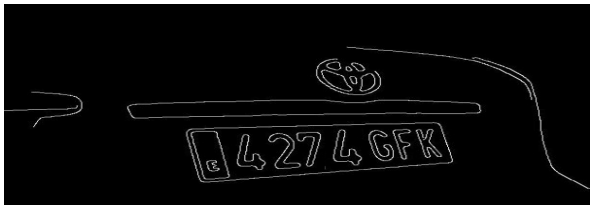

Fig.4 binarization the plate region

2.2 Calculation of intensities by rows

Once binarized the image proceeds to perform a calculation of intensities by rows. This calculation is based on several assumptions:

1- The area where the registration is will have a very intense row (1's) zones very close to each

other. Keep in mind that the registration will occupy several rows.

2- A row containing a piece of the license plate will follow a certain pattern. That is, the numbers will have blank space between them and in their region.

The algorithm consists of traversing all the rows of the binarized image one by one. For each row, its value will be increased by 1 (starting from 0) as long as we meet some of the following patterns in their pixels: (0, 0, 1) or (1, 0, 1). The idea is to penalize those areas with continuous borders or without borders and favors those rows with discontinuous edges, a pattern that will follow the numbers of a license plate.

The result of this process is the following graphic:

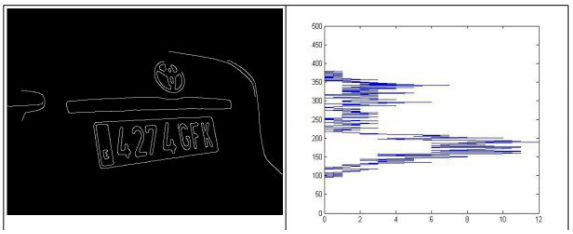

Fig.5 intensities of the plate region

If we look at the graph we can see that in the area of the registration is where the rows are concentrated with greater intensity.

2.3 Crop the image

From the calculation of intensities, the row with greater intensity is obtained. Once this index is obtained, the image 81 is trimmed up and down, size enough to contain the license plate.

Fig.6 crop the plate region

3. Location and extraction of the license plate

Once the image is trimmed, the last step is to locate and extract the license plate. To do this, the image is subjected to several processes:

1- Morphological transformations
2- Edge detection
3- Image convulsion
4- Calculation and extraction of regions
5- Removal of the license plate

3.1 Morphological transformations

This first step is to perform a series of morphological transformations in the image. These transformations will allow us to soften the edges of the different regions of the image (specifically the region of the license plate), separate the different regions and facilitate their computation.

Three types of transformations will be used:

1- First of all, an erosion of the image is applied. This morphological transformation combines two sets using vector subtraction. One of these sets will be the image resulting from the previous processes and the other will be the following: [0 0 1 0 0; 0 1 1 1 0; 1 1 1 1 1; 0 1 1 1 0; 0 0 1 0 0].
2- Then the transformation called opening is calculated. To calculate this transformation to the result of applying erosion to the image, a dilation process is applied. This transformation, dilation, combines two sets using the addition of vectors.
3- Finally, the image is closed. For this the result of the erosion is subtracted from the result of the opening.

The result is an image with perfectly defined edges and closed regions, which will allow detecting the position of the license plate.

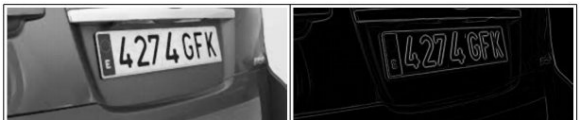

Fig.7 showing the edge and position of the license plate.

3.2 Edge detection

the image is then subjected to a binarization process in order to detect its edges. The Canny algorithm is reused with the same parameters as in the previous steps.

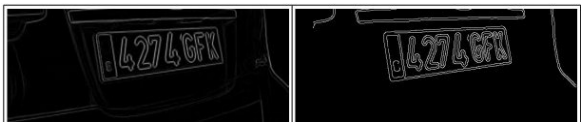

Fig.8 canny algorithm for the license plate.

3.3 Image convulsion

In order to facilitate the detection of the regions, a convulsion process is performed in the binarized image. This convulsion will serve to soften the image and reduce the number of connected components, in order to minimize false positives. The following filter will be used:

msk = [0 0 0 0 0;
0 1 1 1 0;

0 1 1 1 0;

0 1 1 1 0;

0 0 0 0 0;];

The result is as follows:

Fig.10 convulsion the license plate

3.4 Calculation and extraction of regions

The next step is to calculate the existing regions. This will allow us to later identify the enrollment since it will be a region itself. The process consists of several steps:

1- We label the connected regions. In our case, we also indicate that the connected regions must have at least 8 connected objects.
2- The second step is to fill in the connected regions.
3- Finally, the regions are identified.

Below are the images resulting from steps 2 and 3.

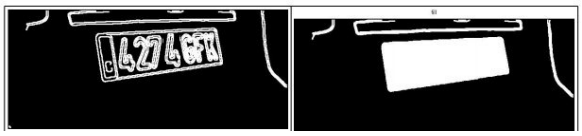

Fig.11 the result for 1 and 2 steps in Calculation and extraction of regions

In the previous image, we can see the filling of connected regions from the image obtained in the previous steps.

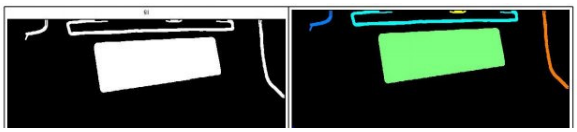

Fig.12 final step from Calculation and extraction of regions to detect the number

From the image with the filled regions each one is identified.

3.5 Removal of the license plate

As we saw in the previous image, the region of the license plate is the one with the largest area. To obtain the registration, the regions are sorted by area in descending order. The first region should correspond with the registration.

From the coordinates of the region of the position registration is calculated and extracted from the image.

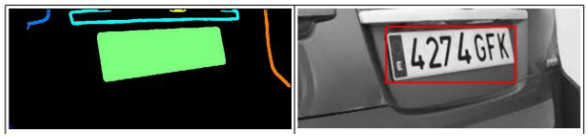

Fig.13 region of license plate is detect

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4. Conclusion

The method described in this communication has shown a relatively high success rate when used in sequences of images. The phase of locating license plates handles complex scenes quite well, demonstrating a high discriminatory power. However, it would be desirable to improve the character recognition in the future as well as the location of the license plate sides.

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