License Plate Detection Using Neural Networks

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Abstract. This work presents a new method for license plate detection using neural networks in gray scale images. The method proposes a multiple classification strategy based on a Multilayer Perceptron. It consists of many classifications of one image using several shifted window grids. If a pixel belongs or not to the licence plate is determined by the most frequent answer given by the different classifications. The result becomes more precise by means of morphological operations and heuristic rules related to shape and size of the license plate zone. The whole method detects the license plates precisely with a low error rate under non-controlled environments.

1 Introduction

The license plate recognition (LPR) is a complex matter widely written about. The problem itself is how to recognize license plate characters of a front or rear image of a vehicle. In general, the LPR system has the following parts: the acquisition of the image, the image preprocessing, the detection of the license plate, the segmentation and the characters recognition [1].

The focus of this paper is the detection step, in other words, determining the zone where the license plate is. In the literature many techniques for this step have been reported. A segmentation method based on thresholds is proposed in [2]. Usage of Fuzzy Logic is shown in [3]. Edge detection by means of gradient and morphological techniques are presented in [4]. The image scanning using adaptive windows, considering heuristics of statistical descriptors is proposed in [1]. The horizontal and vertical projection is presented in [5]. The line detection using the Hough transformation is proposed in [6]. Learning techniques and Neural Networks have also been studied in this problem. Methods based on backpropagation networks are presented in [7,8,9], the use of Support Vector Machines is proposed in [10], and the Pulse Coupled Neural Network in [11].

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We propose for the license plate detection problem a strategy of multiple classification based on a Multilayer Perceptron (MLP)[1]. Some descriptors of texture and contrast are considered [12]. The image is scanned classifying windows partially shifted. This means that the image is many times classified. According to the window used a group of pixels would belong to the license plate or to the rest of the image. The nature of the group of pixels is defined by the most frequent answer given by the different classifications.

Our set of images has 350 samples[2]. The quantity of the samples is in size range reported in the related works [9]. The paper structure is the following: the adopted zone descriptors are described in section 2. Section 3 presents the idea of multiple classification. Section 4 explains the steps of the method for license plate detection. Section 5 shows the results, and section 6 presents conclusions and projections of our research.

2 Adopted Descriptors for License Plate Characterization

In order to characterize the region of the license plate, the adopted descriptors are: the mean value (m) , the standard deviation (σ), a measure of smoothing (R), the third statistical moment (μ_3), a measure of uniformity (U) and the entropy (e). The expressions of this descriptors are the following:

$$m = \sum_{i=0}^{L-1} z_i p(z_i) \ , \ \sigma = \sqrt{\sum_{i=0}^{L-1} (z_i - m)^2 p(z_i)}$$

$$R = 1 - \frac{1}{1+\sigma^2} \ , \ \mu_3 = \sum_{i=0}^{L-1} (z_i - m)^3 p(z_i)$$

$$U = \sum_{i=0}^{L-1} p^2(z_i) \ , \ e = -\sum_{i=0}^{L-1} p(z_i) \log_2 p(z_i)$$

where z_i is an aleatory variable that indicates the image intensity, $p(z_i)$ is the histogram, L the quantity intensity levels, and m the intensity media value.

The previous descriptors to measure the contrast or homogeneity are based on the variance computation. To improve the input information of the classifier, we propose using a contrast descriptor $C = z_{min}/z_{max}$, where z_{min} and z_{max} are the minimum and maximum values respectively of the analyzed area. This descriptor is easily computed, and it is perfectly adapted to the processing in real time.

3 The Multiple Classification Idea

Multiple classification means that an image can be analyzed more than once. We train a neural classifier to determine if a window of the image corresponds

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[2] The set of images is available from www.lfdp-iprg.net