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Publication Type	International publication
Publisher (Journal name, issue no., page no etc.)	21st International Computer Science and Engineering Conference (ICSEC) King Mongkut's Institute of Technology Ladkrabang (KMITL), Bangkok, Thailand
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License Plate Detection of Myanmar Vehicle Images from Dissimilar Angle Conditions

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***Abstract*— It has been studied that there is no established LPR (License Plate Recognition) to detect and identify the license plates from dissimilar angles. The aim of the paper is to detect the dissimilar angles of the license plate with the non-fixed LPR system. Therefore, the horizontal and vertical dilation, skew angle detection and automatic bounding box have been proposed to detect the license plate. The proposed method has been applied to the four different types of Myanmar license plates, e.g., private cars, taxi, tour buses and religion cars. One car each is taken into four different types of angles on the dissimilar conditions. Experimental result indicated that this method can detect the disparate types of license plates with a high accuracy, i.e., the proposed approach achieved a favorable outcome rate of 97% at 100 license plates.**

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I. INTRODUCTION

Vehicle's license plate detection is a favored and essential. At the present time, there are a variety of number plate detection systems are available for traffic control; automatic payment of tolls on roads or bridges; general security systems wherever there is the need for identifying vehicles. The license plate detection is applied nowadays. The objective is to construct and run a safe and effective trade system. In this paper, the dissimilar characterizations of vehicle license plate background color and different types of angle are recorded exactly. These angles are special in many ways. The classifying type of angles in this license plate is an acute angle. Any angle with its terminal arm between 0 and 90 degrees can be called acute. The 90 degrees, 60 degrees, 45 degrees and 30 degrees of acute angles are measured.

The system is brilliant enough to detect the acute angles of number plate in the image. To quickly search for capture license plates, one is a normal analogue camera while the other is specifically designed to capture license plates. Any camera used to capture license plates but that's only true under optimum. This research proposes the smartphone's built-in camera based instead of the LPR (License Plate Recognition) camera. The Samsung GALAXY A7 smartphone with a full metal body, a stunning 5.5" FHD sAMOLED display and 6 unique colors. Main camera resolution is 13 MP. However, the result is great and it can detect every license plates of the vehicle images. The viewpoint by the research is the non-fixed LPR system.

At first, it is needed to introduce the interpretation of a Myanmar car license plate, which is composed of two lines. The first line describes the city and the second line represents the license number. In this second line, there are six characters: second character is an alphabet and others are numbers. The second character is capital letter and numbers that are made of 0 - 9. There are dissimilar types of license plates. They are set out in the Figure 1. These consist of disparate type in terms of colors as follows: a private car has a white character and a black background, a taxi car has white characters and a red background, a foreigner car has white characters and a blue background and a religion car has black characters and a yellow background. All of these vehicles comprise boundary. To address these dissimilar angle situations, these challenges made difficult in detecting a region of interest, i.e., the license plate from the captured image by the traditional methods as detailed below in Section II. Therefore, in this paper, we proposed the method dealing with different types of angles of license plates. This project is intended to be practical used by the traffic-light development in Myanmar.

90° 60° 45° 30°

Fig. 1. Dissimilar Angles of Myanmar License Plates

I. Related Work

A great deal of methods has been proposed for license plate detection. Recently, A. Choudhury and A. Negi presented the detection of a license plate from an Indian vehicle, according to a new zone based algorithm. The proposed method showed the effective performance with an adaptive template matching system to recognize the identified numbers [1]. A. Elbamby, E.E. Hemayed, D. Helal and M. Rehan proposed the method for license plate detection in videos. This novel algorithm can identify in an actual time numerous license plate with various sizes in an unfamiliar and complicated situation [2]. This paper presented a robust and efficient method for plate detection with the motivation of accurately localizing vehicle license plates from complicated scenes in real time [3]. S. Miyata and K. Oka reported the new method of detecting the license plates in the images of vehicles where the license plate is shown. A Support Vector Machine is used to determine the candidate area and the position of the license plate. It's the effective method and detection rate of is about 90% [4]. The authors submitted the recent method for automatic vehicle license plate detection. The system of methods was 95% classification accuracy rate [5]. This paper offered the license plate detection (LPD) method. It is the vital process in the License Plate recognition (LPR) execution. This algorithm has been tested and compared each other of stability and repeatability [6]. R. Yang, H. Yin and X. Chen presented the license plate detection build by sparse auto-encoder. They used the novel method to detect the vehicle license plate. The investigation results indicated that this can detect the diverse types of license plates with a great accuracy [7]. The purpose of this paper is to present the Histogram based Edge Processing algorithmic model. The system is implemented using MATLAB. The accuracy is tested for dissimilar sets of input images and expressive performance has been investigated [8]. Hetal N. Patel, K. Desai and T. Panchal proposed the algorithm for automatic plate detection by using corner features from video. The method of Harris algorithm can express the license plate successfully completed from an input video file. The benefit of the algorithm is top speed, quality and less complication [9]. In this paper proposed the technique of ULEA (unwanted-line elimination algorithm) for identifying the vehicle license plate [10]. H. Weber and C.R. Jung presented the new approach for automatic license plate detection using a "baseline" detector. The main idea of this method is to recognize the shadowed regions under the back of visible vehicles. Their experimental results showed that 93% [11]. License plate recognition is the key safety at the transportation system. The authors used the novel pattern recognition techniques. The results showed that the faster recognizing in compare with other techniques that is used in the industry at the present time [12]. The algorithm can remove, approach and recognize the characters from the image of the plate. The primary contribution, in this paper, is to present the new experiment that was not done in the previous papers. This is an extensive research area and that is why some difficulties should be there. Some existing methods [15,16] are expressed to compare the proposed method. These methods illustrated the partially cut character structure to recognize the Myanmar license plate characters and HV color histogram was utilized for the license plate extraction. The aim of analysing the dissimilar angle analysis is our proposed research on the license plate detection for individual use without fixing the LPR system.

II. Proposed Method for Number Plate Detection

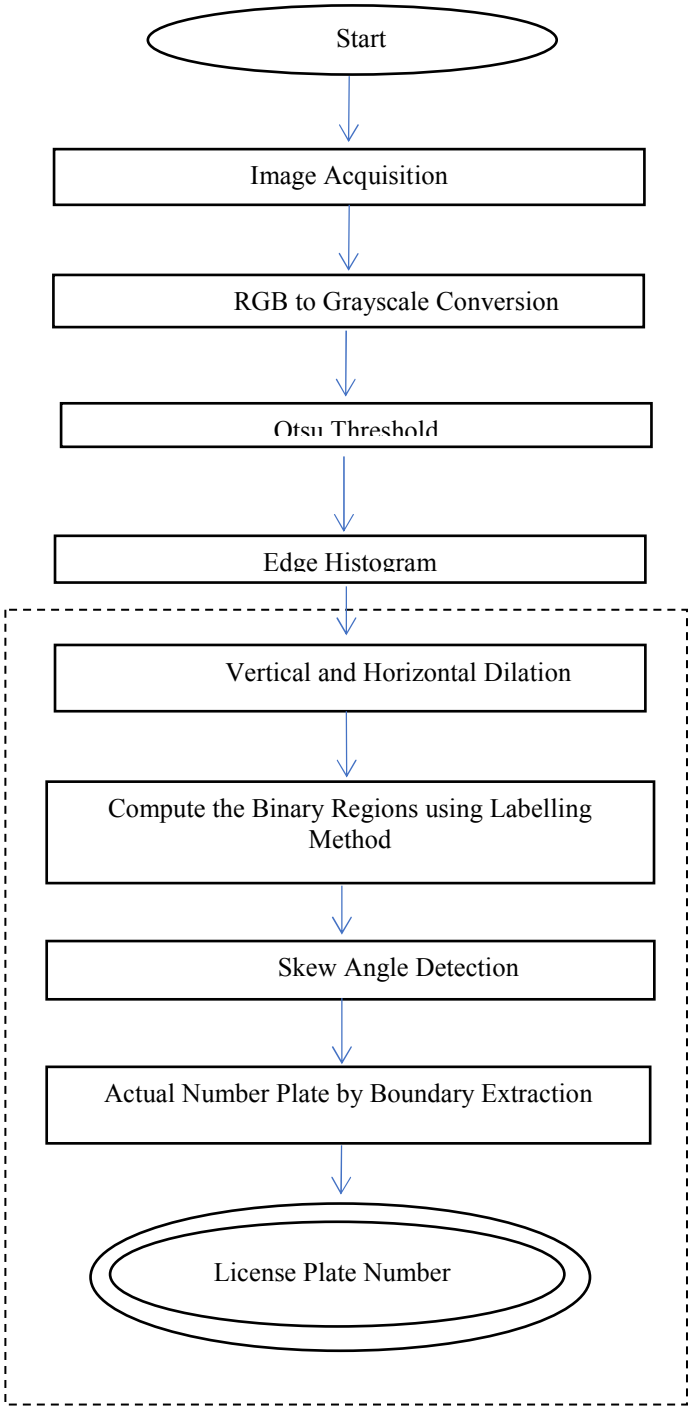
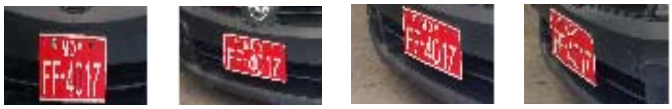


Fig. 2. Flowchart of Proposed Approach

The proposed method is applied for Myanmar license plate only due to license plates are varying from the other countries depending on the type, design, plate style and serial format. The Myanmar car license plate which is composed of two parts. The first part represents the name of city, e.g. Mandalay, Yangon, Nay Pyi Taw. In the second part, there are six characters and the second character is alphabet and the others are numbers. The license plates are also varying in color based on the type of ownership. The proposed system is made up of two main processes: dilation and skew detection. The dilation process starts with the search and extraction of the edge of the license plate. After the skew angle of the plate has been recognized, this algorithm rotates it to correct for this skew. Lastly, the extracted license plate has got. The proposed method of working system is shown in *Fig. 2*. The novelty method is highlighted in square box. This paper reports the dilation and boundary extraction approach to detect the license plates. In the experiment process, there are eight stages. Results of the process are shown in the *Fig. 3* to *Fig. 10*.

A. Image Acquisition

The different angles of vehicle images are captured. The four types of the 90 degrees, 60 degrees, 45 degrees and 30 degrees of each license plate are taken as shown in Fig. 3. The angles of the image are taken at the distances about 200cm. The Samsung GALAXY A7 smartphone is used. Main camera resolution is 13 MP. The camera can detect every license plate of the vehicle images. The viewpoint by experimentation is the non-fixed LPR system.



90° 60° 45° 30°

Fig. 3. Captured Images

B. RGB to Grayscale Conversion

The colour image is converted to the grayscale image in the process. The RGB image is made up of 30% of red, 60% of green and 11% of blue. The value range of 0 is black and the value 255 is white. The limits are between black and white values. It converts color to grayscale by eliminating the hue and saturation information. It filters out unnecessary information and noises. The resulting images are pointed out in the figures.

Let an RGB color pixel is given by [R, G, B] and the corresponding gray value is given by [L, L, L] where

$$L=0.30\ R + 0.59G + 0.11B \qquad (1)$$

90° 60° 45° 30°

Fig. 4. Grayscale Images

C. Threshold (Otsu)

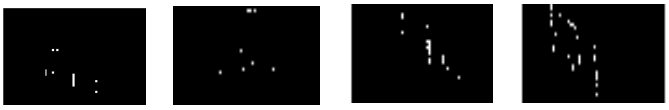
The threshold value is a very critical thing. That value is decided through many checks. Once make a histogram of brightness information. This method is used to modify a gray image to a binary image. It splits the objects from background. The image involves two classes of pixels following bi-modal histogram, the algorithm calculates the maximum threshold separating the two classes so that their mixed spread is lowest.

Algorithm:

The Otsu's method [13], [14] is defined by:

$$\sigma_w^2(t) = w_1(t)\sigma_1^2(t) + w_2(t)\sigma_2^2(t) \qquad (2)$$

In "(2)," weights w_1 and w_1 are the two classes divided by a threshold t. σ_1^2 and σ_2^2 are the variances of these classes.

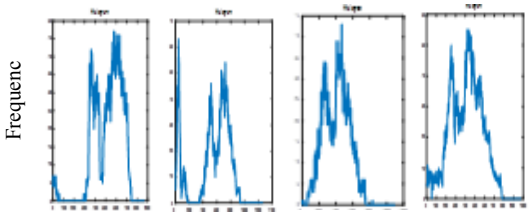


90° 60° 45° 30°

Fig. 5. Otsu Thresholding

D. Edge Histogram

This step is to build a histogram with the directions of the edges. The histogram identifies the edges in an image. If the number of horizontal, vertical and diagonal edges in the window is above a threshold value, then assume that the region is plate area.



90° 60° 45° 30°

Fig. 6. Edge detection based on histogram

E. Vertical and Horizontal Dilation

The dilation method identifies the plate area after the entire image is input. The output value of the pixel is the best value of all the pixels that fall within the structuring element's size and shape. In a binary image, if any of the pixels is set to the value1, the output pixels are set to 1. From the experimental results, the plate areas are successfully detected if the input image are not blurred.

90° 60° 45° 30°

Fig. 7. Results of dilation method

F. Compute the Binary Regions using Labelling Method

Now we are trying to clip the plate area using labeling method. To figure out the connected components in the binary image the alignment height and position of these components. It is required to know the exact location of different angles of each plate. The first processing is 'binarization'. It takes in a binary image. This image contains many objects that are separated from each other's. The experimental results of each license plate are shown in *Fig. 8*.

90° 60° 45° 30°

Fig. 8. Binary Regions by Labelling Method

G. Skew Angle Detection

There are a few skew angle detection methods, some depend on detecting associated part and finding the regular angles connected their centroids. After the skew angle of the plate has been distinguished, this algorithm rotates it to correct for this skew. This algorithm is moderately fast and accurate. The first takes a little time on huge images, but obtains the rotation exactly. The next process was less accurate, but faster and works pretty well with slightly skews that is typical in licensing images. The alternative method uses two shears to produce its result. Final choice was the coordinate rotation, applying more on accuracy than speed. This method was not slow.

90° 60° 45° 30°

Fig. 9. Skew Angle Detection and Correction of the Images

H. Actual Number Plate by Boundary Extraction

Here the symbols are extracted from the vehicle image as shown in *Fig. 10*. This method analyzes the boundary of object in an image. To get the more accurate results, this process draws the boundaries on the border of an object in an image and try to figure out rectangles on an image in MATLAB.

90° 60° 45° 30°

Fig. 10. Actual Number Plate Detection by Boundary Extraction

III. Experimental Results and Discussions

An experiment has been carried out on the captured car image that had been taken by a variety of cars in Myanmar. Different types of 100 vehicles' images are recorded. Images are taken in dissimilar angles circumstances. The different style and color of images are captured at various angles. To capture the four dissimilar angles of 90°, 60°, 45° and 30°, we used the below measurement method as depicted in the *Fig. 11*. In the figure, point A is perpendicular to the license plate at 90° with distance of 200cm. Point B is the same plane to point A and far from point A with the distance of 115.5cm. Point C is far from the point A with distance of 200cm and point D is far from the point A with the distance of 346.5cm.

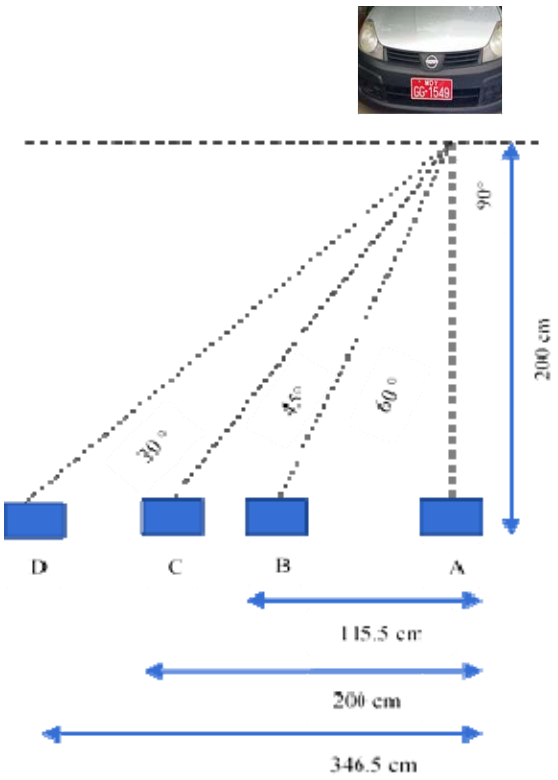


Fig. 11. Taking photos in four different angles

In our experiment, four plate styles at dissimilar angles and is extendable to other plate styles. The proposed method experimented the 100 Myanmar vehicle images and the result

achieved an average detection rate of 97%. We found that the dimension of the images samples affected the proposed approach. We tested the program with different image dimension of 151×120, 1904×916, and 160×114. For the accuracy, images dimension of 151×120 were used in our system experiment. Using the large size of 2322×4128 images showed the incorrect detection result. It was also searched that the detection rate was affected by the brightness of vehicle body and the clearance of license plate when the vehicle images were captured.

The proposed model works on the four different types of vehicle models. The obtained results of proposed method for number plate detection is shown in TABLE I.

TABLE I. ACCURACY RATE RESULTS

Type of License Plate	90 Degrees	60 Degrees	45 Degrees	30 Degrees	Accurate Rate
Private Cars	10/10	10/10	10/10	9/10	97% (39/40)
Taxi	10/10	10/10	10/10	9/10	97% (39/40)
Tour Buses	3/3	3/3	3/3	2/3	91% (11/12)
Religion Cars	2/2	2/2	2/2	2/2	100% (8/8)
Total	25/25	25/25	25/25	22/25	97% (97/100)
Average [a]					97%

a. Results of Average Accuracy

IV. EVALUATION OF RESULT

The proposed method is compared with the past work [15], in which Myanmar license plate character recognition is implemented based on partially cut character structure of the number plate. The comparison is described in TABLE II. The 92.7% of the license plate characters are recognized.

In the other work, the license plate detection is compared with [16], in which HV color histogram was applied for extraction of candidate plate regions. In this method, 9% error which has the same color between car and plate or the size of license plate is very small compared with the car. It can be improved by using the postprocessing.

In this proposed method, 97% of the license plates are well detected in 100 real car images of private cars, taxi, tour buses and religion.

TABEL II. PERFORMANCE COMPARISON OF RESULTS

Type of License Plate	Proposed Method	Conventional Method [15]	Conventional Method [16]
Private Cars	97% (39/40)	-	-
Taxi	97% (39/40)	-	-
Tour Buses	91% (11/12)	-	-
Religion Cars	100% (8/8)	-	-
Average	97%	93%	91%

V. CONCLUSION

The main purpose of this research is to examine and search a suitable approach to detect the Myanmar vehicle license plate from the dissimilar angle conditions. This paper presents the results of the experiment that shows a very strong detection for the four different angles of the license plate. To validate the proposed method, experiments are done with the vehicle images. There may be the detection failure if the images are same color with body and plate of the vehicle or size of the plate is very small compared with the whole vehicle. Moreover, we found that post processing can solve this problem. However, the detection result using the proposed model shows the better performance since 97% of the photos are accurately identified. For the future improvement, the system will be necessary to automatically detect the all angles of the vehicles, brightness, various weather conditions and other features.

ACKNOWLEDGMENT

This research study was supported by AUN/SEED-Net (ASEAN University Network/Southeast Asia Engineering Education Development Network) grant. The authors would like to thank those who took part in this experimentation.

REFERENCES

[1] A. Choudhury and A. Negi, “A New Zone Based Algorithm for Detection of License Plate from Indian Vehicle,” Fourth International Conference on Parallel, Distributed and Grid Computing (PDGC), pp. 370-374, 2016.

[2] A. Elbamby, E.E. Hemayed, D. Helal and M. Rehan, “Real-Time Automatie Multi-Style Lieense Plate Deteetion in Videos,” IEEE, pp. 148-153, 2016.

[3] Y. Yuan, W. Zou, Y. Zhao, X. Wang, X. Hu and N. Komodakis, “A Robust and Efficient Approach to License Plate Detection,” IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 26, NO. 3,pp. 1102-1114, MARCH 2017.

[4] S. Miyata and K. Oka, “Automated License Plate Detection using a Support Vector Machine,” 14th International Conference on Control, Automation, Robotics & Vision Phuket, Thailand, 13-15th November 2016.

[5] G. L. Corneto, F. A. Silva, D. R. Pereira, L. L. Almeida, A. O. Artero, J. P. Papa, V. H. C. de Albuquerque and H. M. Sapia , “A New Method for

Automatic Vehicle License Plate Detection," IEEE LATIN AMERICA TRANSACTIONS, VOL. 15, NO. 1, pp. 75-80, JAN. 2017.

[6] K. Horak, J. Klecka, and P. Novacek, "License Plate Detection Using Point of Interest Detectors and Descriptors," IEEE, pp. 484-488, 2016.

[7] R. Yang, H. Yin and X. Chen, "License Plate Detection Based On Sparse Auto-Encoder," 8th International Symposium on Computational Intelligence and Design, pp. 465-469, 2015.

[8] S. Chhabra, H. Jain and S. Saini, "FPGA based Hardware Implementation of Automatic Vehicle License Plate Detection System," 2016 Intl. Conference on Advances in Computing, Communications and Informatics (ICACCI) Jaipur India, pp. 1181-1187, Sept. 21-24, 2016.

[9] Hetal N. Patel, K. Desai and T. Panchal "An Algorithm for Automatic License Plate Detection from video using corner features," International Conference on Information Processing (ICIP) Vishwakarma Institute of Technology, pp. 301-306, Dec 16-19, 2015.

[10] A. Dev, "A Novel Approach for Car License Plate Detection Based on Vertical Edges," Fifth International Conference on Advances in Computing and Communications, pp. 391-394, 2015.

[11] H. Weber and C.R. Jung, "Low-Cost License Plate Detection Using a Calibrated Camera," pp. 4763-4767, ICIP 2015.

[12] H. V. Dastjerdi, V. Rostami and F. Kheiri, "Automatic License Plate Detection System Based on the Point Weighting and Template Matching," 7th International Conference on Information and Knowledge Technology, 2015.

[13] D. Gautam and M. Ahmed, "Efficient Fuzzy edge detection using Successive Otsu's Method," International Conference for Convergence of Technology, pp. 1-5, 2014.

[14] N Otsu, "A Thresholding Selection Method from Gray-Level Histograms"*, IEEE Trans System Man Cybernetic,* pp. 62-66, 1979.

[15] M.M. Htay and A.K. Gopalakrishnan, "Localization and recognition of a Myanmar license plate based on partially cut character structure" *14th International Conference on ICT and Knowledge Engineering (ICT&KE)*, pp. 38 - 43, 2016.

[16] E.R. Lee, P.K.Kim and H.J. Kim, "Automatic recognition of a car license plate uslng color image processing" in Image Processing, *1994. Proceedings. ICIP-94., IEEE International Conference*, pp. 301-305, 1994.