DETECTION OF ORIENTED NUMBER PLATE IN VEHICLE USING AUTOCORRECTION FEATURE FROM GRAY LEVEL CO-OCCURENCE MATRIX

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ABSTRACT

The efficiency of an automatic number plate recognition system depends directly on the proper effective preprocessing of the number plate. The OCRs available for recognition are capable of reading the number plates which are in proper orientation of 00. In many situations the vehicle number plates captured may be in any different orientation like 900, 1800 and 2700. These orientations in number plates are due to declamping of number plate at one end or toppling of vehicle. Such differently oriented number plates cannot be subjected for reading by OCRs and such situations require the system to detect the direction of orientation and correct the same before subjecting the same for reading. This paper proposes a work to detect the orientation of segmented number plates from vehicle image using autocorrelation feature from gray level co-occurrence matrix. A good volume of training samples are generated synthetically to train the system and the system is tested using sufficient test samples. The results of system shows an overall efficiency of 65.61% and performs an essential preprocessing in an automatic number plate recognition system.

KEYWORDS

Number Plate, Orientation, Autocorrelation, OCRs

1. INTRODUCTION

Vehicle Number Plate Recognition(VNPR) system is an image processing application, developed to track the information about vehicles through the number plates. This application is gaining popularity in security and traffic monitoring systems. The number plate recognition system is important for variety of applications like automatic traffic congestion charge system, access control, tracing of stolen vehicles and identification of vehicles for traffic rules violations. The VNPR system plays a major role in automatic monitoring of traffic rules and maintains law enforcement on public roads. A VNPR system goes through a series of preprocessing task for

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efficient automatic reading. The generic OCRs available are designed to read the text in 0^0 orientations and are not capable of reading text in other orientations. The number plates segmented from captured vehicle images may not be in correct orientation i.e number plate instead of being at 0^0 orientation, it may be in any one of the 90^0, 180^0 and 270^0 orientations. The samples of segmented number plate in different orientation directions are shown in Figure1.

Figure. 1 (a) 0^0 Orientation (b) 90^0 Orientation (c) 180^0 Orientation (d) 270^0 Orientation

The different directions of orientations in number plates are due to unclamped number plates at one end or it may be due to toppled vehicles. Since OCRs do not to read such number plate oriented in other directions, the automatic number plate recognition (ANPR) system demands requirement of a preprocessing stage to detect the orientation of number plate and correct the same before subjecting for reading by OCRs. This requirement has motivated us to explore a method to detect the direction of orientation of the plate in vehicle images.

The work presented in this paper focuses on implementation of orientation detection in vehicle number plate. The rest of the paper is organized as follows section 2 gives brief survey about related research work. Section 3 presents the model designed for detection of orientation in vehicle number plate. Section 4 discuss about the experimental results and a brief conclusion is provided in section 5.

2. LITERATURE SURVEY

Many researchers have proposed good number of methods to detect tilt in the number plate of vehicles[1]. Tilt is the angular rotation noticed in the number plate. These methods are designed to detect the tilt which are less than 35^0 . These approaches are based on Principle Component Analysis [2], Fourier Transform[3], Hough Transform[4], Nearest neighbor connectors[5], Extreme points[6] and Moments[7,8]. But most approaches fail to detect the orientations of 90^0, 180^0 and 270^0. In literature sufficient quantum of works are reported on text skew detection in documents. The work in [9] proposed a modified approach of Hough transform for skew detection and correction of document images, the algorithm is computationally less efficient. The work in [10] proposed an integrated skew detection and correction using Fourier transform and DCT which is also computationally less efficient. Many different methodologies to detect skew in a given document page [11] were discussed. A traditional projection profile approach is proposed in [12]. In this approach features are extracted from each projection profile to determine the skew angle and it is quite cost effective. The improved nearest-neighbor based document skew detection method is proposed in [13] to estimate skew in documents respective to skew angle limitation. Another approach uses k-NN [14] clustering of the connected components. This approach has a relatively high accuracy but has a large computational cost, independent of the detection range. A skew detection method using the cross correlation between the text lines at a fixed distance [15] is based on the fact that the correlation between vertical lines in an image is maximum for a skewed document, is presented. It is found that the proposed method is computationally expensive and gives lesser accuracy. A bottom up technique for skew estimation based on nearest neighbor clustering is proposed in [16]. In this method, nearest neighbors of all the connected components are determined. Since only one nearest neighbor connectivity is made for each component, connection with noisy sub parts of characters would reduce the accuracy of the method. The above reported techniques have some limitations and depends on the factors like, speed, suitable only for text of sufficient size. Few techniques provide accurate results but slow in processing and other few techniques are cost effective but efficient in speed and accuracy. Some works are reported in literature to recognize the number plates in vehicle using size features of number plates[17]. But these approaches fail in distinguishing between number plate in 0^0 and 180^0 as well as between 90^0 and 270^0 for rectangle shaped number plates. In addition, the methods cannot be extended for square shaped number plates.

To the best of our knowledge, we could find a couple of works on detection of orientation in document images [18] and [19]. These methods are suitable for large text document and not ideal for number plate which contain very little text or very few characters. Hence a more suitable method is required to detect orientation of number plates and the work presents an attempt made in this direction.

3. PROPOSED MODEL

Input to the system is assumed to be the segmented number plate from the vehicle image. The sequence of stages in the work is shown in Figure.2. The process begins with necessary preprocessing to enhance the input number plate image for better character segmentation and character recognition. The preprocessed input image is subjected to detect the direction of orientation using autocorrelation feature from gray level co occurrence matrix (GLCM). Once the direction of the orientation is detected, next the same is corrected by rotating the segmented number plate in the counter direction. The subsequent subsections discuss the process in detail.

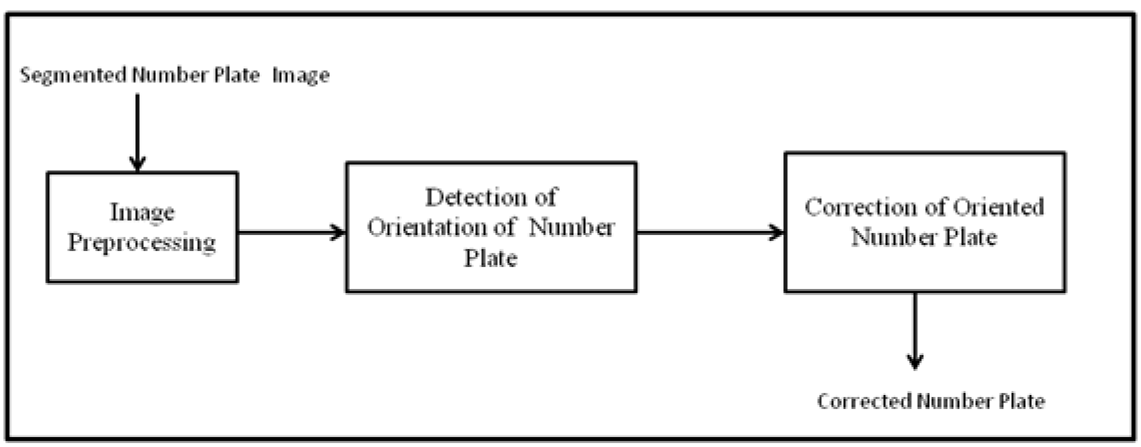

Figure 2. Stages in the Proposed Model

3.1. Preprocessing

The input image is converted into a grayscale image for easy analysis as it consists of only two color channels. The preliminarily preprocessing is carried out to remove noise using median filtering [20] from the input image. Median filter is a non-linear filter, which replaces the gray value of a pixel by the median of the gray values of its neighbours. A 3 × 3 mask is used to get eight neighbours of a pixel and their corresponding gray values. The gray value of the centre pixel of the mask is replaced by the median of the gray values of the pixels within the mask. This operation removes salt-and-pepper noise from the image. Figure.3 (a), (b) and (c) show the input, gray scale converted and filtered images respectively.

Figure 3. (a). Input Image (b). Gray Scale Image (c). Median Filtered Image

3.2. Orientation detection using Gray Level Co-variance Matrix (GLCM)

Texture is an important feature of an image. Texture plays an important role in many machine vision tasks such as surface inspection, scene classification, surface orientation and shape determination. Texture is characterized by the spatial distribution of gray levels in a neighbourhood. We can define texture as repeating patterns of local variations in image intensity which are to fine to be distinguished as separate objects at the observed resolution. Thus, a connected set of pixels satisfying a given gray-level property which occur repeatedly in an image region constitutes a textured region. To describe the texture of the region three approach are used in image processing these are statistical, structural and spectral. Statistical approaches specify the characterization of the textures by smooth, coarse, grainy, silky and so on. Since the texture is a spatial property, a simple one dimensional histogram is not useful in characterizing texture. In order to capture the spatial dependence of gray level values which contribute to the perception of texture, a two-dimensional dependence matrix known as gray level co occurrence matrix [21] is extensively used in texture analysis. Using a statistical approach such as co-occurrence matrix will help to provide valuable information about the relative position of the neighbouring pixels in an image. Another measure that has been used extensively in GLCM is the autocorrelation function[22] and this feature is mainly used for detection of orientation patterns in images.

3.2.1. Autocorrelation

The autocorrelation function [21] P(K, L) for an image 'f' is given by equation (1)

$$P(K,L) = \frac{\frac{1}{(N-K)(N-L)}\sum_{i=1}^{(N-K)}\sum_{j=1}^{(N-1)} f(i,j)f(i+k,j+l)}{1/N2\sum_{i=1}^{N}\sum_{j=1}^{N} f2(i,j)} \qquad 0 \leq K,l \leq N-1 \qquad (1)$$

For images comprising repetitive texture pattern the autocorrelation function exhibits periodic behavior with a period equal to the spacing between adjacent texture primitives. When the texture is coarse, the autocorrelation function drop off slowly, where as for fine texture it drops off rapidly. The measure of periodicity of texture as well as a measure of the scale of the texture primitives. The autocorrelation range values for different orientations are computed and tabulated from the training samples. The Table.1 represents the Autocorrelation value ranges obtained from training samples for different orientations with limited overlaps.

Table 1 Autocorrelation value ranges

Orientation	Autocorrelation
0^0	>50
90^0	12 - 31
180^0	45 - 50
270^0	32 - 44

4. EXPERIMENTAL RESULTS

The experiments are conducted through testing 495 segmented vehicle number plate images obtained in different orientations. For each test sample the autocorrelation value is computed and the classification is made based on range values specified in Table 1. The Figures 4 (a), (b), (c),(d), (e), (f) and (g) shows few samples of oriented input images and corresponding corrected number plates.

Figure 4. (a) 0^0 Orientation (b). 90^0 Orientation (c). 180^0 Orientation (d).270^0 Orientation

(e). Corrected image of (b) (f). Corrected image of (c) (g). Corrected image of (d)

The results of the experiments are tabulated in table2. The result of overall efficiency of proposed method is 65.61% with 22.16% of wrong detections and 11.85% of rejections. The rejections are due to failures in autocorrelation threshold values. The wrong detections are due to overlapping of autocorrelation threshold values.

Table 2 Results of Detection Orientation in Vehicle Number Plate Image

Orientation	No. of Samples	Correct Detections	Wrong Detections	Rejections
0^0	100	75(75%)	17(17%)	8(8%)
90^0	145	89(61.38%)	36(24.82%)	20(13.79%)
180^0	115	70(60.87%)	30(26.09%)	15(13.04%)
270^0	135	88(65.18%)	28(20.74%)	17(12.59%)
Total	**495**	**322(65.61%)**	**111(22.16%)**	**60(11.85%)**

5. CONCLUSION

The work presented in this paper detects oriented number plates in vehicles which is an essential preprocessing required for an Vehicle Number Plate Recognition system under certain situations. The direction of orientation is detected using autocorrelation features from GLCM. The overall efficiency of proposed method is 65.61%. Misclassification is more between (0^0 and 180^0) and (90^0 and 270^0) due to overlapping of autocorrelation threshold values and rejections are due to computed in autocorrelation values does not fit in threshold ranges. Since it is an initial attempt made in this direction the success rate is relatively less. However there is much scope to minimize the misclassification using multi features of GLCM with multilevel classification which is under investigation.

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