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Automatic Number Plate Recognition System using A Fast Stroke-Based Method

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***Abstract*—Locating the text and its localization in natural images and in number plates is very important factor for image analysis. Due to the problems like non-uniform illumination, variations of text font, complex background, intensity of the background color has made the issue more conflict. An automatic License plate number recognition system makes use of the image processing technique to identify the characters and the number plate which can be later used in many fields and places. Real-time stroke-based method for text detection in text images has been used in this paper , which is robust to the change of stroke intensity and width. Particularly it has been proposed to characterize the text confidence using an edge orientation variance (EOV) and an opposite edge pair (OEP) feature. Depending upon the result of text confidence map, candidate text components are extracted and grouped into text lines by using the thresholding and connected component analysis. After the image processing algorithm applied we are able to detect each digit from the given image. As per the received data we arranged the same into classifier, using a training set based on digits extracted from approximately 50 license plates. Once a license plate is detected, its digits are recognized, and checked against a database. Our main focus is on the efficient design of algorithms for image processing used for extracting the license plate from an image of the vehicle i.e. number plate and then isolating the characters of the plate and identifying characters which will be used for many other applications.**

***Keywords*— text detection, edge-based, stroke-based, stroke edge pair feature Segmentation, Feature Extraction; Character Recognition, ANN.**

I. Introduction

With the increasing use of digital image capturing devices, such as digital cameras, mobile phones ,content-based image analysis techniques are receiving intensive attention in recent time. Among all the contents in images, text information has inspired great interests, since it can be easily understood by both human and computer, and finds wide applications such as license plate reading, sign detection and translation, mobile text recognition, content-based web image search, automatic face recognition and so on [19]. Jung et al. define an integrated image text information extraction system (TIE, shown in Fig. 1) with four stages: text detection, text localization, text extraction and enhancement, and recognition . The steps involved in recognition of the license plate are acquisition, candidate region extraction, segmentation, and recognition using predefined database. The texts in text images provide an informative clue for image indexing and retrieval because texts carry semantic information more relevant to the video contents than images. However, the detection and recognition of texts in image is a challenging problem because of the variable font type , color of texts, dimension in which it is located, and the cluttered background. Despite the numerous efforts reported so far [1-16], this problem is not solved yet.

Text detection and location is the first step of image followed by character segmentation, and image text information extraction, which has received high attention in research. The proposed methods so far can be roughly categorized into three groups [3][4]: connected-component (CC)-based, texture-based and edge-based ones.

CC-based methods [5] generally assume uniform color in the characters and extract character candidate components by image segmentation using color or gray intensity uniformity. The candidate components are then verified according to character shapes and spatial context, edges of the character. However, the extraction of character components is not trivial in cluttered images due to the variability of character color and illumination.

Texture-based methods [6] assume that text regions in images and images have distinct textural properties from the background. Usually, candidate regions of variable scales are scored using a binary classifier on extracting textural features (such as Gabor filters, wavelet transform, gradient orientations, local binary pattern (LBP) features). The classification of a large number of candidate regions makes

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texture-based methods computationally expensive and hence they are not used as consequently.

Edge-based methods [1][2][7], taking advantage of the rich edge information of text regions, have been adopted for fast text detection. On edge detection of the whole image using, e.g., the Sobel or Canny operator, some strategies are used to enhance the text edges and inhibit the background edges. These algorithms provide the wide variety of the features for character edge extraction. Then, text edges are grouped into text regions, often using morphological operators. This method may detect text of variable size without need of multi-scale scanning of candidate regions, and therefore, is computationally efficient. However, its performance relies on the extraction of text edges, which are often contaminated by background edges.

To better distinguish text regions from the background, some methods have utilized the stroke characteristics of texts [8-12]. A distinct characteristic of strokes is that they have approximately uniform width and double edges of opposite gradient directions. Ye et al. [8] calculated the double-edge strength of gray scale image based on the oriented two-sided intensity contrast. Jung et al. [9][10] proposed a stroke filter to generate a stroke map based on the oriented two-sided contrast as well as the homogeneity of central region and lateral regions of each pixel. The assumption of stroke intensity homogeneity, however, is not observed in many images due to the illumination change. This method also suffers from high computation because of the hypothesized stroke width in a wide range. Epstein et al. [11] proposed the so-called Stroke Width Transform (SWT), which searches for each pixel the stroke width along the direction of gradient. Despite its promise of text candidate region filtering, the search of stroke width for all pixels is computationally demanding and is likely to be sensitive to image noises.

In this paper, we propose a fast stroke-based method for text detection in text images. Particularly, we propose to characterize the text confidence of image using an edge orientation variance (EOV) and an opposite edge pair (OEP) feature. These features are calculated in local regions efficiently and are robust to the changes of stroke intensity and stroke width. Also, the features are independent of languages, and so, they enable our method to detect multilingual texts (provided source images are available in database). Our experimental results on a large image dataset demonstrate the effectiveness and efficiency of the proposed method.

II. DATABASE

The database (50 Images with license plates) contains images of good quality (high-resolution: 1280x960 pixels resizes to 120x180 pixels) of vehicles seen of face, more or less near, parked either in the street or in a car park, with a negligible slope.

Let us note that in our system we will divide in a random way the unit of our database into two:

1) A base of Training on which we regulate all the parameters and thresholds necessary to the system so as to obtain the best results.
2) A base T by which we will test all our programs.

The images employed have characteristics which limit the use of certain methods. In addition, the images are in level of gray, which eliminates the methods using color spaces.

Figure 1: Some examples from the database training.

III. LICENSE PLATE CHARACTERS EXTRACTING

Our algorithm is based on the fact where an area of text is characterized by its strong variation between the levels of gray and this is due to the passage from the text to the background and vice versa (see fig. 1.). Thus by locating all the segments marked by this strong variation and while keeping those that are cut by the axis of symmetry of the vehicle found in the preceding stage, and by gathering them, one obtains blocks to which we consider certain constraints (surface, width, height, the width ratio/height,…) in order to recover the areas of text candidates i.e. the areas which can be the number plate of the vehicle in the image.

Figure 2: Extracting of license plate.

We digitize each block then we calculate the relationship between the number of white pixels and that of the black

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pixels (minimum/maximum). A matrix based approach has been utilized in this case. This report/ratio corresponds to the proportion of the text on background which must be higher than 0.15 (the text occupies more than 15% of the block).

First, the block of the plate detected in gray will be converted into binary code, and we construct a matrix with the same size block detected. Then we make a histogram that shows the variations of black and white characters.

To filter the noise, we proceed as follows: we calculate the sum of the matrix column by column, then we calculate the min _sumbc and max_ sumbc representing the minimum and the maximum of the black and white variations detected in the plaque.

To define each character, we detect areas with minimum variation (equal to min _sumbc). The first detection of a greater variation of the minimum value will indicate the beginning of one character. And when we find again another minimum of variation, this indicates the end of the character. So, we construct a matrix for each character detected.

The Headers of the detected characters are considered as noise and must be cut. Thus, we make a 90 degree rotation for each character and then perform the same work as before to remove these white areas. after this we will be available with the character. We match this character set with the predefined database to get the exact output character.

I. PROPOSED METHOD

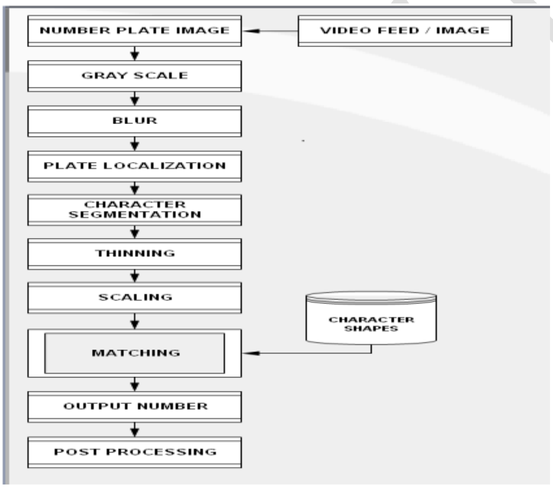


Figure 3. Implementation Algorithm

On observing a great deal of edge maps in scene text and video text images, we summarize three prominent characteristics of text regions. First, the test regions have dense and strong edge pixels. Second, the edge orientations of text region are highly variable. Third, because characters are made up of strokes, the stroke edges always appear in pairs with opposite gradient direction. Inspired by the above observations, we devise our text detection method by extracting features highlighting these text and stroke characteristics.

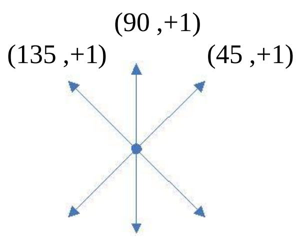
The block diagram of our video text detection system is shown in Fig. 1. The input to the system is a text image sequence, and the output is a sequence of number strings. We sample one frame per three, and each sampled frame is processed by edge detection, text confidence map (TCM) generation, and candidate text region detection. Moreover, the final text region image is refined by multiple frame integration (MFI).

A. Edge detection

The richness of edges is an effective and efficient characteristic of text regions and have widely adopted for text detection. The edge strength is a widely used feature and have shown promising performance [1][2]. Moreover, due to the variable shapes of characters and strokes, the edges in text regions often show high variance of orientations (usually quantized into four orientations: horizontal, vertical, up-right and up-left) [1].The edges may vary according to the shape of the vehicle.

In addition to edge strength and variance of orientations, our method makes use of more characteristics of text edges. It has been observed that strokes not only have multiple orientations, but also have nearly constant width (though it is unknown a priori) [9][11][12]. The double edge with opposite gradient directions has also been observed and utilized in text detection [10-12]. We call this as opposite edge pair (OEP) (Fig. 2) and measure it in a computationally efficient manner.

As a pre-processing step, we first extract the edges of each frame image using the Sobel operator; calculate the strength and direction of gradient for each edge pixel. The gradient direction is quantized into eight directions, represented by two parameters , as shown in Fig. 4. represents the quantized orientation of edge pixels (0,45,90,135); represents polarity of orientation (1, 1 , “+1” denotes up-right, “-1” denotes down-left).



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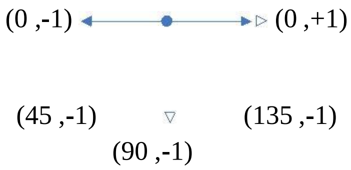

Figure 4. Edge gradient directions represented by, .

B. *Text Confidence Map Generation*

The text confidence map (TCM) is a gray-scale image with the same size as the input image, measuring the probability that each pixels belongs to text region. Based on the TCM, text candidate regions detection and grouping become easier than that on the original image. We generate the TCM taking into account three features based on edges: edge density, variance of edge orientation and the number of OEP. The last feature, OEP number, characterizes the nature of strokes.

C. *Candidate Region Generation*

Since the intensity of the text confidence map represents the possibility of text, OTSU algorithm and connected component analysis (CCA) are used to get highlight candidate text region. Then, each candidate region is enclosed in a boundary box (text box). Though our confidence map is fairly accuracy, there still exist a few falsely alarm blocks. Therefore, two constraints are used to filter out those text blocks which are too small to contain text.

These two constraints are defined as follows:

in $text\_box\_width, text\_box\_height \quad t_1$, (8)

max $text\_box\_width, text\_box\_height \quad t_2$, (9)

where t1and t2are predefined threshold, and the values of them are determined by the size of text in the video frame.

D. *Text Region Refinement*

In order to calculate the duration of a candidate text, we need to get its beginning frame and ending frame. In our system, when a candidate text region is firstly detected in a frame, we defined this frame as its beginning frame. After getting the beginning frame, whether the following framesis the ending frame is judged by following two steps.

II. Proposed Software Design

Interactive software is developed to do the reliable monitoring and management of number plate recognition system using stroke method. We use the object oriented programming language C++ and java to develop the algorithm. We are implementing edge detection algorithm using the sobel edge operator. Dynamic region merging algorithm and nearest neighbor graph on color image. This operation is totally software part. In the proposed method we will compare the value of each segment with the corresponding database value.. While implementing the system we are using component analysis method which represent the probability of accepting an "inconsistent" model as "consistent" and rejecting a "consistent" model as "inconsistent" .Matrix value determines the most possible solution. Output at each stage will be monitored and will be compared with the defined database.

III. RESULT

In order to evaluate the performance of the proposed approach, we took the experiments on local database [17]. There have been some other datasets for text detection in the literature, but they are either very small or not publicly available. local database was created on the own machine and includes fifty images containing English (Numeric and Alphabet) and a few digital texts, in which the size of text frame are 624*352, 720*416, 576*304, and 608*366, we normalize the height of all the text frames to height of 352 pixels and proportional to width for obtaining the computation time equitable. Here, we divide the experiments into two phases. The first phase focuses on the validity of f EOV and f OEP . The second phase focuses on the performance of our method.

IV. CONCLUSION

In this work, a system for recognizing the number of a license plate with Indian text style was designed. For this goal, we used 50 images of license plates, from which we received 1200 images of digits. These images were taken as earlier during the experiment as the sample images.

Our algorithm of license plate recognition, allows to extract the characters from the block of the plate, and then to identify them using artificial neural network and fast stroke

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method.. The experimental results have shown the ability of VDE to recognize correctly characters on license plate with probability of 87% more than existing system which has a weaker performance of 80%.

The proposed approach of license plate recognition can be implemented by the police to detect speed violators, parking areas, highways and toll collection. Also the prototype of the system is going to be integrated and tested as part of the sensor network which has been utilized on many indian roads.

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References

[1] Bo Bai and Cheng-Lin Liu, *NLPR: A Fast Stroke-Based Method for Text Detection in Video*. Beijing Chaina: Prentice-Hall, 2012.

[2]L. Ladicky, C. Russell, P. Kohli, and P. Torr, “*Associative hierarchical CRFs for object class image segmentation*,” in *Proc. ICCV*, 2009, pp.

[3] J. Canny, “A computational approach to edge detection,” *IEEE Trans. Pattern Anal. Mach. Intell.*, vol. PAMI-8, no. 6, pp. 679–698, Nov.1986739–746.

[4] R. C. Gonzalez and R. Elwood, *Digital Image Processing*. Reading, MA: Addison-Wesley, 1992.

[5] L. Zhang and B. Paul, “Edge detection by scale multiplication in wavelet domain,” *Pattern Recognition. Lett.*, vol. 23, no. 14, pp.1771–1784, Dec. 2002.

[6] B. Paul, L. Zhang, and X.Wu, “Canny edge detection enhancement by scale multiplication,” *IEEE. Trans. Pattern Anal. Mach. Intell.*, vol. 27, no. 9, pp. 1485–1490, Sept. 2005.

[7] Dorin Comaniciu, Peter Meer, “Mean Shift Analysis and Applications”.

[8] S. Thilagamani1 and N. Shanthi, “A Survey on Image Segmentation Through Clustering”, International Journal of Research and Reviews in Information Sciences Vol. 1, No.

[9] F. Lecumberry, A. Pardo, and G. Sapiro, “Simultaneous object classification and segmentation with high-order Wesley, 1992.multiple shape models”, *IEEE Trans. Image Process.*, vol. 19, no. 3, pp. 625–635, Mar. 2010.

[10] R. C. Gonzalez and R. E. Woods, *Digital Image Processing*. Reading, MA: Addison

[11] National Programs on Technology Enhanced learning http://nptel.iitm.ac.in/courses/106105032/39,

[12] R. Nock and F. Nielsen, “Statistic region merging,” *IEEE Trans. PatternAnal. Mach. Intell.*, vol. 26, no. 11, pp. 1452–1458, Nov. 2004.

[13] K. Haris, S. N. Estradiadis, N. Maglaveras, and A. K. Katsaggelos,“Hybrid image segmentation using watersheds and fast regionmerging,” *IEEE Trans. Image Process.*, vol. 7, no. 12, pp. 1684–1699,Dec. 1998.

[14] P. F. Felzenszwalb and D. P. Huttenlocher, “Efficient graph-basedimage segmentation,” *Int. J. Computed. Vis.*, vol. 59, no. 2, pp. 167–181,Sep. 2004.

[15] B. Peng, L. Zhang, and J. Yang, “Iterated graph cuts for image segmentation, ”in *Proc. Asian Conf. computed. Vis.*, 2009, pp. 677–686

[16] D. Comanicu and P. Meer, “Mean shift: A robust approach toward featurespace analysis,” *IEEE Trans. Pattern Anal. Mach. Intell.*, vol. 24, no. 5, pp. 603–619, May 2002.

[17] D. Eppstein, M. S. Paterson, and F. F. Yao, “On nearest-neighborgraphs,” *Discr. Comput. Geom.*, vol. 17, no. 3, pp. 263–282, Apr.1997.

[18] A. Wald, *Sequential Analysis*, 3rd ed. Hoboken, NJ: Wiley, 1947.