ISSN 2278-3091

International Journal of Advanced Trends in Computer Science and Engineering, Vol.5 , No.1, Pages : 46 -50 (2016)
Special Issue of ICACEC 2016 - Held during 23-24 January, 2016 in Institute of Aeronautical Engineering, Quthbullapur, Telangana-43, India

AUTOMATIC LICENSE PLATE DETECTION AND CHARACTER RECOGNITION IN LICENSE PLATE

ANILGANTALA[1], DASARI SWATHI[2],J SRAVANA[3],PAPARAO NALAJALA[4]

Asst. Professor, Dept. of Electronics &Communication Engineering at Institute of Aeronautical Engineering, anil.gantala@gmail.com

Asst. Professor, Dept. of Electronics &Communication Engineering at Sreyas institute of technology, dasariswathi3@gmail.com

Asst. Professor, Dept. of Electronics &Communication Engineering at Institute of Aeronautical Engineering, sravana02@gmail.com

Asst. Professor, Dept. of Electronics &Communication Engineering at Institute of Aeronautical Engineering, nprece@gmail.com

Abstract: The main motivation of this project is that an efficient detection and character recognition in the license plate. The algorithm should be robust against distortions caused by variations in illuminations and rotations and colours in the license plate.

Automatic License Plate Detection and Character Recognition in the license plate is a mass surveillance system that captures the image of vehicle and recognize the license plate characters. This system can be assisted in the detection of stolen vehicles and vehicles which overrides the traffic rules. The detection of stolen vehicles and vehicles which overrides the traffic rules can be done in an efficient manner by using this system located in the highways. In This recognition method in which the vehicle plate image is obtained by the digital cameras and the image is processed to get the number plate information. A rear image of a vehicle is captured and processed using various algorithms. In this context, the number plate area is localized using a "novel morphological-based number plate localization" method.In the above method height by width ratio of connected components is calculated and by this approach license plate region is detected and segmentation of license plate characters can be done by label the connected components and recognition of characters are done by template matching technique in this correlation between the templates of the characters and license plate characters is calculated. For which correlation is more that characters are detected this process is repeated for all the characters in the license plate. In the above process about 92% license plates can be detected effectively.

***Keywords*:** OCR Optical character recognition, SVM Support vector machine, MSER Maximally Stable External Regions, SCW sliding concentric windows

INTRODUCTION

In literature, many license plate detection algorithms have been proposed. Although license plate detection has been studied for many years, it is still a challenging task to detect license plates with different poses, partial occlusion or multiple instances. License plate detection investigates an input image to identify some local patches containing license plates. Since a plate can exist anywhere in an image with various sizes, it is infeasible to check every pixel to locate it. Generally, it is preferable to extract some features from images and focus only on those pixels characterized by license plate. Based on the involved features, traditional license plate detection methods can be classified into three categories: color-based, edge-based and texture-based. In the following, we will review the related works of each category. Color-based approaches are based on the observation that some countries have specific colors in their license plates. It is intuitive to extract license plate by locating their colors in the images. In [8][9], a test image is checked with a classifier of color model. Then, candidate regions from the classification results are verified with some post-processing to locate the plates. In [10][11], a color interval is determined from a mapping function to label potential regions of license plate. In [12], the collocation of license plate color and character color is used to generate an edge image. Then, it checks neighbors of pixels with value within the license plate color range to find candidate license plate regions. In [13], the color of each pixel in the image is identified using characteristic function. Then a series of morphological operations are used to merge the same plate color pixels into separate candidate areas. The license plate is then extracted from candidates using the prior knowledge of its position in the image. In [14]color images are segmented by the Mean Shift algorithm into candidate regions, which are subsequently classified as with or without plate. Then, a feature combination of rectangularity, aspect ratio, and edge density is exploited to determine the candidate regions. To address the effect of illumination variation,

By above different methods I concluded that each method has its merits and demerits.

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IMPLEMENTATION

Yellow colour region extraction of car image: to extract the yellow colour region in an image first the rgb image is converted in the to cie-xyz space model. In the cie-xyz model the yellow colour region in the extracted image. By using below formula the yellow colour region is going to extract.

The rgb image is converted into xyz-space model by using below formula

x = (pic(:,:,1).*0.412453 + pic(:,:,2).*0.35758 + pic(:,:,3).* 0.180423)

y = (pic(:,:,1).*0.212671 + pic(:,:,2).*0.715160 + pic(:,:,3).* 0.072169)

z = (pic(:,:,1).*0.019334 + pic(:,:,2).*0.119193 + pic(:,:,3).*0.950227)

By converting it into below model rgb image is converted into cie-xyz space model. By summing all the pixels of an image the value of all pixels is calculated.

Sum = x + y + z

x_bar = x. /sum, y_bar = y. /sum

Then the yellow colour region is going to extract by using below threshold values in the above operations. For the two dimensional image.

x_sum_conds = (((x_bar > 0.34) & (sum > 400) & (sum < 500)) | ((x_bar > 0.37) & (sum > 200) & (sum < 500)))

xy_conds = ((y_bar > 0.35) & (y_bar < 0.5) & (y_bar > (lower_A*x_bar + lower_B)) & (y_bar < (upper_A*x_bar + upper_B)))

y_image = (x_sum_conds & xy_conds)

By above process the given image extract the yellow colour region in the given image. But the disadvantage with the above process it is unable to recognize the other vehicle license plates except yellow colour. So the above algorithm has limited applications in the real time scenario. To overcome the above limitations I implemented another algorithm which can recognize all the vehicle license plates .it has more advantages compared to previous method.

Fig: 1 Design and Implementation

PROBLEM IDENTIFICATION

By the above process license plate region is extracted.ie extracting yellow colour region in the license plate.

Fig. 2 License plate regions

Rotation of an image-1

If the image is having any angle deviation it should be rotate to corresponding angle.and fix the license plate horizontally so that the licence plate can be ready to do any further morphological operations .

Fig.3 Yellow region rotated

Dilation of an image-1

By using the dilation operation if any connectivity lost between the components that can be connected. The dilation operation occurs by below process. The opening off set X by structuring element B Is denoted an $X \oplus B$, is defined .$X \oplus B = X + b = \{ x + b : x \in X \& b \in B\}$.

If X is any gray scale shape and B is symmetric structuring element. The output of dilation is the set of translated points such that translate of the reflected structuring element has a non-empty intersection with **X**.This equation is based on obtaining the reflection of B about its origin and shifting this reflection by b. this dilation of X by B then is the set of all displacements, b, such that x and b overlap by at least one element. One of the simplest applications of dilation is for bridging gaps. The structuring element has used for repairing the gaps. The gap shave been bridged.

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Fig. 4 Yellow regions dilated

Improved license plate of image-1 region

After dilation process the improved license plate region is shown in below Fig..

Fig. 5 Improved license plate regions

Cropped license plate of image-1 image

After the improving the license plate region the unwanted region in the license plate can be eliminated by using the cropping operation. By this operation the desired region in the license plate can be enhanced in the further process.

Fig. 6 Cropped yellow colour license plate image

Gray scale image of license plate of image-1

In photography and computing,a gray scale or grey scale digital image is an image in which the value of each pixel is a single sample, that is, it carries only intensity information. Images of this sort, also known as black-and-white, are composed exclusively of shades of gray, varying from black at the weakest intensity to white at the strongest.

Gray scale images are distinct from one-bit bi-tonal black-and-white images, which in the context of computer imaging are images with only the two colours, black, and white . Gray scale images have many shades of gray in between.

The intensity of a pixel is expressed within a given range between a minimum and a maximum, inclusive. This range is represented in an abstract way as a range from 0 (total absence, black) and 1 (total presence, white), with any fractional values in between. This notation is used in academic papers, but this does not define what "black" or "white" is in terms of colorimeter.

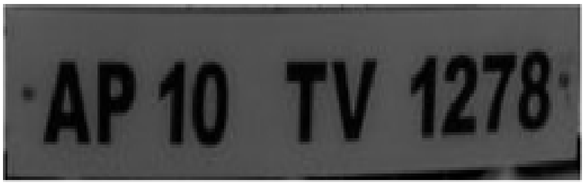

Fig.7 Gray scale image of yellow colour license plate

Binary image of license plate of image-1

The above grey image is converted into binary image by changing the image intensity values into 0 and 1.0 represents black image 1 represents white. If the image pixel intensity less than threshold that is converted to black and the value is greater than threshold that pixels converted into white. By above process the image becomes in the below Fig..

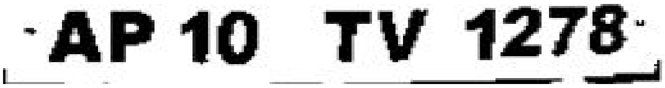

Fig. 8 Binary image yellow colour license plate

Normalization of license plate of image-1

In order to arrange the license plate height and width normalization method is used.By this height and width of license plate can be arranged according to the requirement to get better results.

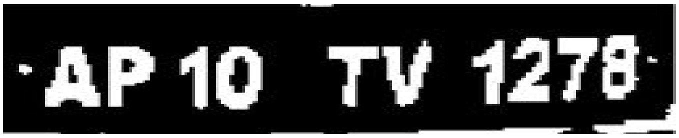

Fig. 9 Normalized yellow colour license plate

Horizontal contours adjustment of license plate of image-1

By this process contours of an image can be adjusted of a license plate. The license plate image start where the characters or numbers of a license plate. By above process elimination of unwanted components or unwanted region can be eliminated.

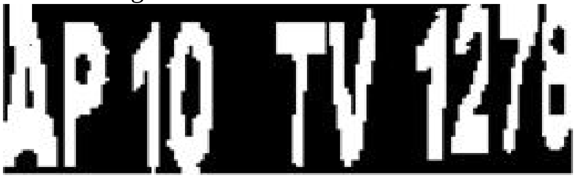

Fig. 10 Yellow colour license plate after horizontal contours adjusted

Segmentation of license plate of image-1

Connected components labelling scans an image and groups its pixels into components based on pixel connectivity, i.e. all pixels in a connected component share similar pixel intensity values and are in some way connected with each other. Once all groups have been

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determined, each pixel is labelled with a gray level or a colour (colour labelling) according to the component it was assigned to. After the Localization of the number plate of the vehicle involved, we need to recognize the number plate into a standard form. The vehicular number plates maybe of Non-standard forms and may vary in their fonts. If the number pixels connected in the extracted license plate are less than 50 pixels that object is eliminated. By above process noise or unwanted connected components can be removed. In the connectivity of labelled components 8-connectivity is used. It is an effective connectivity technique compared to 4-connectivity analysis. After connecting the license plate character components label the each character components.The next we have to recognize the extracted character components by using simple template matching technique.

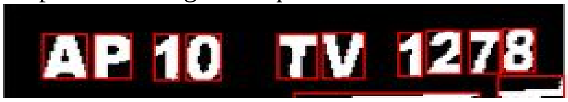

Fig. 11 Segmented characters of yellow colour license plate

Templates of characters and numbers

Templates of characters and numbers are taken and these are used to correlate with the numbers and characters of license plate.

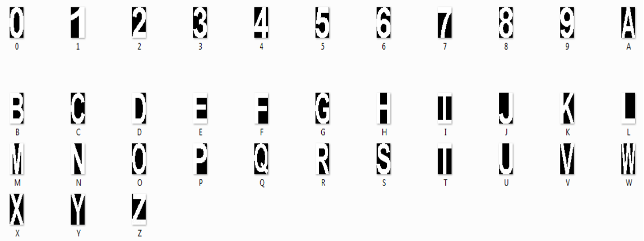

Fig. 12 Templates of characters and numbers

Template matching technique

There exist many techniques to perform OCR .The simplest way is to compare the picture with template pictures of each character and choose the most likely one.

This method is suitable to recognize highly structured text like in ALPR, where the font is known and the characters are structured with equal spacing and size together with a limited number of letters .If more fonts are possible characters and sizes were supposed to be recognizable, the number of templates to match with would grow fast and with that computational time as well as the risk of a mismatch. To support the template match decisions, simple feature extracting can be suitable to use. For instance, if it is hard to distinguish between F and P ,extra care should be taken to check the area of the P's etc.Methods that are most sophisticated can analyze the characters to find features like arcs, lines and circled, which combined, together forms the pattern of a certain letter. That method is more independent of size and font of the character, but it is on the other hand more sensible to noise. Many OCR techniques use knowledge about spelling and grammar to support their decision in difficult cases. In ALPR most combinations of letters can occur.The present implementation will use the simple and robust method of comparing the plate with predefined templates. The comparison is done with normalized correlation calculation to get the degree of match. The Indian license plate contains 10 numbers and 23 characters, since only capital letters are used and o and 0 are excluded due to the risk of misinterpretations. There also exist some yellow colour number plates for taxis and government number vehicles and white number plates for all other cases.

The technique used to compare the picture with the templates is normalized cross correlation. The correlation is performed with a template and a section of the picture, both of size M / N pixels. A general form is presented below where f* denotes the complex conjugate. Images are however always real valued why the conjugate can be ignored here. To get a uniform output with comparable degree of match normalized cross correlation is used instead since the ordinary correlation is used. Let F1 (j,k) and F2 (j,k) for $1 \leq j \leq J$ and $1 \leq k \leq K$ Represent two discrete images denoting the image to be searched and the template respectively. The normalized cross correlation between the image pair is defined as the for m=1, 2….M and n=1, 2, .N, where M and N are odd integers

$$R(m,n)=\frac{\sum_j \sum_k F_1(j,k)F_2(j-m+(M+1)/2,k-n+(N+1)/2)}{\left[\sum_j \sum_k |F_1(j,k)|^2\right]^{1/2}\left[\sum_j \sum_k |F_2(j-m+(M+1)/2,k-n+(N+1)/2|^2\right]^{1/2}}$$

First, the pixel-values of the images and templates are normalized to zero mean instead of being in the interval 0 to 255, i.e the mean value is calculated and subtracted from each pixel. The normalized cross correlation is calculated with where f and h now zero-mean valued arrays of the image and template data.

The resulting co-efficient c is in the interval -1 and 1 .In the application the result is scaled times one hundred and presented as a percentage. This is of course incorrect but the 0% results would be the result of a correlation between the template and a randomized noise image. The negative results occur only when there is more mismatch than randomness. If c equal to -1 occurs only if the image is equal to the negative image of the template. The incorrect value is good to present though, as the most probable template always has a positive match. The correlation coefficient is calculated for a sequence of positions in the picture for each template in order to find the best local match.

The third important thing in the OCR process, after choosing the templates and the technique to compare the templates with the picture, is the strategy in which way the matching is done. Here is specified where and which templates are matched against which part of the picture and in what order. When the first character is searched for the uncertainty of the position used. Therefore, a

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variable for the used. The variable specifies against how many positions the templates will be matched. For the first character the uncertainty is set to seven pixels. This means that in the search for the first character the whole set of templates must be matched against seven consecutive positions. The matching of the template is in other words started a few pixels to the right of the expected position, and then performed for as many positions to the left as the uncertainty variable specifies. When the first character is determined, the uncertainty is r each character is tested at each position in the uncertainty interval and the highest probability is stored along with its position in the uncertainty interval. When all templates have been tested for this position in the uncertainty interval. When all templates have been tested for this position, the highest character match is selected. The position of that character is then used as reference to step to the next position and the process is repeated. If the plate is wider than average is the step increased with one or two pixels. When all characters are matched, an array with the degree of match from all templates at each position of the plate is produced.

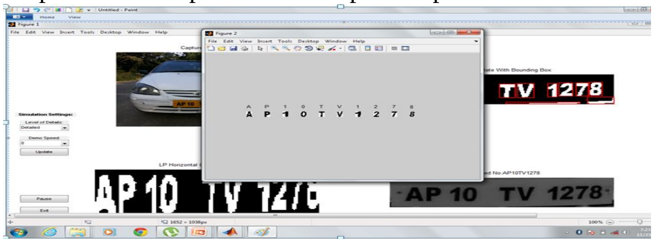

Fig. 13 detected and characters recognized yellow colour license plate

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AUTHORS BIOGRAPHY

Anil reddy G, Working as Asst. Professor in the Dept.of ECE at IARE,Hyderabad.1years Experience in relative field.he research interests includes Embedded systems Image processing and Communications

Swathi D Working as Asst. Professor in the Dept.of ECE at SRYS, Hyderabad. 1 years Experience in Teaching and 1 Years in Research.Her research interests includes Embedded systems, Image processing, Communications and Wireless sensor networks

J Sravana Working as Asst. Professor in the Dept.of ECE at IARE,Hyderabad.4years Experience in relative field.She research interests includes Embedded systems Image processing and Communications.

N.Papa rao Working as Asst. Professor in the Dept.of ECE at IARE,Hyderabad.5years Experience in relative field.he research interests includes Embedded systems Image processing and Communications