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License Plate Detection of Myanmar Vehicle Images Captured from the Dissimilar Environmental Conditions

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***Abstract*— Due to the difficulty in defecting the images, in this paper, we proposed the method that can detect region of interest of the license plate for Myanmar vehicles captured from the dissimilar environmental conditions, e.g., different type of license plates, angle of image capturing, and real environmental conditions. In this paper, the horizontal and vertical dilation, skew angle detection and automatic bounding box were proposed to detect the license number from input images. In our experiment, the obtained results showed that an average detection accuracy of 99% which was substantially applied for the license plate detection from the dissimilar environmental conditions.**

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I. INTRODUCTION

Vehicle license plate detection is essential in numerous implementations: traffic control in unlimited areas; automatic payment of tolls for highways or bridges; general security systems wherever there is the need for distinguishing vehicles. According to the varying types of vehicles, the vertex of the plate from the ground varies depending on the car model and in some cases the plate is located in the lower-left or lower right part of the vehicle. Besides these displacements of the plate position in the vehicles, the distance between the camera and the vehicles may also vary, and then the localization of the plate inside the captured image plays a very critical role. Consequently, Myanmar characters and English characters license plates are investigated in this paper. Nowadays, Myanmar character plates are required for more advanced improvements in terms of modernized technologies. Currently, the vehicles license plates are being changed into English character. However, the Myanmar character is still remained.

First of all, it is necessary to introduce the interpretation of a Myanmar car license plate, which is composed of two lines. The first line represents the city and the second line represents

Myanmar Characters License Plates

White Color for United Nations

Yellow Color for Religion Persons

Saddle Brown for Hearse

Black Color for Private Cars

Blue Color for Foreigner Tour Buses

Red Color for Taxies

Green Color for Donation

Fig. 1. Types of Myanmar License Plates

the license numbers. There are eight types of license plates. They are described in the Figure 1. These consisting of various types in terms of colors. The first row shows as follows: Myanmar character taxi vehicle has white characters and a red background. In this license plate, there are six characters: second character is alphabet and others are numbers. The second row displays as follows: United Nations vehicle has black characters and a white background. In this license plate, there are five characters: the first two characters are alphabet and others are numbers. In the third row presents as follows: a religion

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vehicle has black characters and a yellow background, a hearse vehicle has white characters and a saddle brown background. In these license plates, there are seven characters: the first three characters are alphabet and others are numbers. The last row describes as follows: a private vehicle has a white character and a black background, a foreigner vehicle has white characters and a blue background, a taxi vehicle has white characters and a red background, a donation vehicle has white characters and a green background.

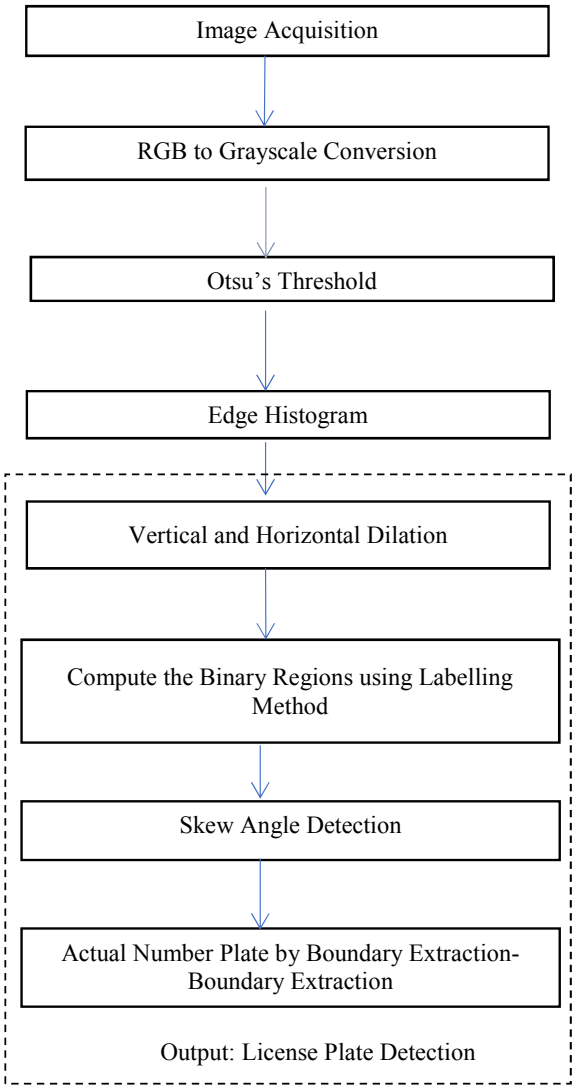

Fig. 2. Flowchart of Proposed Approach is Marked for Main Steps

In these license plate, there are six characters: second character is alphabet and others are numbers. All of the license plate include boundary. To address these dissimilar environmental conditions, these challenges made difficult in detecting a region of interest, i.e., license plate, from the original image by the traditional methods as detailed below in Section II. Therefore, in this paper, we proposed the method dealing with different types of license plates. The experimental result is intended to be a traffic-light development in Myanmar. This experimental paradigm has been expressed to arrangement top rates of convergence and properties of strength and good condition of the solution. The data at hand, includes digitized images of vehicles, captured by a high-resolution Nikon D90 (14-megapixel resolution) camera and recorded in a DVD.

II. LITERATURE REVIEWS

Effective approaches occur and have been illustrated in the previous literatures. They are mainly found on a high definition detection algorithm and stroke transform and neural network. Recently, M.M. Htay and A.K. Gopalakrishnan presented the localization and recognition according to the partially cut character structure and compare them in terms of pros, cons, accuracy and processing speed [1]. In [2], S. Kaur proposed method for number plate extraction. For plate extraction, several traditional images processing techniques such as morphological operations, image subtraction, thresholding and Sobel edge detection. In [3], V. Shapiro et al. presented the License Plate Localization (LPL) component of a Car License Plate Recognition (CLPR) system which runs with single frame gray-level images, captured at individual daytime and weather conditions as an input. The described plate localization method gave the excellent results. In [4], B. Shan contended based text-line construction and neural network for license plate recognition. A new method of vehicle license plate recognition (VLPR) was presented in this paper. In [5], A.P. RamyaSri proposed the number plate localization system. In this system, edge detection and morphological operation are used. The algorithm was reliable and adjustable for the different lighting conditions. K. Makaoui considered the license plate localization by wavelet transform, morphological operations and projection operations method [6]. In [7], I. Bulugu proposed an algorithm for license plate localization and recognition for Tanzania car plate numbers to design algorithm for localization and recognition. To increase the readable of plate number, part of the image was enlarged, noise removal and smoothing median filter was used due to easy development. In [8], G. Abo Samra and F. Khalefah proposed the localization of license plate number using dynamic image processing techniques and genetic algorithms. It focused on connected component analysis technique (CCAT) to detect the objects. The results showed that the increment of speed and memory. It can be applied in other problem domains

related to the license plate (LP) problem. Some works [10-15] have given consideration on license plate detection. Generally, their techniques are based on adaptive morphological closing, support vector machine, new zone based and Riesz fractional based model, any of which also need a lot of effort and a long time. Besides, the previous algorithms are not consistent with Myanmar license plates due to differences in aspect ratio and types of the plates. In other words, our topic of dissimilar environmental conditions is never studied before.

III. PROPOSED METHOD

The captured images are converted into gray scale images using Otsu's method. Results of the process are shown in Figure 3 to Figure 11. The proposed system consists of two main processes: dilation and skew detection. The dilation process starts with the search and detection of the edge of the license plate. After the skew angle detection of the plate has been recognized, this algorithm rotates it to correct for this skew. The flowchart of our proposed method is shown in Figure 2.

A. Image Acquisition

The images are taken at various distances about 200cm. Both the Myanmar and English characters vehicles images are captured. The resolution of the captured image is 4.15 MB. The images are taken by the digital camera; Nikon D90 (14-megapixel resolution) at various conditions. Region of interest (ROI) is the license plate located on the input image. The taken images are shown Figure 3.

B. RGB to Grayscale Conversion

In this paper, the grayscale images are attained from the colour images. The RGB image comprises 30% of red, 60% of green and 11% of blue. The image or 8-bit resolution which value range of 0 means black and the value 255 means white. The limits are between black and white values. The function converts color images to grayscale by eliminating the hue and saturation information. The resulting images are the two dimensions. The result of this method is shown Figure 4.

C. Thresholding by Otsu's Method

The threshold value is very important thing. That value is decided through many tests. Once made a histogram of brightness information. This method is used to convert a gray image to a binary image. It separates 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. At this stage, Otsu separates objects from the vehicle images ideally. The result of this method is shown Figure 5.

Algorithm:
The Otsu's method [9], [16], is defined by:

$$\sigma_w^2(t) = w_1(t)\sigma_1^2(t) + w_2(t)\sigma_2^2(t) \qquad (1)$$

where the weights w_1 and w_2 are the two categories divided by a threshold t, σ_1^2 and σ_2^2 are the variation of these categories.

D. Edge Histogram

This step is to build a histogram with the directions of the edges. It detects 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 position is plate area. Therefore, edge histogram is used to get the position of plate area. Edge histogram shows better than other histograms. The result of this method is shown Figure 6.

E. Vertical and Horizontal dilation

The goal is to perform the dilation of input image using the structuring element and returning the dilated image. Conventional dilation uses fixed Structuring Element. In other words, the resolution and model of vehicle cannot be changed when it is applied. Another way is using the dilation is practically interesting because of its property [10]. The main idea of dilation specifies and determines the element of the neighborhood by MATLAB functions as: `imdilate(IM, SE)` and `imdilate(IM, NHOOD)`.

In the localization part, the entire images are input, and then the dilation method identifies the plate area. The 4288 x 2848 pixels of the sizable input images are applied in this process. The value of the output 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 images have good condition. In order to identify the plate area, the dilation method is needed for computing the binary regions of next step. The result of this method is shown Figure 7.

F. Compute the Binary Regions using Labelling Method

The result of previous step was handled by labelling method. This method is required to know more exact location of plate. The first processing is '`binarization`'. It takes in a binary image. This image contains many objects that are separated from each other's. In this paper, we use the labelling method to receive the high region as important features to detect license plates. The result of this method is shown Figure 8.

The pseudo-code for integral image `num`, binary region `BL`, license plate `L`, column of input image *c,* row of input image `r`,

index of input image `v`, area `A`, maximum m, largest binary region indexes `La` and `Lb`, as follows.

Pseudo-code of the Labelling Method is:

```
1: procedure LM (c, r, L, A,)
2: L= BL
3: num=BL
4: A=0
5: for i = 1 to num
6: if (L==i) then
7: r=L
8: c=L
9: v=L
10: A(i)=sum(v)
11: end if
12: if (Area ==max(Area)) then
13: La= Area
14: Lb=Area
15: end if
16: end for
17: end procedure
```

G. Skew Angle Detection

There are a few methods for skew angle detection, some depend on detecting associated components and searching the regular angles fixing 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 few times on large images, but gets the rotation exact. The next is somewhat less accurate, but faster and works pretty well with slight skews that are typical in license images. This method uses two shears to produce its outcomes. Final choice is the coordinate rotation, applying more on accuracy than speed and this method is not slow. Although, this method is not steady under inappropriate rotation of the detected plate.

The `imrotate()` function creates an output image to include the entire the input image. Similarly, this function uses nearest-neighbour interpolation to determine the value of pixels in the output image. We specify the image to be rotated and the rotation angle, in degrees. The block diagram of skew angle detection method is shown in Figure 9 and result of this method is shown Figure 10.

H. Actual Number Plate by Boundary Extraction

The method for extraction is presented. The current method is based on bounding box. The function `bwboundaries` specifies the objects on the vehicle image with a rectangle boundary marked in blue. In other words, the proposed method is effect on the different types of license plates.

Here the symbols are extracted from the vehicle images as shown in Figure 11. It analyses the boundary of objects in the images. To get the more accurate results, this process also fills the traced region with pixels. This process extracts the various positions of license plates.

Fig. 3. Typical Examples of Captured Myanmar License Plates

Fig. 4. Grayscale Images

Fig.5. Otsu's Thresholding

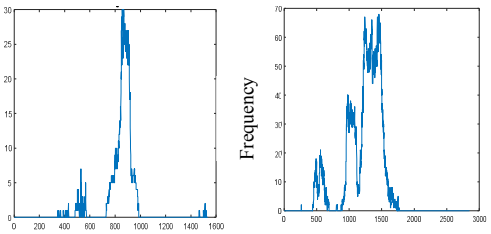

Fig. 6. Edge Detection Based on Histogram

Fig. 7. Results of Dilation Method

Fig. 8. Binary Regions by Labelling Method

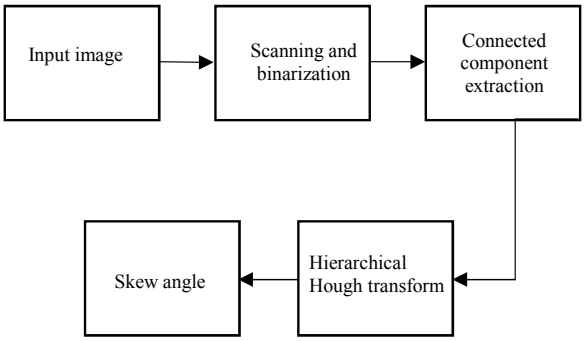

Fig. 9. Block Diagram of Skew Angle Detection

Fig. 10. Skew Angle Detection and Correction of the Images

Fig. 11. Actual Number Plate Detection by Boundary Extraction

IV. ERIMENT AND RESULTS

An experiment has been carried out on the captured vehicle images that are taken by traffic-light development in Myanmar. Over 30 vehicles' images are recorded. For expanding the complexity, the images are obtained at dissimilar circumstances, darker and cloudy, sizes, positions, resolutions and colors of plates from the various distances. The obtained results of proposed method for number plate detection is shown in TABLE I.

For comparisons, the recommended method [3] in which edge detection, filtering and slope evaluation is used for license plate extraction. Despite the fact that, different daylight conditions are examined, there are portions of the plate that are shadowed and leading to reject of detection. The accuracy of the existing method is 90%. Furthermore, [11] in which morphological approach and template matching is based for license plate detection and character recognition system. Due to the presence of complicated background and irregular license plate patterns in the vehicle images, the success rate of this algorithm is 93%. For our method, the wanted license plate is greatly detected. The total capacity of the license plate detection is 99%. The advantage of our proposed method can verify through the previous experiments. The performance comparison is shown in TABLE II.

TABLE I. PROPOSED TECHNIQUE RESULTS

Proposed Technique for Different Detected License Plates
Different Sizes and Positions 
Different Types of License Plates 
Cloudy and Darker 
Different Conditions 

TABEL II. PERFORMANCE COMPARISON OF RESULTS

Type of License Plate	**Proposed Method**	**Conventional Method [3]**	**Conventional Method [11]**
Private Cars	96% (24/25)	-	-
Taxi	100% (4/4)	-	-
Tour Buses	100% (1/1)	-	-
Myanmar Character Cars	100% (3/3)	-	-
Average	99%	90%	93%

Based on the proposed method, 1% error in license plate detection is due to the dimensions of image. The error of detection is due to the compact size of image, e.g., 162×102. It can be upgraded by contrast enhancement techniques. Since in this proposed method, 300 dpi resolution of 4288×2848 pixels are used. The essential parameter of image size is used in this work. In real world, it is the sizable image and can be practically used by traffic light development in Myanmar.

V. CONCLUSIONS

The essential purpose of this research project is to examine and observe a suitable approach to detect the Myanmar vehicles license plate from the dissimilar environmental conditions. This paper conferred some of the results of the experiment that showed a very strong detection for the isolated license plate. To validate the proposed method, experiments are done with the vehicle images. There may be the detection failure if the images are related color between body and plate of a vehicle or the size of a plate part is very small compared with the whole image. Moreover, we found that post processing can solve this problem. However, the detection result using the proposed model shows better performance since 99% of the photos tested are accurately identified. In the future work, the character recognition of the detected license plate should be developed.

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