A NOVEL METHOD FOR CHARACTER SEGMENTATION OF VEHICLE LICENSE PLATES

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Abstract

Segmentation is a part of License Plate Recognition (LPR) technique, used to find out a vehicle by its number plate without direct human involvement. Segmentation is a process of partitioning a digital image into multiple segments. The objective of segmentation is to simplify and/or change the representation of an image into something that is more expressive and easier to analyze. The proposed algorithm focuses on segmenting the characters of two rows license plate image. Before the segmentation algorithm is applied, the License plate must be localized correctly by using localization algorithm.

Keywords: *License plate, two rows, segmentation*

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1.INTRODUCTION

The recognition of specific object in an image is one of the most challenging tasks in the field of computer vision or digital image processing. Automatic License Plate Recognition (ALPR) is a very interesting area, which includes finding license plate area and recognizes the characters from license plate image. License plate extraction is widely used for detecting high speed vehicles, security control in restricted areas, unattended parking zone, traffic law implementation and electronic toll collection. Recently the necessity of ALPR has increased significantly. This system must guarantee robust extraction under various weather and lighting conditions, independent of orientation and scale of the plate.

A lot of work has been done to segment the characters written in one row, but this paper is mainly concentrating on the character segmentation of license plates written in two rows without any chunk.

2. APPLICATION

Automatic License Plate Recognition (ALPR) system is mostly used in Intelligent Transportation System. ALPR is important in the area of high way toll collection, traffic conjunctions, borders and custom security, highly secured areas like restricted areas, V.I.P houses, etc.

3. RELATED WORK

Different techniques are developed for license plate extraction. Every character on detected license plate is segmented in character segmentation step. Segmentation, method based on projection analysis, Hough transform, connected components are proposed in the text. Xinanjilan He et al[1] used horizontal and vertical projection analysis for character segmentation . W. Q. Yuan et al [2] developed connected components method for character segmentation. Yuangang Zhang et al [6] developed character segmentation using Hough transform. In this horizontal edges of the plate area were decided initially, using Hough transform which helped to segment the character with rotation. This is for single line license plates only.

4. PROPOSED SYSTEM

This work of ALPR is concentrating on segmentation of vehicles license plate, mainly written in two rows. In this the characters of license plates are segmented without any chunk. Since Binarization method is applied before segmentation A clear segmentation is possible. Noise removal is also applied. For that weighted medianfilter is used. Finally zone segmentation is applied.So more effective segmentation with a very high speed can be obtained.

4.1 Acquisition of the Input Image

License plate image is acquired from the vehicle for further processing. For this process, any of the localization algorithms which will localize the License plate correctly from the vehicle can be used. We are not concentrating on this part. Also not concentrating on the correction techniques

4.2 RGB to Gray Scale Conversion

The color image is converted into Gray Scale Image. To convert any color to a grayscale demonstration of its luminance, initially obtain the values of its red, green, and blue (RGB) primaries in linear intensity encoding, by gamma expansion. Then, add together 30% of the red value, 59% of the green value, and 11% of the blue value (these weights depend on the exact choice of the RGB primaries, but are typical). Regardless of the scale employed (0.0 to 1.0, 0 to 255, 0% to 100%, etc.), the resultant number is the desired linear luminance value; it typically needs to be gamma compressed to get back to a conventional gray scale representation. By human eye method,

Gray = 0.2989 * Red + 0.5870 * Green + 0.1140 * Blue

To convert a gray intensity value to RGB, simply set all the three primary color components red, green and blue to the gray value, correcting to a different gamma if necessary.

4.3 Binarization using Thresh Hold Value

It is the pre-processing step before the segmentation of the characters start. In the course of the thresholding process, individual pixels in an image are marked as "object" pixels if their value is greater than some threshold value (assuming an object to be brighter than the background) and as" background"pixels set otherwise. This concord is known as threshold above. Variants include threshold below, which is opposite of threshold above; threshold inside, where a pixel is labelled "object" if its value is between two thresholds; and threshold outside, which is the opposite of threshold inside .Typically, an object pixel is given a value of “1” while a background pixel is given a valueof “0.” Finally, a binary image is created by coloring each pixel white or black, depending on a pixel's labels.

The key parameter in the thresholding process is the choice of the threshold value. Several different methods for choosing a threshold exist; users can manually choose a threshold value or a thresholding algorithm can compute a value automatically, which is known as automatic thresholding.

A simple method would be to choose themean or median value, the rationale being that if the object pixels are brighter than the background, they should also be brighter than the average. A more erudite approach might be to create a histogram of the image pixel intensities and use the point which has the minimum intensity value as the threshold. The histogram approach assumes that there is some average values for both the background and object pixels, but that the actual pixel values have some variation around these average values. However, this may be computationally expensive, and image histograms may not have clearlydefined valley points, often making the selection of an accurate threshold difficult.

By default the destination image bounds are equal to those of the source image

# white color ----1

# black color-----0

For noise removal Centre Weighted median filter is applied. Noise spikes are normally expressively brighter or darker than their neighbouring pixels. Centre weighted median filter is used to keep the shape of the character stroke much better. Only in a black and white image noise removal can be done effectively without affecting the character pixels.

Binarization is performed so as to convert the RGB and gray scale images to the black and white pixel images. Only in a black and white image noise removal can be done efficiently without affecting the character pixels.

The pseudo code for “binarize” is as follows

```
Dist(x,y)=src(x,y)>=threshold ? 1:0
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In current techniques, the binarization (threshold selection) is usually accomplished either globally or locally. Some hybrid approaches have also been proposed. The global methods use one calculated threshold value to divide image pixels into object or background classes, whereas the local schemes can use many different adapted values selected according to the local area information. Hybrid methods use both global and local information to decide the pixel label.

The most conventional approach is a global threshold, where one threshold value (single threshold) is selected for the entire image according to global/local information. In local thresholding the threshold values are determined locally, e.g. pixel by pixel, or region by region. Then, a specified region can have ‘single threshold ' that is changed from region to region according to threshold candidate selection for a given area.

The formula to binarize each pixel x is defined as

$$b(x)=\begin{cases} 0, & \text{if } \mathrm{gray}(x) < \mu_r(x) - k.\sigma_r(x); \\ 255, & \text{if } \mathrm{gray}(x) > \mu_r(x) + k.\sigma_r(x); \\ 100, & \text{otherwise,} \end{cases}$$

Where $\mu_r(x)$ and σ_r (x) are the intensity mean and standard devaiation of the pixels within a r- radius window centred on the pixel x and the smoothing term k is empirically set to 0.4. After binarization, connected components with 0 or 255 value are extracted as candidate text components and those value 100 are not considered further.

4.4 Noise Removal

Noise removal can be done by using Weighted average Filter. The median filter replaces each pixel in the input image by the median or gray levels in the neighbourhood. Thus it leads to smoothing and hence reduces noises.

If the number of pixels, K in a window is odd, the median is said to be the (K+1)/2 largest value.

The number of comparison needed to find median in this case :

$$N= 3(K^2-1)/8$$

The median filters have excellent noise reduction capability they are very effective in reducing salt and pepper noise and also used to remove some types of random noise.

4.5Algorithm for Noise Removal

Input: Document image affected by noise

- Centre weighted median filter has been used to remove noise.
- (3*3) mask has been selected.
- Pixels are sorted in order.
- Weights are given for each pixel and centre pixel is given highest weight.
- Median value of the pixels has been found.
- Median value is assigned to the centre pixel of the group.
- Pixel whose weight is lesser than median has been rejected.

Output: Document image cleared from noise

The formula for centre weighted median filter is

$$v_i(n) = \text{median}\begin{bmatrix} b_i(n-N), \dots \\ , b_i(n) \quad b_i(n), \dots b_i(n), \quad b_i(n+1), \dots b_i(n+N) \end{bmatrix}$$

4.6 Segmentation

Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. More specifically, image segmentation is the process of conveying a label to every pixel in an image such that pixels with the same label share certain visual characteristics.The result of image segmentation is a set of segments that jointly cover the entire image, or a set of contours extracted from the image. Each of the pixels in a region are similar with respect to some characteristic or computed property, such as color, intensity, or texture. Adjacent regions are significantly different with respect to the same characteristic(s). When applied to a stack of images, typical in medical imaging, the resulting contours after image segmentation can be used to create 3D reconstructions with the help of interpolation algorithms like Marching cubes.

After pre-processing, the noise free image is passed to the segmentation module, where the image is decomposed into wordsto segment the document image into several text lines.The number of rows are found by horizontal projection method which is computed by a row-wise sum of black pixels.The space where the number of black pixel is minimum is considered to be the separation between two lines. The position between two consecutive horizontal projections where the histogram height is least denotes one boundary line. Using these boundary lines, document image is segmented into several text lines. Similarly, to segment each text line into several text words, we use the valleys of the vertical projection of each text line obtained by calculating the column-wisesum of black pixels. The position between two consecutive vertical projections where the histogram height is least indicates one boundary line. Using these boundary lines, every text line is segmented into several text words. Then we can segment each character separately.Figure shows the processing of segmentation.

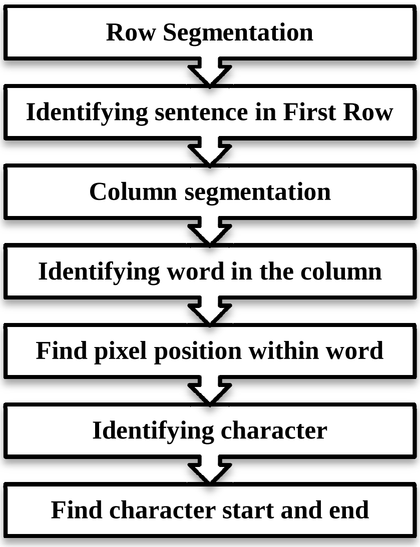
Row Segmentation
Identifying sentence in First Row
Column segmentation
Identifying word in the column
Find pixel position within word
Identifying character
Find character start and end

Fig.1. Processing of segmentation

4.7 Algorithm for Segmentation

Input: Binarized image

* First line has been identified.
* Inter line spacing has been calculated.
* First pixel in the line has been identified.
* Inter word spacing has been calculated.
* First pixel within a word boundary has been identified.
* Inter character spacing has been calculated.
* Trimming of characters to their exact width and height has been performed.

Output: Character segmented image

4.8 Zone Segmentation

Once the characters are mined from words, spaces on both the sides of the characters are trimmed to extract the exact black pixel density. Next, total character has been divided into four zones and black tone and white tones of every zone have been seized. Applying a single horizontal and vertical bisection over the character four zones are obtained. Figure shows the processing of zone segmentation. The character image of I*J pixels is divided into 2*2 grids. One Horizontal projection is applied over a character for the entire trimmed width of the character and one Vertical projection is applied for the entire trimmed height of the character.

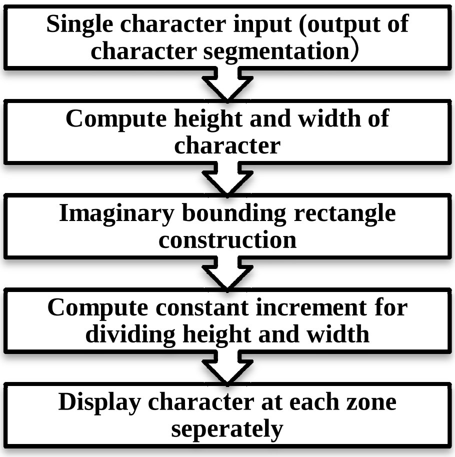
Single character input (output of character segmentation)
Compute height and width of character
Imaginary bounding rectangle construction
Compute constant increment for dividing height and width
Display character at each zone seperately

Fig.2. Processing of zone segmentation

The figure shows the character “C” on which zone segmentation is applied. The algorithm for zone segmentation is simple and performance of the system depends upon the number of zones for which segmentation is done. However this system works on just four zone segmentation.

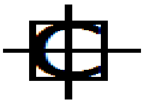

Fig.3.Sample image for zone segmentation

4.9 Algorithm for Zone Segmentation

Input: Complete character

* Constant increment has been calculated to segment the width into two zones.
* Constant increment has been calculated to segment the height into two zones.
* Pixel in each zone has been extracted
* Shape obtained in each zone has been reported.

Output: Character segmented into four zones

5. EXPERIMENTAL RESULTS

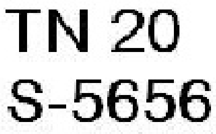

Fig.5. Sample Input 1

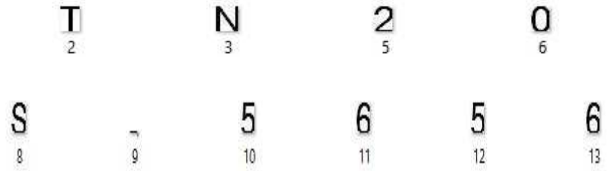

Fig.6. Segmented Characters

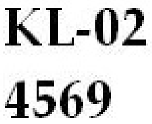

Fig.7. Sample Input 2

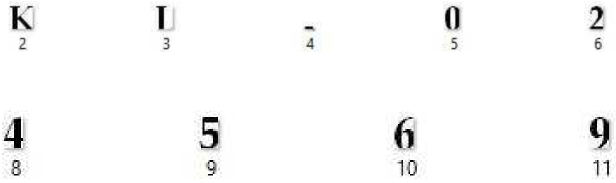

Fig.8.Segmented Characters

CONCLUSIONS

Most of the existing character segmentation algorithm will segment the characters of licence plate image containing single row. In this paper, we presented application software designed to overcome the drawbacks of the existing segmentation algorithms and segment the characters from the license plate image containing single row as well as two rows. Segmenting as a chunk is completely avoided here and the speed of segmentation is also considerably high. The zonal segmentation gives a more effective segmentation.

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