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An Efficient Geometric feature based License Plate Localization and Stop Line Violation Detection System

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Abstract— Stop line violation causes in myanmar when the back wheel of the car either passed over or reach at the stop line when the red light changes. the objective of this work is to design and implement algorithms for stop line detection system (slds) in myanmar. this paper presents a robust time algorithms of license plate localization, segmentation and detection of the stop line violated car in the low resolution videos. the proposed license plate localization algorithm consists of required preprocessing operations leading to successful plate detection. projection analysis is designed to estimate the position of the license plate region within the scene image in order to reduce the search space before applying any technique and rectangle detection based on the geometric features of license plate for localization of the license plate. evaluation is conducted on the video files from the surveillance camera of the road in myanmar in accordance with accepted rules. this system is intended to use for one sided way. it is extracted the segmented license plate and then calculated depending on the location of the stop line and the license plate. if the location of the license plate is passed over the stop line, it is defined as the violated car. otherwise, the car is non-violated. this detection system should be performed in real time, almost watching cars passing the stop line at a street intersection in front of video recording device.

***Index Terms*— license plate localization system, violated car, detection system.**

I. Introduction

All kinds of violations at a street intersection include red light running, speed violation, stop line violation and lane violation by tracking individual vehicles. According to an in-depth investigation of road accidents in Myanmar, 75% of traffic accidents are preceded by at least one traffic law violation. Traffic signals using time separation are aimed to reduce motor-vehicle crashes at intersections involving traffic congestion. Review of the police reported crashes found that running red lights and other traffic-control devices such as stop signs is the most common type of the accident, and the resident injuries more occurred crashing in the red light running, compared with other crash cases. A system for monitoring and recording incidences of red light violations at the traffic intersection is presented in this paper. As soon as the red light changes, the detection system starts and then grabs the video frame from the input video file to acquire the decision whether the car is violated or not. Software will be developed with the video files from the surveillance camera of the road in Myanmar in accordance with accepted rules. Among them, license plate localization (LPL) is considered the most crucial stage because a high accuracy and real time segmentation and correct decision making can be performed only if the license plates are correctly localized [1] [2].In real life, the LPL has to take place some difficulties which result from uncontrolled imaging conditions such as complex scene, bad weather condition, low contrast, blurring and viewpoint changes [2][3].Even though many researches focus on LPL, these are not convinced for Myanmar. In this paper an application namely the system for detecting License Plate of real-time stop line violation vehicles is introduced .In Section 1 gives an introduction. Section2 introduces a theoretical background about previously used techniques for system. Section 3 presents the data set used in the present work and applied on frame after grabbing stage based on motion analysis. Section 4 discusses the propose technique and license plate localization based on Geometry-based method of the license plate. The last Section presents decision making step.

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II. Related WoRks

This section provides a descriptive summary of some methods that have been implemented and tested for Vehicle License Plate Detection System (VLPD). A modified color texture-based method for detecting license plate in images was presented in [5]. A support vector machine (SVM) was used to analyze the color and texture properties of LPs and to locate their bounding boxes applied by a continuous adaptive mean shift algorithm (CAMShift). The combination of CAMShift and SVMs produces efficient LP detection as time-consuming color texture analysis for less relevant pixels is restricted, leaving only a small part of the input image to be analyzed. In the light of this observation, LPL methods can be categorized in the three global types: region-based, contrast-based and hybrid methods. Region-based methods use the properties of the color in LP region. Color-based methods extract LP’s background pixels by using some predefined colors [7] or color image segmentation [8].

Contrast-based methods are founded on the contrast between the plate boundary and overlapping region in the vehicle or the high contrasted characters in comparison with the rest of

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the plate region. This category of methods can be categorized into three sub-types: straight-line-based, morphology-based and edge-based. Straight-line-based methods detect lines in binarized edge image and then group two pairs of overlapping parallel lines in the horizontal direction and the vertical direction to form potential LP boundaries [9][10]. Morphology-based methods [11][12] use morphology operators to enhance the local regions which are rich in contrast information (LP region is belong to this type) and reduce the other regions. Then, a thresholding step removes regions with low edge density. Edge-based methods occupy the majority of existing methods, generally, thanks to their high localization capacity in various conditions and their low computation time. This sub-category of approaches exploit the edge information of characters inside LP, especially the vertical strokes properties [13][2][14][15]. Hybrid methods are developed to face the large diversity of LP color and contrast information where a single type approach suffers from completeness. Heo et al. [16] propose a double chance scheme using line grouping and edge density methods.

For finding an efficient solution to LPL problem, the pros and cons of existing approaches have been analyzed. Color is very useful when the lighting condition is good, but color information is not stable when the illumination changed. CC-based methods are robust to viewpoint and illumination conditions, but interference characters cause high false positive rate. Methods based on plate boundary detection can solve the scale and orientation problems; however the plate boundary is not always clear in real scenes. Morphology-based methods are robust to noise and broken character strokes, but its slow operation makes it rarely used in real-time system. Hybrid methods with learning-based techniques are very efficient in many scenes nevertheless they are time consuming at the learning stage, needs a large and diversified image database and are database dependent. Edge-based methods are widely used for the advantage of plate candidates under different lighting conditions efficiently and fast. The main inconvenient of this strategy is its noise sensitivity. Hence, robust constraints are vital in the LP verification stage [6].

III. DATA SETS

The dataset for the current experiment is collected as a part of a demonstration project on Vehicle Stop Line Violation Detection system for a Government traffic monitoring authority of a major city in Myanmar. Surveillance cameras were installed at an important road crossing in Yangon at a height of around ten meters from the road surface. These are static CCTV camera and focus, fixed at a given orientation with the road surface. All the surveillance cameras were synchronized with the traffic signaling system such that the camera captures the video snapshots only when the traffic signal is turned RED. All the cameras were focused on the Stop-Line to capture back images of vehicles violating the Stop-Line on a RED traffic signal. The complete image dataset comprises of more than 150 surveillance video snapshots, captured over several times in an unconstrained environment with varying outdoor lighting conditions, pollution levels, wind turbulences and vibrations of the camera. 24-bit color bitmaps were captured through CCTV cameras with a frame rate of 25 fps and resolution of 240x320 pixels. Not all these video snapshots contain vehicle images with a clear view of license plate regions. For the current experiment, 200 images have been identified with complete license plate regions appearing in different orientations in the image frame.

Figure.1 Original video

IV. PROPOSE TECHNIQUE

The overall traffic violation detection system of the proposed design is shown in figure 2.

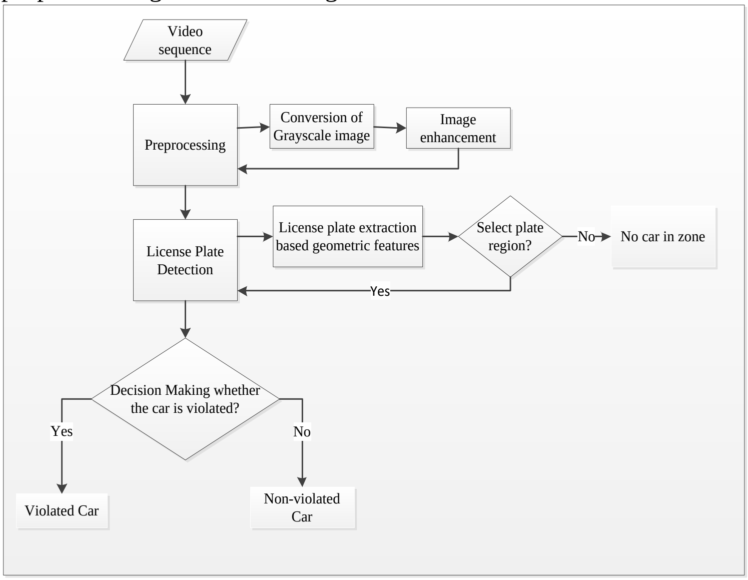

Figure.2 Myanmar Car Stop Line Violation Detection System (MCSLVDS)

The controlling of traffic violation processing system mainly comprises three main modules (i) Preprocessing stage (ii) License Plate Localization (iii) Decision making process. In first module, after the vehicle image is captured by the camera, it will be passed to motion analysis stage and then captured the image based on the car's speed driving along the distance for further processing by the system. In Myanmar, traffic surveillance system uses Application Visualization System (AVS). Matlab cannot execute this format. It is converted to Matlab executable file format. The driving speed is supposed that 40 km/h. The red light in traffic light signal is taken 30sec in one section. The grabbed picture is used as the input image.

3600seconds=40000meters (40Kilometer/hour)
30seconds =333meters
333meters=3558frames
4.5meters (15feets) =48frames

Therefore, it has the 48 frames. It is grabbed one frame after jumping over the sequence of 10 frames. There are 4 frames last finishing one section of 30seconds after passing through this stage.

A. Preprocessing

In second module, the preprocessing stage is mainly used to enhance the processing speed, improve the contrast and reduce the noise. The grabbed images are used as the input images. To convert RGB image to gray scale image formulated it by forming a weighted sum of the R,G and B components:

Gray = 0.2989 * R + 0.5870 * G + 0.1140 * B

If the input image is a colored image represented by 3-dimensional array in MATLAB, it is converted to a 2-dimensional gray image before further processing. The sample of original input image and a gray image is shown figure 4(a) and figure 4(b). Gray Image is converted to the binary image with appropriate threshold and median filtering is used to enhance image.


Fig.3(a). Original Image Fig.3(b). Gray Scale Image

B. License Plate Detection

License Plate Detection stage is the key step, which influences the accuracy of the system significantly.

1) Projection Analysis

This is implemented horizontal and vertical projection by counting the number of white pixels and non-white pixels in each row and column of the image. By computing a component's projection valued its variance value, it is possible to differentiate between components that are license plate and components that are other components.

Vertical projection (white pixel in each row)

$$F(y) = \sum_{y=0}^{height-1} T(I(x,y))$$

Horizontal projection (black pixel in each column)

$$F(y) = \sum_{x=0}^{width-1} T(I(x,y))$$

$$T(P)\begin{cases} 0 \text{ when } p \text{ is black} \\ 1 \text{ when } p \text{ is white} \end{cases}$$

Histogram is a graph representing the values of a variable quantity over a given range. This step is used horizontal and vertical histogram. To find a horizontal histogram, it traverses through each column of an image. In each column, it starts with the second pixel from the top. The difference between second and first pixel is calculated. If the difference exceeds certain threshold, it is added to total sum of differences. Then, it will move downwards to calculate the difference between the third and second pixels. So on, it moves until the end of a column and calculate the total sum of differences between neighboring pixels. At the end, an array containing the column-wise sum is created. The same process is carried out to find the vertical histogram. In this case, rows are processed instead of columns.

2) Passing Histograms through a Low Pass Digital Filter

To prevent loss of important information in upcoming steps, it is advisable to smooth out such drastic change in value of histogram. Each histogram value is averaged out considering the values on it right-hand side and left-hand side.

3) Filtering out Unwanted Regions in an Image

The unwanted areas are the rows and columns with low histogram values. A low histogram value indicates that the part of image contains very little variations among neighboring pixels. Such areas are removed from an image by applying a dynamic threshold,that is equal to the average value of a histogram.

3) Region of Interest Extraction

This step is to find all the regions in an image that has maximum number of edges containing a license plate compared to any other part. The input images have resolution 1600*1200.

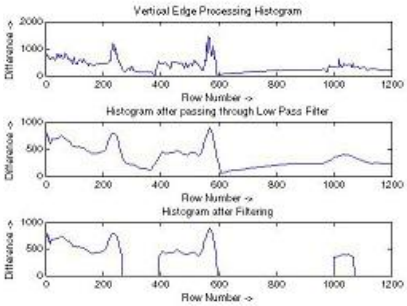

Fig.4(a). Vertical Edge Processing Histogram

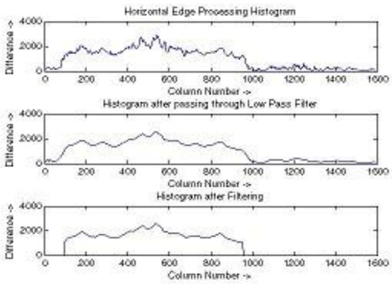

Fig.4(b). Horizontal Edge Processing Histogram

Fig.4(c). A frame after Histogram equalization

C. License Plate extraction based on geometric features

The rectangle shape is detected using geometric properties. Geometry-based methods use measuring differential geometry features. Myanmar license plates have the dimensions 350 mm width and 162 mm height. Each plate has at most seven characters and at least three characters written in a single line. The dimensions of the plate can most have the most common size. All standard license plates contain Myanmar alpha-numeric characters, slash and digits. All standard license plates can have 30 characters of alphabetic Myanmar characters, followed by four or five numbers of digits. All characters and digits are written in white color on five colors background plates as shown in the following figure 5.

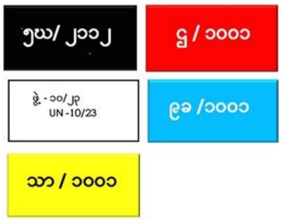

Fig.5. Myanmar Standard License Plate

All of the geometric features define the limit with the upper and lower thresholds. If the labeling object exist between these confine thresholds, it is extracted as a possible result. It is extracted the possible License Plates results used the following geometric features.

$$\text{Standard License Plate Ratio} = \frac{\text{Width of License Plate}}{\text{Height of License Plate}}$$

Box_Area=Width of License Plate*Height of License Plate
Extent=length of Width/ Box_Area

In the process of eliminating candidate regions which are not license plate, following criteria are considered:

- If the plate area is too large or too small related to the size of the image, it can be discarded.
- Normally plate background is black and foreground is white. In the candidate region, if only almost white pixels or black pixels exist, it can be removed.
- If the number of white objects (characters) inside the candidate region is more than 10 objects or less than 4, it cannot be a real plate.
- White pixels count must be in the range of between 1/3 and 2/3 of all the pixel counts of the plate area.
- Centre of gravity of the white pixels must be nearly in the center of the plate area.
- One “slash” (thin and tall object) must exist in license plate area.
- White object of ‘slash’ must exist at the second or third place in the set of white objects.

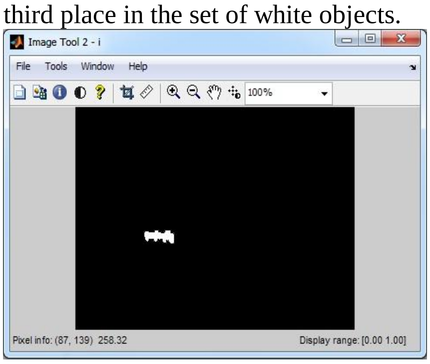

Fig.6. Location of Y-coordinate of License Plate

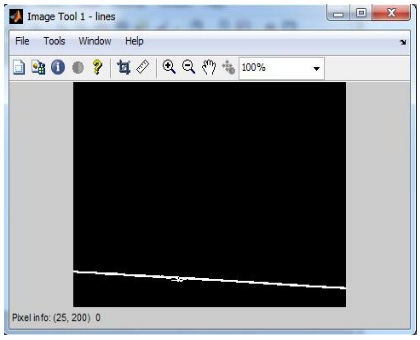

Fig. 7. Location of Y-coordinate of stop line

V. DECISION MAKING

Extract the location of Y-coordinate of License Plate. If the location of the Y-coordinate of License Plate is greater than the location of the Y-coordinate of the stop Line, it is the violated car. Otherwise, the result is non-violated car. The Y coordinate of License Plate is defined as threshold. In present work, the threshold value is 200 depending on the result of figure 7.

If Y-coordinate of License Plate<threshold
Then Violated car
Else Non-Violated car.

VI. EXPERIMENTAL RESULTS

Experiments have been performed to test the proposed algorithm and to measure its accuracy. The system is simulated in MATLAB version (R2012a) for the extraction and segmentation of number plate. The video files taking 17 hours are used for testing the technique. All the images being normalized to size 240x320 because some images are double this size and also it is normal to use the size. The video files are collected from RTAD (Road Transport Administration Department) at Nay Pyi Daw, Myanmar. The distance between the camera and the vehicle varied from 3 up to 7 meter.However, the proposed method is sensitive to the angle of view, physical appearance and environment conditions.

VII. CONCLUSIONS

A simple but efficient stop line violation detection system is presented in this paper. The proposed method is mainly designed for real-time Myanmar Car stop line violation detection system. To measure the efficiency, this method has been tested over a large number of video files. The combination of hough transform and segmentation algorithm produces the higher accuracy and faster speed for VLP detection. This made the approach practical for real time systems. In practice, this algorithm is used in the automatic Stop Line Violation Detection system.

REFERENCES

[1] P. Wu, H.-H. Chen, R.-J. Wu, and D.-F. Shen. License plate extraction in low resolution video
In 18th International Conference on PatternRecognition, 2006.

[2] H. Mahini, S. Kasaei, and F. Dorri. An efficient features - based license plate localization method. In The 18th International Conference on Pattern Recognition, volume 2, pages 841–844, 2006.

[3] B. Hongliang and L. Changping. A hybrid license plate extraction method based on edge statistics and morphology. In 17th International Conference on Pattern Recognition, volume 2, pages 831–834, 2004.
[4] Retting, R.A., Williams, A.F., Preusser, D.F. and Weinstein, H.B. 1995. Classifying Urban Crashes For Countermeasure Development Accident Analysis and Prevention 27 (3): 283-94.
[5] K. -I. Kim, K. Jung and J. -H. Kim, "Color Texture- Based Object detection: An application to License Plate Localization," In Lecture Notes on Computer Science, vol.2388, S.-W. Lee and A. Verri, Eds. New york: Springer-Verlag, pp. 293-309, 2002.
[6] Chu-Duc Nguyen, Mohsen Ardabilian , Liming Chen," Real-time license plate localization based on a new scale and rotation invariant texture descriptor",2008.
[7] S. M. Youssef and S. B. AbdelRahman. A smart access control using an efficient license plate location and recognition approach. Expert Systems with Applications, 34(1):256–265, 2008.
[8] W. Jia, H. Zhang, and X. He. Region-based license plate detection, Journal of Network and Computer Applications, 30(4):1324–1333, 2007.
[9] H. Chen, D. Rivait, and Q. Gao. Real-time license plate identification by perceptual shape grouping and tracking. The 9th International IEEE Conference on Intelligent Transportation Systems, pages 1352–1357, 2006.
[10] D. T. Tran, L. H. D. Tran, P. V. Tran, and V. H. Nguyen. Building an automatic vehicle license-plate recognition system. In 3rd International Conference in Computer Science: Recherche, Innovation et Vision du Futur, 2005.
[11] P. Wu, H.-H. Chen, R.-J. Wu, and D.-F. Shen. License plate extraction in low resolution video. In 18th International Conference on Pattern Recognition, 2006.
[12] C. C. Chen, J. W. Hsieh, and Y. S. Chen. Detecting license plates from videos using morphological operations and adaboosting algorithm. In International Computer Symposium, volume 3, pages 1201–1204, 2006.
[13] C.-T. Hsieh, Y.-S. Juan, and K.-M. Hung. Multiple license plate detection for complex background. In 19th International Conference on Advanced Information Networking and Applications, volume 2, pages 389– 392, 2005.
[14] V. Sharpiro and D. Dimov. Adaptive license plate image extraction. In 5th International Conference on Computer Systems and Technologies, 2003.
[15] H. Chen, J. Ren, H. Tan, and J. Wang. A novel method for license plate localization. 4th International Conference on Image and Graphics, pages 604–609, 2007.
[16] G. Heo, M. Kim, I. Jung, D.-R. Lee, and I.-S. Oh. Extraction of car license plate regions using line grouping and edge density methods. International Symposium on Information Technology Convergence, 0:37–42, 2007.

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