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USE OF GENETIC ALGORITHMS TO AUXILIATE VEHICLE PLATE DETECTION IN IMAGE SEGMENTATION USING OPENCV

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Abstract. One of the fundamental steps of image processing is the segmentation of images, which aims to partition the image in a way that makes data analysis and extraction simple. In this article, a method is proposed that performs the segmentation of images, using multiple thresholds, through genetic algorithms to find the contours of a car's plate. For this, the algorithm should validate a set of characteristics that define a region as being a car plate. Identify optimal threshold parameters in order to obtain the best possible solution for image segmentation and detection of vehicular plaques. The methodology used consists of the bibliographic review of an image segmentation article on Genetic Algorithm Application for the Evolution of Parameters for Image Segmentation and an article on the detection of vehicular plaques using Python and OpenCV. The employee image bank was obtained from a public repository of images. The parameters that will be estimated to validate whether or not a given object is detected on a board are: the board's outline and the presence of alphanumeric characters. In this way, it will be possible to optimize detection efficiency by eliminating false positive results, such as image contours that do not correspond to the plates. The segmentation of the image

through multi-thresholds occurred and it was possible to identify vehicle plates in the image with greater precision.

Keywords: Segmentation of images; Plate Detection; Genetic Algorithm.

1 Introduction

Computational Vision is the study of extracting information from an image, or is the explicit description of physical objects from images [1] . While the Digital Image Process (DPI) performs the processing of the images through transformations of the image in another image, Computational Vision is the understanding of the image, that is, if it uses the PDI as prerequisite for recognition, manipulation, and decision-making about objects in an image.

In the last ten years, Machine Learning has replaced DPI as the basis for computer vision. Machine Learning solutions are known as black boxes, because the programmer does not need to understand which logic or function that maps the inputs and outputs of a system, by simply mounting a the model and inform it which inputs and outputs are desired. [1]

A lot of vision problems it was noticed that ML presented more robust solutions than the obtained with years of study in DPI. In Computer Vision the most used Machine Learning technique is the Networks Neural Artificial, but in this article we use Genetic Algorithm.

A recurring application of computer vision is in vehicle access control. In these systems, the vision algorithm must find or detect a vehicle image or video and perform OCR (Optical Character Recognition) or recognition to read the card number. With this information it is possible to access the vehicle or not to a locality, control the vehicle and enter the number of vehicles inside the vehicle locality. [2]

One of the fundamental steps of image processing is the segmentation of images, which aims to partition the image in a way that makes data analysis and extraction simple. In this article, a method is proposed that performs the segmentation of images, using multiple thresholds, through genetic algorithms to find the contours of a car's plate [2]. For this, the algorithm should validate a set of characteristics that define a region as being a car plate.

2 Digital Image Processing

Computational Vision systems commonly follow the set of steps exemplified below: acquisition; pre-processing; segmentation; representation and description; and recognition and interpretation [1].

2.1 Pre-processing

The pre-processing step aims at improving the quality of the image coming of the acquisition, for that it is used the techniques of noise attenuation, contrast correction and brightness, to cite the histogram equalization. It is followed by the segmentation step which consists of the process of separating the image into regions of similar pixels [2]. The idea is to divide the image in the structural units of the scene or in the ones that distinguish the objects of interest, separating the foreground objects from the background information.

Currently, for the classification stage, the use of neural networks and deep learning is recurrent. The convolutional neural networks have been shown to be a highly efficient tool for solving

the problems of recognition of patterns and objects in images, some of which already incorporate, besides classification, the steps of pre-processing, segmentation and description. [1]

2.2 Segmentation

Image segmentation is the process of identifying pixels with similar characteristics through labels or tags. Pixels labeled with the same label represent an object. In other words, segmentation is responsible for distinguishing objects from an image from the background or distinguishing one object from another. [3]

3 Genetic Algorithms

Genetic algorithms (GA) are a series of computational algorithms inspired by the theory of evolution, which incorporates concepts identical to those of the chromosome, selection, reproduction and mutation to solve mainly optimization problems. The possible data set of a problem is called population. Each state is an individual and is encoded as a chromosome. Usually, the chromosomes are represented by the figure of the man in the window (1) or absence (0) of a characteristic. However, representations by means of vectors can be used as the combination of characteristics determines the final (phenotype) aspect of the individual. The glasses reproduce, generating new populations. Individuals are selected in such a way that the fittest are more likely to reproduce by transmitting their own origin to the next steps. To quantify this ability, an evaluation function is used to return larger values to the best. This function depends on the problem addressed. In the reproduction process, as in the real world, it applies to the chromosomes in crossing-over and mutation operations, which generate new individuals [3].

In this article, the chromosomes were identified as characteristics of the square regions of the image. If the region has alpha numeric characters, the chromosome will receive 1, otherwise 0. Thus, chromosomes were selected for elitism, since only those with the highest value would be considered relevant in the segmentation. Figure 1 shows the flowchart of the operation of the genetic algorithm.

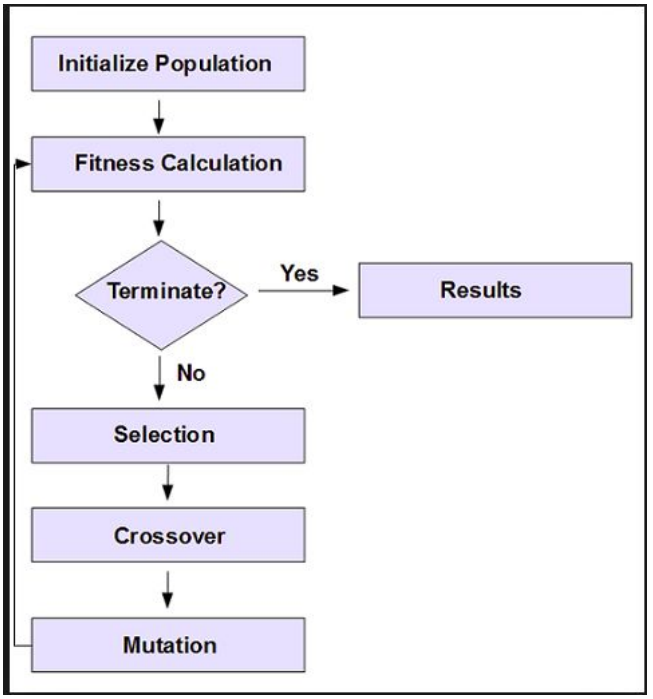

Figure 1. Fluxogram of Genetic Algorithm.

4 The Proposed Algorithm

Figure 2 shows a flow chart of the system operation.

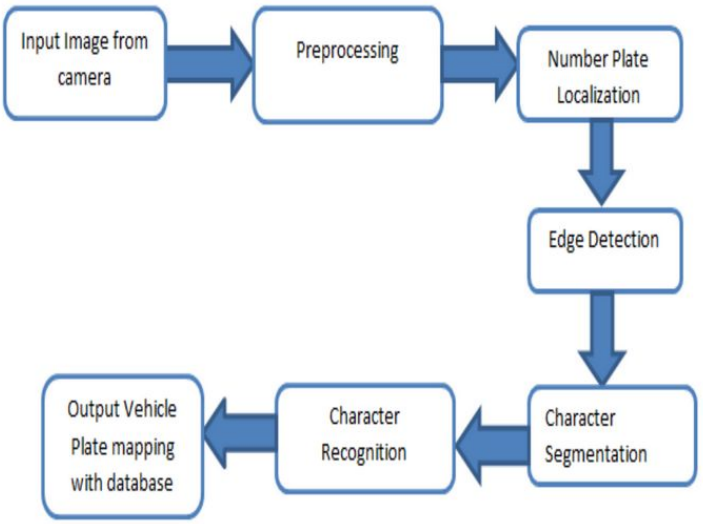

Figure 2. Genetic algorithm pseudo code

In the image processing step, there are four parts that have been examined. Each part influenced the algorithm and the plate identification detection threshold. The first part examined was proportional to the image. It is at this stage that the adopted algorithm acts by comparing the detected contour with the actual size required for a candidate board. The second part was a test in the rotation or alignment of the image. This particular process was important in determining the slope limit that the board possesses in order to be identified by the program. It has also been performed in order to anticipate the likelihood that the image will tilt as a result of the improper position of the camera or a slanted board. The third part was the distance measurement. This particular measure is needed to evaluate the 16-megapixel camera in terms of determining the distance required to accurately identify and detect a board. The fourth part determined the value of the binary limit with the Global Threshold and the Adaptive Threshold. The Adaptive Threshold formula is shown in Eq. (1).

$$\mathbf{dst(x,y)} \quad = \quad maxV\,alueifsrc(x,y) > T(x,y)\ 0, otherwise \tag{1}$$

5 Database

The database was obtained from photos of vehicular plates taken in the parking lot of the State University of Maranhão and images obtained on the Internet. The obtained photos have different angles, distance and illumination of the same plate, simulating diverse conditions for treatment of the images and the recognition of the plate.

6 Implementation and Results

The Algorithm was implemented in the PyCharm IDE and the initial population size is 5 chromosomes, the interaction number is 25, the mutation and crossover rates are 0.15 and 0.1, respectively. Figure 3 shows the results obtained in the image processing in the recognition of the region of the car plate characters with normal brightness.

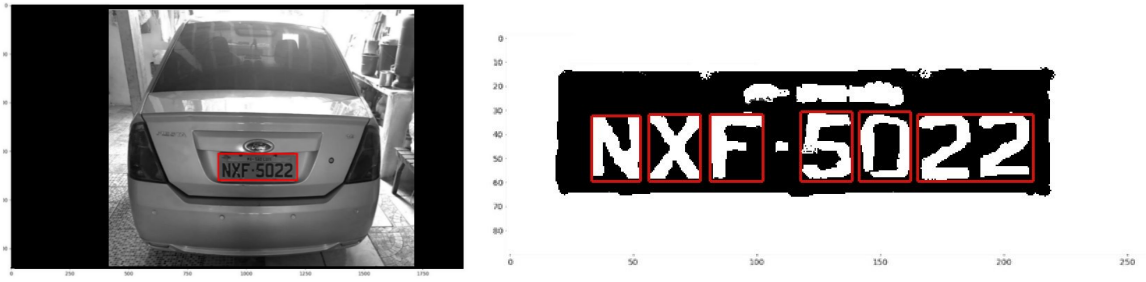

Figure 3. Vehicle plate region recognition and region of characters in normal brightness.

In figure 4 shows the results obtained in the image processing in the recognition of the region of the car plate characters with restricted luminosity.

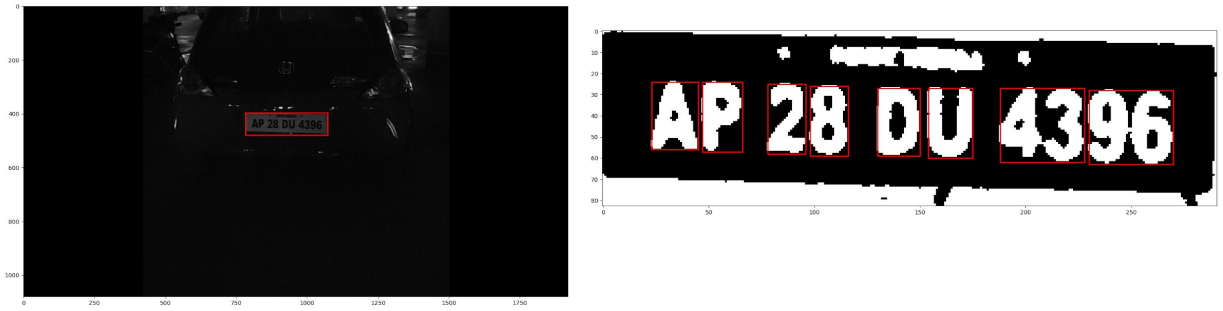

Figure 4. Plate Region recognition and character region with low light.

The algorithm initially selected all contours of the figure that are quadrilateral. Then, through the characteristics of each region, we identified the region with the best values of the chromosomes, chosen as the region most likely to contain a plaque.

It is observed that the genetic algorithm helped in choosing the best detection threshold of the plaque identification. Thus, the proposed algorithm was able to be satisfactory for detection of plaques in two distinct lighting environments, considering normal light and reduction of illumination. Similar articles have used similar techniques, as for example in [4], which use a license plate size ratio (division between height and plate height, which is usually between 2.5 and 5 units).

7 Conclusion

In this work, a new technique for automated detection and recognition of vehicular plates was presented in real time. For the detection of vehicular plaques, an approach based on binarization operations, extraction of edges and contour detection was used to ensure a high accuracy rate at the localization of the vehicular card, while maintaining interactive processing time for the algorithm. For the interactive recognition of vehicle plates, the plate located in the previous step was segmented and a specific character recognition algorithm was applied in order to locate the alphanumeric characters of

the plate.

The results were obtained after the evaluation of the techniques in a dataset with hundreds of images obtained from vehicle plates produced not only in Brazil, as in other countries. Processing time was measured on a conventional configuration computer. It has been shown that the techniques proposed herein obtain good accuracy for both detection and recognition of the carrier plate with genetic algorithm, while maintaining low processing time for the techniques.

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