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Car-License-Plate Detection Method Using Vertical-Edge-Detection and Canny Edge Detector

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Abstract: Automatic number plate recognition, Car License Plate Detection (CLPD) is a mass surveillance method that uses character recognition on images to read number plates. Existing system focused on character segmentation (CS) and License plate detection in the license plate (LP) recognition system,in which low contrast and dynamic-range problems occurs. In this paper we present a robust car license plate detection method using vertical edge detection algorithm (VEDA) and Canny edge detector. To extract number plate, first image binarization technique is applied.Then for reorganization of LP data, system starts character identification process which is based on VEDA and Canny Edge Detector. After character identification process, results of VEDA are compared with Canny Edge operator and VEDA results. Proposed method shows better accuracy as compare to VEDA alone.

Keywords: Car License Plate Detection (CPLD), VEDA, Character Recognition, Adaptive Thresholding(AT), unwanted-line elimination algorithm (ULEA), LP(license plate),Automatic license plate recognition(ALPR)

I. INTRODUCTION

In recent years, Intelligent Transport systems have a wide impact in peoples life as their improve scope of transportation safety and mobility to increase the productivity of users advanced technologies. Some of the companies and residential areas parking system can be done in many ways such as hiring security guards to give and then receive cards from car drivers using RFID technology etc. for more effectiveness CCTV's are installed to provide secure parking and to utilize the space properly but still have some drawbacks like time delay to check and get pass. The same issues are raised in highway tollgates and heavy traffic leads to huge maintenance issues. This paper describes to resolve all these issues based on Digital Image Processing technology is used to identify the vehicles by capturing their car license plates (CLPs).

The proposed number plates recognition is also known as Automatic number plate detection vehicle identification, for cars. Detection of car license plates region system consists of mainly three contribution, first one is binarization of input image (LP) by using adaptive threshold technique, then apply unwanted line elimination algorithm(ULEA) to remove the unwanted line and noise in binarized image. Then after that apply the segmentation technique for detecting the number plate region based on edges of characters starting region to ending region on number plate region. These methods are the most important part in the CLPD system because it affects the systems accuracy. Fast and accurate CLP detection systems have many issues that should be resolve the poor quality images, processing time, number plate region and background details. For the tracking and detection of vehicle number plates for crime prevention cameras are used and installed in front of police cars to detect the vehicle number plate and identify those vehicles. These numerous application of vehicle tracking outstanding cameras are lead to increase the cost of the system in both hardware and software implementation. This paper proposes LP recognition system with lowest cost of its hardware devices, and also it will give more practical and accurate than before. And finally we compare results of VEDA and Canny edge operator to find out which is better. The paper proposed design method for CLPD, which is low resolution web cameras are used. However the web camera is used to capture the image and to processes an offline it perform to detect the plate region from the whole scene image. The vertical edge extraction and detection is a very important task inthe CLPDRS because it affects the system's accuracy and computation time. This paper is organized as follows. Section II introduces a brief of related work. Section III describes two parts. The first part discusses in detail our proposedapproach to vertical edge detection and canny edge operator.The second partdiscusses the proposed CLPDmethod.Section IV draws ourconclusions.

II. RELATED WORK

A vertical edge map has been used for LPDfor many years [3]. The given algorithms useda one-directional Sobel operator to extract the vertical edges.Nevertheless, some undesired details such as horizontal edgesare kept in such vertical edge map. Therefore, these details canincrease the

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processing time and reduce the system accuracy. In [2], [17] an image enhancement and Sobel operatorwas used to extract the vertical edges of the car image. Theyused an algorithm to remove most of the background and noisyedges. Finally, they searched the plate region by a rectangularwindow in the residual edge image.

[Reference]	Advantages	Shortcomings
[7]	• High efficiency; • Able to process rotated, low contrast LP	- Fixed sizes of LP are used.
[15]	• High efficiency; • Tolerance to rotation	- Complex background
[18]	• Tolerance to complex background, rotation, lighting, and low contrast	- High complexity
[20]	• Tolerance to lighting, low contrast, varied sizes of LP	- Complex background
[21]	• Good LP detection result; • Tolerance to lighting and low contrast	- Vulnerable to complex background and rotation
Proposed CLPD	• Tolerance to lighting, tilt, varied sizes and designs of LPs • Able to process complex background • Able to process low resolution image	- High complexity

Table 1: Comparisons between the Proposed Method And Other Several Methods.

In[11], (1)extracting the Plate region, edge detection algorithm and vertical projection method are use.(2) In segmentation part filtering, thinning and vertical and horizontal projection are used. And finally, (3)chain code concept with different parameter is used for recognition of the characters. Shows final system Efficiency: 98%. Limitation:The proposed method is mainly designed for real-time Malaysian license plate.In[7],Extraction of plate region: edge detection algorithms and smearing algorithms, segmentation of Characters: smearing algorithms, filtering and some morphological algorithms, recognition of platecharacters template matching. This shows extraction of plate region :%97.6 segmentation of the characters :%96 , recognition unit:%98.8.overall system performance: %92.57 recognition rate . Limitation:it having some limitation like it recognition of car license plate only, and this system is designed for the identification of Turkish license plates.

In[12], It involve three approaches:(1)in plate localization Noise alleviation, Changing color space, Intensity dynamic range modification, Edge detection, Separating objects from background, Finding connected component ,Candidate selection, all above process are used (2) in segmentation part multistage model are used.(3) for the recognition artificial l 1Feed forward neural network is used.Limitation:detection only for English and Parisian number plate.

III. PROPOSED METHOD

We first apply adaptive Thresholding [13] on image,then,apply ULEA in order to remove noise and enhance thebinarized image, and finally, extract the vertical edges byusing VEDA, then, when comparing the VEDA with Canny operator; we found that which was faster.CLPDmethod processes low-quality images produced by a web camera,which has a resolution of 352 × 288 with 30 fps; andthe computation time of the CLPD method is less than severalmethods.The following diagram shows the flowchart for ourproposed approach as illustrated in Fig.1

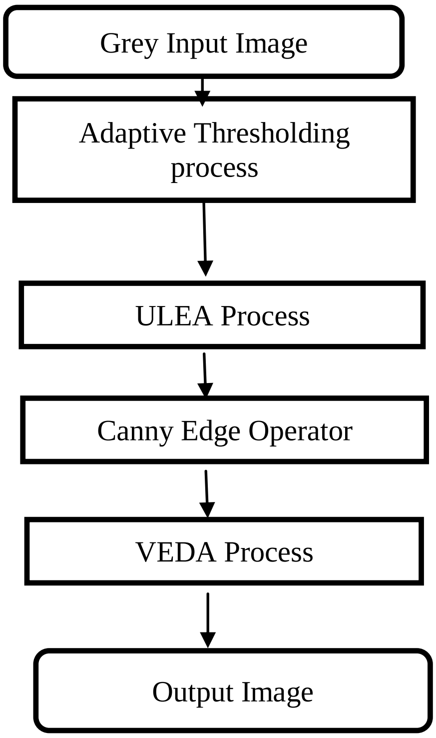

Fig. 1: The flowchart of proposed approach

A. Adaptive Thresholding Process :

The input image is grey scale and has the values between[0-255]. Fig. 2 shows theinput image and the result of applying adaptive thresholding the idea in algorithm is thatthe pixel is compared with an average of neighbouring pixels. If the value ofthe current pixel is T percent lower than the average, then itis set to black; otherwise, it is set to white. The range 0.1 < T <0.2 in our method.However, algorithm depends on the scanning orderof pixels. Since the neighbourhood samples are not evenlydistributed in all directions, the moving average process isnot suitable to give a good representation for the neighbouringpixels. Therefore, using the integral image in [37] has solvedthis problem.

$$Intgr1Img(i,j) = \begin{cases} sum(i) & if\ j-0 \\ \text{IntgrlImg}(i,j-1)+\text{sum}(i) & otherwise \end{cases} \quad (1)$$

Fig. 2 (a): Input image

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Fig. 2 (b): Thresholded image

B. ULEA Process :

In Fig. 2(b), we can see thatthere are many long foreground lines and short random noiseedges beside the LP region. These background and noise edges are unwanted lines.These lines may interfere in the LP location. Thresholding process in general will produce many thinlines which do not belong to car plate region. So eliminationof these lines will contribute in CLPDRS accuracy and reducethe processing speed. Therefore, an algorithm is proposed inorder to eliminate these unwanted lines.

It is clear from Fig. 2(b) that the image has some unwanted lines in angles 0^0, 90^0,45^0, and 135^0 with width of one pixel.Therefore, we have proposed an algorithm to eliminate themfrom the image.

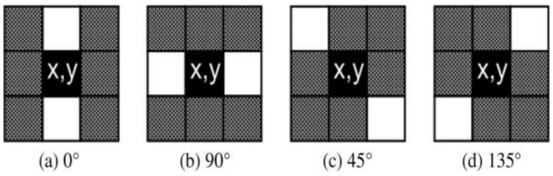

Fig. 3. Four cases for converting the centre pixel to background.

(a) Horizontal. (b) Vertical. (c) Right inclined. (d) Left inclined.

A 3x3 mask is used throughout all imagepixels. Only black pixel values in the thresholded image aretested. Supposed that g(x,y) are the values for thresholdedimage. Once, the current pixel value located at centre of themask (x,y) is black, the 8-neighbor pixel values are tested. Iftwo corresponding values are white in the same time, then thecurrent pixel is converted to white value as background pixel.

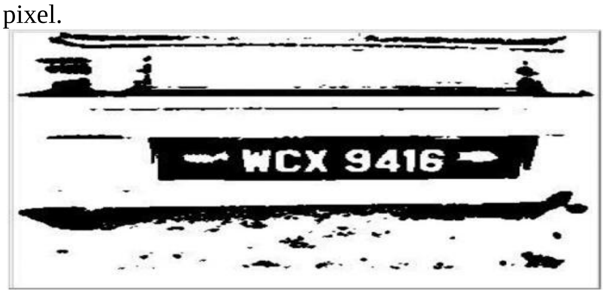

Fig. 4. ULEA output.

C. The Canny Operator :

Edge detection is a basic tool which has widespread us in processing images. It is applied in a variety of applications such as determining the object which could detect and identify certain objects of an image very clearly.A lot of edge-detection methods are widely used based on several possible optimization mechanisms. As an example, error minimization, fuzzy logic, morphology, genetic algorithms, neural network and Bayesian approach. A number of edge detection methods perform to wavering degrees of quality within altered conditions.Therefore, it is advisable to apply multiple edge-detection algorithm.

CannyEdge Detector is complex anduses a multi-stage algorithm to detect a wide range of edges in images. It is most commonly implemented edge detection algorithm. It has three basic objectives:

- Low error rate
- Edge points should be well localized
- Single edge point response

The Canny Edge-Detector is an operator which uses a multistage algorithm to find out a wide range of edges images that contain a lot of noise, as follows

1) Smooth image with a Gaussian

optimizes the trade-off between noise filtering and edge localization

2) Compute the Gradient magnitude using approximations of partial derivatives • 2x2 filters

3) Thin edges by applying non-maxima suppression to the gradient magnitude

4) Detect edges by double thresholding.

D. VEDA Process:

In order to distinguish the plate detail region, particularly thebeginning and the end of each character VEDA is mostsuitable. Then the plate details will be easily detected and the character recognition process will be done faster. After the Thresholding and ULEA processes, the image will only have black and white regions and the VEDA caneasily processing these regions. In an image, ROIs are rectangular regions with white background and dark characters. The most important characteristic of theserectangles is the existence of lots of edges. The idea ofthe VEDA concentrates on intersections of black–whiteand white–black as shown in Figure below.

Fig. 5: The intersection of black-white and white-black areas

A 2 × 4 mask is proposed for this process. The centrepixel 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

Regions will only be kept. Similarly, the first black pixel in the caseof white–black regions will be kept. This process isperformed for both of the edges at the left and right sidesof the object-of-interest. Theproposed mask has the size of 2 × 4 to fulfil the following two criteria.

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(a)In this type of a mask, it is divided intothree sub masks: The first sub mask is the leftmask "2 × 2," the second sub mask is the centre"2 × 1," and the third sub mask is the rightmask "2 × 1". Simply, after each two pixelsare checked at once, the first sub mask isapplied so that a 2 pixel width "because twocolumn are processed" can be considered fordetecting. This process is specified to detectthe vertical edges at the intersection of black–white regions. Similarly, the third sub mask isapplied on the intersections of white–blackregions. Thus, the detected vertical edge hasthe property of a 1 pixel width.

(b) The number "2" points out the number ofrows that are checked at once. The consumedtime in this case can be less twice in case eachrow is individually checked. The first edgecan have a black-pixel width of 2, and thesecond edge can have a black-pixel width of 1.The 2 × 4 mask starts moving from top tobottom and from left to right. If the four pixelsat locations (0, 1), (0, 2), (1, 1), and (1, 2) areblack, then the other mask values are tested ifwhether they are black or not. If the wholevalues are black, then the two locations at (0, 1) and (1, 1) will be converted to white.

Fig. 6. VEDA output.

E. Car License Plate Detection (CLPD) :

To extract plateregion and characters four steps are involved. They areHighlight Desired Details(HDD), Candidate RegionExtraction (CRE), and Plate Region Selection (PRS).

1) HDD: After applying the VEDA, the nextstep is to highlight the desired details such asplate details and vertical edges in the image.The HDD performs NAND–AND operationfor each two corresponding pixel values takenfrom both ULEA and VEDA output images. This process depends on the VEDA output inhighlighting the plate region. All the pixels inthe vertical edge image will be scanned.

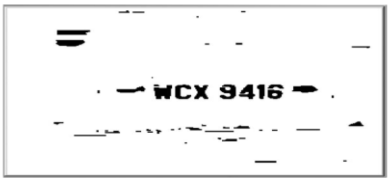

Fig. 7. HDD output.

When there are two neighbour blackpixels and followed by one black pixel, as inVEDA output form, the two edges will bechecked to highlight the desired details bydrawing black horizontal lines connecting each Two vertical edges. First, these two verticaledges should be surrounded by a blackbackground, as in the ULEA image. Second,the value of horizontal distance hdrepresents the length between the two verticaledges of a single object. After all pixels arescanned, the regions in which the correct LPexists are highlighted.

2) CRE: Candidate Region Extraction process is divided into four steps,

1) Count the Drawn Lines per Each Row: Thenumber of lines that have been drawn per eachrow will be counted and stored.

2) Divide the Image into Multigroups: Toreduce the consumed time, gathering manyrows as a group is used here. Therefore,dividing the image into multigroups could bedone.

3) Count and Store Satisfied Group Indexesand Boundaries: It is useful to use a thresholdto eliminate unsatisfied groups and to keep thesatisfied groups in which the LP details existin.

4) Select Boundaries of Candidate Regions:This step draws the horizontal boundariesabove and below each candidate region.

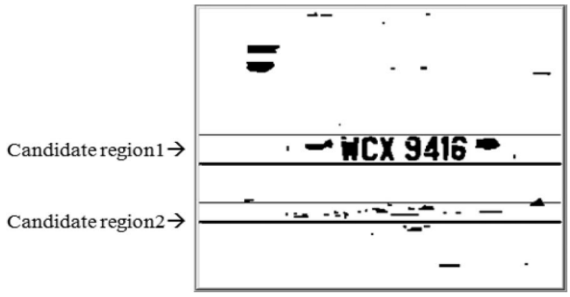

Fig. 8. Output of the boundaries of drawing candidate regions.

3) PRS:

For plate region selection(PRS), check blackness ratio ofeach pixels lies in candidate region. After detecting region, the region will replaced by vertical lines. Column With top and bottom neighbour have a high blackness ratiowill give a vote. After voting section, the candidateregion, which has highest vote will be selected. Finally,plate will be detected and extracted.

This process aims to select andextract one correct LP. The process isdiscussed in five parts. The first partexplains the selection process of the LPregion from the mathematical perspectiveonly. The plate region can be checked pixel by pixel,whether it belongs to the LP region or not. A mathematical formulationis proposed for this purpose, and once this formulationis applied on each pixel, the probability of the pixel being anelement of the LP can be decided. The second part applies the proposedequation on the image. The third part givesthe proof of the proposed equation usingstatistical calculations and graphs. Thefourth part explains the voting step. The columns whose top and bottomneighbours have high ratios of blackness details are given onevote. This process is done for all candidate regions. Hence, thecandidate region that has the highest vote values will be theselected region as the true LP.Thefinal part introduces the procedure ofdetecting the LP.

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IV. CONCLUSION

In this paper, we have proposed a new technique by using CannyEdge Detector and VEDA in order todetect number plate of vehicles.The VEDA contributes to make the whole proposed CLPD method faster, as canny operator uses Gaussian filter to remove noise so it gives better results by applying double hysteresis.The computation time of the CLPD method is low, which meets the real-time requirements.From above results it proves that proposed method shows better accuracy as compare to VEDA alone.

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