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DETECTION OF CAR-LICENSE PLATE USING MODIFIED VERTICAL EDGE DETECTION ALGORITHM

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Abstract - ***The Car License Plate detection and recognition system became an important area of research due to its various applications, such as the payment of parking fees, highway toll fees, traffic data collection, and crime prevention. There are many issues that to be resolved to create a successful and fast Car license plate detection system e.g., poor image quality, plate sizes and designs, processing time, and background details and complexity. To overcome these issues we proposed an algorithm called modified VEDA, for detecting vertical edge, which enhances the performance of the car license plate detection in terms of computation time and to increase the detection rate.***

Keywords— Edge Detection,License plate,Vertical edge detection algorithm, Modified VEDA.

I .INTRODUCTION

Localization of potential license plate regions(s) from vehicle images serves as a challenging task on account of huge variations of size, shape, colour, texture and spatial orientations of license plate regions in such images.Normally, objective of any Automatic License Plate Recognition (ALPR) system is to localize potential license plate region(s) from the vehicle images captured with a road-side camera and interpret them using an Optical Character Recognition (OCR) system to have the license number of your vehicle.Various techniques has already been developed recently for the exact purpose for efficient detection of license plate regions from offline vehicular images. Normally, most of the functions on ALPR systems apply edge based features for localizing standardized license plate regions.

Many of these works captures the image associated with a vehicle carefully placed when in front of a camera occupying the complete view of it and having a clear picture of the license plate. However in an unconstrained outdoor environment there may be huge variations in lighting conditions/ wind speed/ pollution levels/ motion etc. that produces localization of true license plateregions difficult.

M.Fukumi *et al*., 2000 have introduced a method to recognize characters of vehicle license plate in Malaysia by using a neural network based threshold method. For separation of characters and background, a threshold of digitalization is important and is determined using a three-layered neural network. Furthermore, in the extracted character portions, we segment characters and recognize them by obtaining their features[5].

H.Zhang *et al.,* 2008 have proposed a fast algorithm detecting license plates in various conditions. It defines a new vertical edge map, with which the license plate detection algorithm is extremely fast. Then construct a cascade classifier which is composed of two kinds of classifiers[9].

F.Shafait *et al*.,2011 have introduced Adaptive Binarization an important step in many document analysis and OCR processes. It describes a fast adaptive Binarization algorithm.That yields the same quality of Binarization as the Sauvola method, 1 but runs in time close to that of global Thresholding methods (like Otsu's method2), independent of the window size. The algorithm combines the statistical constraints of Sauvola's method with integral images.3Testing on the UW-1 dataset demonstrates a 20-fold speedup compared to the original Sauvola algorithm[7].

F.L Cheng *et al.,* 2012 have discussed a novel method to recognize license plates robustly are presented. First, a segmentation phase locates the license plate within the image using its salient features. Then, a procedure based upon feature projection estimate needs to separate the license plate into seven characters. Finally, the character recognizer extracts some salient features of characters and uses template-matching operators to get a robust solution[3].

This proposed method uses modified vertical edge detection algorithm to distinguish the plate detail region, particularly the beginning and the end of each character. Therefore, the plate details will be easily detected, and the character recognition process will be done faster. The VEDA is concentrates intersection of black-white and white-black regions.

II. SYSTEM DESIGN

I. A.Block Diagram
II. The flow diagram for detection of car-license late is shown in figure.

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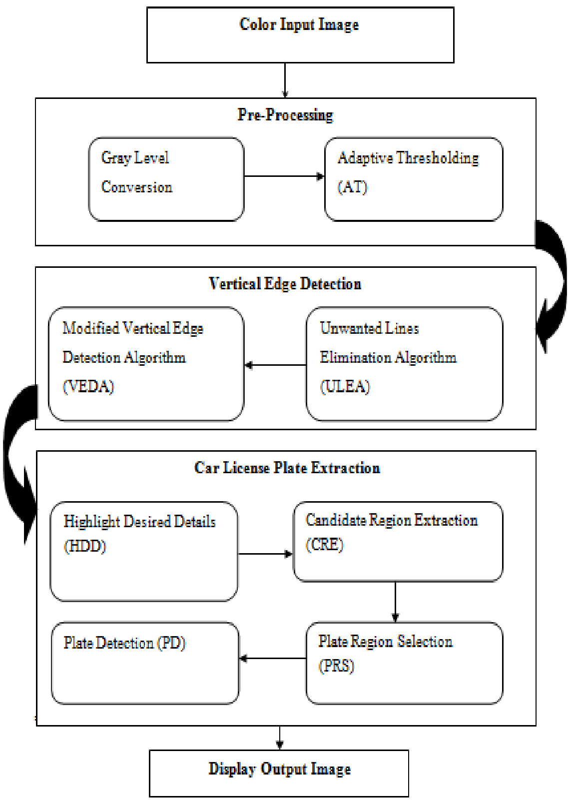

Fig 1. Detection of Car-License Plate

B. Pre-Processing

In image preprocessing, initially the RGB image is converted into gray scale image. And then Adaptive Thresholding Technique is applied on the image to constitute the binarized image. After that the Unwanted Lines Elimination Algorithm (ULEA) is applied to the image. This algorithm is considered morphological operations and enhancement process. It performs removal of noise and enhances the binarized image.

C. Segmentation

Edge detection is probably the most widely used operations in image analysis, and there are probably more algorithms within the literature for enhancing and detecting edges than any other detection approaches. This is due to the fact that edges establish the outline relevant to an object. An edge will be the boundary between a desire and to discover the background, and indicates the boundary between overlapping objects. Recently, license plate edge detection technique is a vital part of vision navigation, which is the key method of intelligent vehicle assistance. The detection outcome is seriously affected through quality of noise and image. This means that in the event the edges in an image can be identified accurately, all of the objects can easily be located andbasic properties such as area, perimeter, and shape can easily be measured.

i) Modified VEDA

VEDA (Vertical Edge Detection Algorithm) is applied to the ULEA output of the image. It performs to distinguish the plate detail region, particularly the beginning and the end of each character. Therefore, the plate details will be easily detected, and the character recognition process will be done faster. The VEDA is concentrates intersection of black-white and white-black regions. The center pixel of the mask is located at points (0, 1) and (1, 1). By moving the mask from left to right, the black–white regions will be found. Therefore, the last two black pixels will only be kept. Similarly, the first black pixel in the case of white–black regions will be kept.

Fig 2. a) Black –White b) White-Black Region

A 2 × 4 mask is proposed for this process.

0	x,y-1	x,y	x,y-1	x,y+2
1	x+1,y-1	x+1,y	x+1,y+1	x+1,y+2

a)

x,y-1
x+1,y+1

b)

x,y	x,y-1
x+1,y+1	x+1,y+1

c)

x,y+2
x+1,y+2

d)

Fig 3. Design of Proposed Mask

a) Moving Mask
b) left mask (0, 0), (1, 0)
c) Centre Mask (0, 1), (0, 2), (1, 1) (1, 2)
d) Right Mask (0,3),(1,3)

In this type of a mask, it is divided into three sub masks: The first sub mask is the left mask “2 × 2,” the second sub mask is the center “2 × 1,” and the third sub mask is the right mask “2 × 1”. Simply, after each two pixels are checked at once, the first sub mask is applied so that a 2 pixel width “because two column are processed” can be considered for detecting. This process is specified to detect the vertical edges at the intersections of black–white regions.

And unwanted vertical edges are removed from the image by using binary to open area operator. For Sobel, both vertical edges of a detected object have the same thickness. As VEDA’s output form, the searching process for the LP details could be faster and easier because this process searches for the availability of a 2 pixel width followed by a 1 pixel width to stand for a vertical edge.In addition,there is no need to search again once the 1 pixel width is faced. These two features could make the searching process faster.

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ii) Algorithm For Edge Detection

Input : Test number Plate Image.
Output : Segmented Image.
Step 1 : From the given image we are proposing 2 x 4 mask.
Step 2 : And this mask is divided into three sub mask, the first mask is the left sub mask of 2 x 1,the second sub mask is the center 2 x 2, and third sub mask is the right mask 2 x 1.

l=x(i,j-1)&&x(i+1,j-1)
m=x(I,j)&&x(i,j+1)&&x(i+1,j)&&x(i+1,y+1)
n=x(i,j+2)&&x(i+1,j+2)

Step 3 : Where x can be seen as rows or the height of a given image and y can be seen as Columns as well as width of a given image.
Step 4 : If four pixels of centre mask are black, then the other mask values are test to check whether they are black or not.
Step 5 : If the whole values are black, then the First column of the centre mask converted to white.
Step 6 : If the first column of the centre mask and any other column has different values, the pixel value of column one is taken.
Step 7 : This process is repeated with the whole pixels in the image.
Step 8 : And after we are checking for white pixels. If the mask contains less than five white pixels then we are using binary area open operator to remove unwanted Edges from the image.

BW2 = Bwareaopen (BW, P)

D. Extraction

i) Highly Desired Details (HDD)

Highlight the desired details such as plate details and vertical edges in the image. The HDD performs NAND–AND operation for each two Corresponding pixel values taken from both ULEA and VEDA output images. The HDD performs NAND–AND operation for each two corresponding pixel values taken from both ULEA and VEDA.

This process depends on the VEDA output in highlighting the plate region. All the pixels in the vertical edge image will be scanned.

When there are two neighbor black pixels and followed by one black pixel, as in VEDA output form, the two edges will be checked to highlight the desired details by drawing black horizontal lines connecting each two vertical edges.

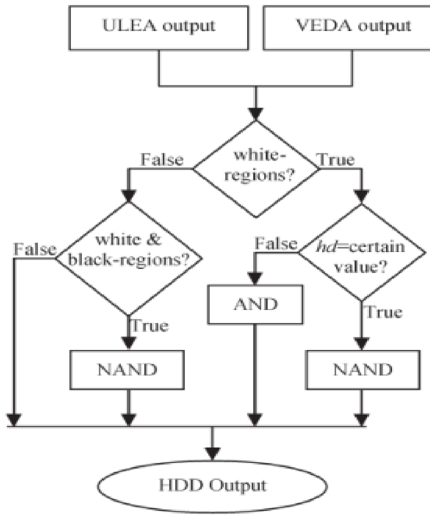

Fig 4. NAND- AND Procedure

ii) Candidate Region Extraction:

Candidates are extracted from the image using four steps. These are

1) Count the Drawn Lines per Each Row
2) Divide the image into Multi-groups
3) Count and store satisfied group indexes and boundaries
4) Select boundaries of candidate regions

Count the Drawn Lines per Each Row:

The number of lines that have been drawn per each row will be counted and stored in matrix variable HwMnyLines[a], where a = 0, 1. . . Height-1.

Divide the image into Multi-groups:

The huge number of rows will delay the processing time in the next steps. Thus, to reduce the consumed time, gathering many rows as a group is used here.Dividing the image into multi-groups by using

How many groups=Height/C

C- Number of lines in each group.

where how_mny_groups represents the total number of groups, height represents the total number of image rows, and C represents the candidate region extraction (CRE) constant. In this paper, C is chosen to represent one group (set of rows). For our methodology, C = 10 because each ten rows could save the computation time. In addition, it could avoid either loosing much desired details or consuming more computation time to process the image. Therefore, each group consists of ten rows.

Count and store satisfied group indexes and boundaries:

It is useful to use a threshold to eliminate those unsatisfied groups and to keep the satisfied groups in which the license plate details exist.

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Most of the group lines are not parts of the plate details. Therefore, it is useful to use a threshold to eliminate those unsatisfied groups and to keep the satisfied groups in which the LP details exist in. Each group will be checked; if it has at least 15 lines, then it is considered as a part of the LP region.

Thus, the total number of groups including the parts of LP regions will be counted and stored. This threshold (i.e., 15 lines) value is determined to make sure that the small-sized LP is included for a plate searching process. If the predefined threshold is selected with a less value than that given, wrong result can be yielded because noise and/or nonplate regions will be considered as parts of the true LP, even if they are not.

4) Select boundaries of candidate regions:

Draws the horizontal boundaries above and below of each candidate region. As shown, there are two candidate regions interpreted from horizontal-line plotting, and these conditions require an additional step before the LP region can be correctly extracted.

E) Localization

This process aims to select and extract one correct license plate. Some of the processed images are blurry, or the plate region might be defected. The plate region can be checked pixel by pixel, whether it belongs to the LP region or not. A mathematical formulation is proposed for this purpose, and once this formulation is applied on each pixel, the probability of the pixel being an element of the LP can be decided.

Plate region selection
Plate detection

For the candidate regions, each column will be checked one by one. If the column blackness ratio exceeds 50%, then the current column belongs to the LP region; thus, this column will be replaced by a vertical black line in the result image, Each column is checked by the condition that, if blckPix ≥ 0.5 × colmnHght, then the current column is an element of theLP region.

Here, the blckPix represents the total number of black pixels per each column in the current candidate region.

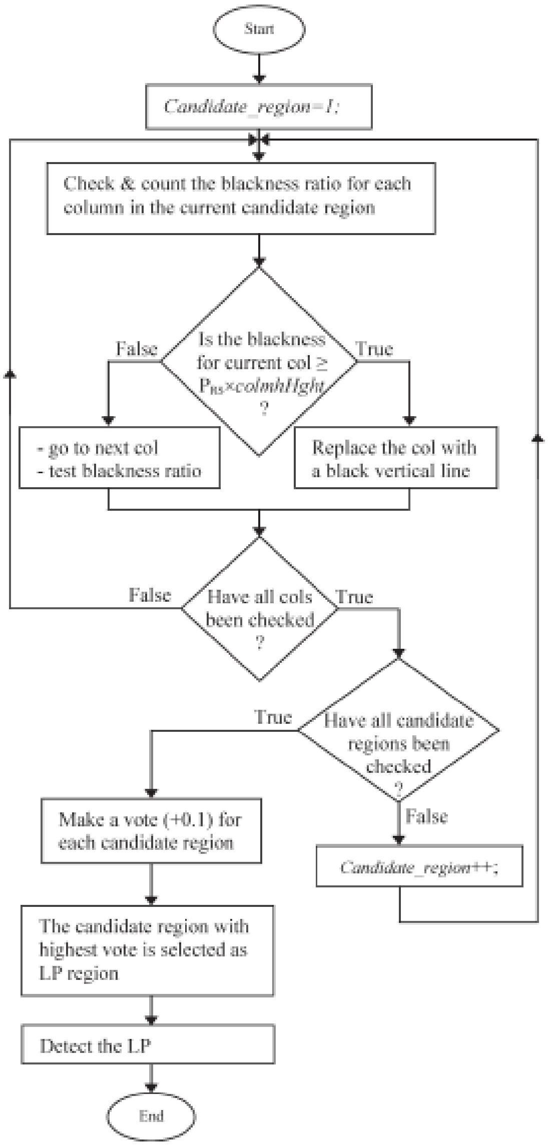

Fig 5. Flowchart of PRS and PD

The first part, the selection process of the LP region from the mathematical perspective only. The second part applies the proposed equation on the image. The third part gives the proof of the proposed equation using statistical calculations and graphs.

The fourth part explains the voting step. The final part introduces the procedure of detecting the LP using the proposed equation. The flowchart of plate region selection (PRS) and plate detection
(PD).

1) Selection Process of the LP Region.
2) Applying the Mathematical Formulation.
3) Making a Vote.

I. 1) Selection Process of the LP Region

The condition will be modified as followsblckPix ≥ PRS× colmnHght, where PRSrepresents the PRS factor.

2) Applying the Mathematical Formulation.

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After applying on the image that contains the candidate candidate regions , and output is obtained.
Making a Vote

The columns whose top and bottom neighbors have high ratios of blackness details are given one vote. This process is done for all candidate regions. Hence, the candidate region that has the highest vote values will be the selected region as the true LP.

III. RESULTS AND DISCUSSION

Detection of car-license plate using vertical edge detection algorithm and extraction was performed and the results are shown below.

Fig 6. Car Image

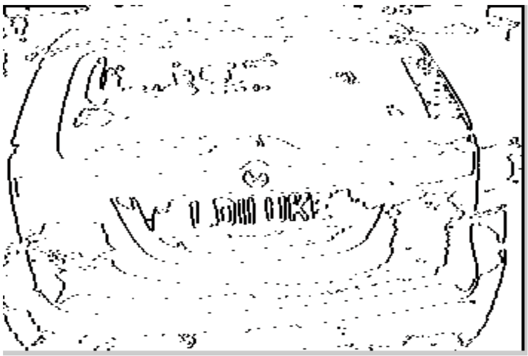

Fig 7.Application of vertical edge detection algorithm(VEDA)

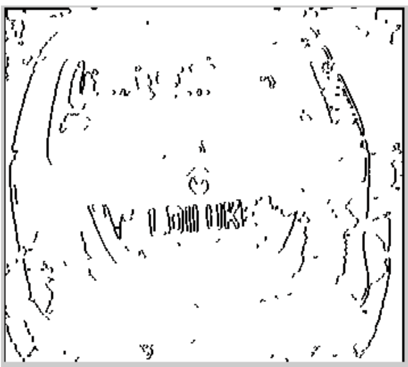

Fig 8. Modified VEDA

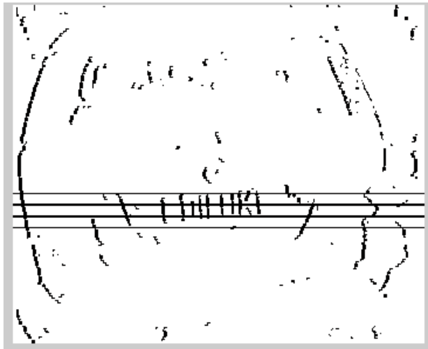

Fig 9. Candidate region extraction

Fig 10. Plate region selection

Fig 11. Plate Detection

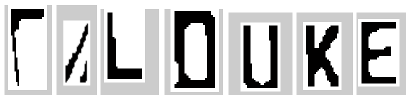

Fig 12. Localization

IV. CONCLUSION

A robust technique for license plate detection is presented here. It exploits the fact that the license plate area contains rich edge and texture information.First, the vertical edges are extracted and the edge map is adaptively binarized. Then, the license plate candidates are detected. The proposed way is tested on various images. It produced fairly and stable results. Consistent acceptable outputs over the various kinds of real life images have proved robustness of th proposed scheme. Thus, the proposed method could be handy for any computer vision task where extraction of edge maps is necessary to produce a large set of images for feature extraction .

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