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Myanmar Warning Board Recognition System

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ORIGINAL ARTICLE

Abstract: In any country, warning text is described on the signboards or wall papers to follow by everybody. This paper present Myanmar character recognition from various warning text signboards using block based pixel count and eight-directions chain code. Character recognition is the process of converting a printed or typewritten or handwritten text image file into editable and searchable text file. In this system, the characters on the warning signboard images are recognized using the hybrid eight direction chain code features and 16-blocks based pixel count features. Basically, there are three steps of character recognition such as character segmentation, feature extraction and classification. In segmentation step, horizontal cropping method is used for line segmentation, vertically cropping method and bounding box is used for connected component character segmentation. In the classification step, the performance accuracy is measured by two ways such as KNN (K's Nearest Neivour) classifier and feature based approach of template matching on 150 warning text signboard images.

Keywords: *Character segmentation; feature extraction; KNN classifier, template matching*

I. INTRODUCTION

Warning signboard recognition is important in several fields of application: machine language translation, text to speech conversion, helping for visually impaired persons and foreigners. Some approaches exist and have been described in literature. Some researchers recognized Myanmar handwritten characters based on structural features and statistical features. Myanmar character recognition systems were developed for the applications of car plate number recognition, date and amount number recognition on the bank cheque, printed character recognition on standard application form, bilingual Myanmar-English character recognition form document image, handwritten Myanmar consonant character recognition [4],[9],[12]. They are mainly based on pattern matching and normalized correlation with a large database of stored templates. In this paper, we describe an experimental system for the recognition of Myanmar warning text signboards. Warning signboards are located in everywhere (for example, the beside of street, front of home or shop, schools, university, hospitals, offices, highway gate, bus car gates, in the places of repairing the street or bridge, etc.) and it may be different warning text according to the different located places. Some warning papers are located on the brick wall, on the tree on the door.

Since the warning boards or warning papers may not located at the exactly front of the camera, there is a skewing problem for that boards or papers. Beside these variations of the warning board position, the distance between the camera and the vehicle may also vary, and the extraction of text from the captured image plays a very important role. This learning approach has been shown to guarantee high rates of convergence and properties of stability and robustness of the solution. The data at hand consist of digitized images of warning boards, acquired by a high-resolution mobile phone camera and collected in a gallery. Common problems for camera captured text images are variations in font style, size, color, orientation, illumination condition as well as the complex background. Recently, Myanmar character recognition is an active research area for various applications. The authors used various methods for Myanmar character recognition. Scene character recognition system has been developed maturely for different languages such as English, Japanese or Chinese etc. but Myanmar signboard character recognition is still infancy.

The probable application of scene text recognition is to assist the visually impaired person, number plate recognition, intelligent vehicle driving systems, machine language translation and may provide help in machine reading for robotics systems. Among various challenges the most prominent is orientation and size of a text in a scene image. Current optical character recognition (OCR) systems can

achieve almost perfect recognition rate on printed text in scanned documents, but cannot accurately recognize text information directly from camera-captured scene images and videos.

The rest of this paper includes related work presented in Section 2. Dataset and Myanmar script nature is described in Section 3. The proposed methodology including text extraction and noise removing, segmentation, feature extraction technique and classification is described in Section 4. Experimental results and comparison is shown in Section 5 and Error analysis is presented in Section 6. Finally, Conclusion is placed in the Section 7.

II. RELATED WORKS

A very few work of character recognition has been reported on Myanmar script. Most of the work is found on Machine Printed document Images and handwritten document images of Myanmar script. In 2005, T.Swe and P.Tin proposed a Myanmar printed character recognition and translation system using a hoped field neural network. They displayed experimental result using a standard application form. They achieved 97.56% on printed character recognition rate and 94.61% on word recognition rate [9]. In 2008, E.E.Phyu and et.al proposed online handwritten Myanmar compound words recognition system based on Myanmar Intelligent Character Recognition (MICR).

They achieved 95.45% and 93.81% recognition rate for typeface and handwritten compound words respectively [2]. In 2010, Y. Thein and S.S. S. Yee contributed an effective Myanmar Handwritten Characters Recognition System using MICR and back propagation neural network. This system only takes 3 seconds average processing time for 1000 word samples and 93% recognition rate for 1000 samples of noise free image [10]. In 2013, Al-Hashemi and Alsharari developed a new system that translates Arabic texts of the signboards into English text by using mobile phone camera. The experimental results of character recognition rate are 81.82% and translation rate is 83.33% [1]. In 2014, Angadi and Kodabagi presented a robust segmentation method for line, word and character extraction from Kannada Text in low resolution display board images. They used projection profile features and pixel distribution statistics for segmentation of text lines. They also used k-means clustering to group inter-character gaps into character and word cluster spaces. This method achieved text line segmentation accuracy of 97.17%, word segmentation accuracy of 97.54% and character extraction accuracy of 99.09% [7].

In 2011, H.P.P.Win proposed a Bilingual OCR System for both Myanmar and English script using multiclass- Support Vector Machine (SVM). They used connected component segmentation method, 25 features of zoning, 60 features of horizontal and vertical profiles methods. This paper achieved 98.89% segmentation rate for 6 Myanmar printed documents [4]. Emmanuel and George, 2013, described a method for the detection and recognition of the Malayalam text from color natural scene image taken by a mobile phone camera. They used edge profile based method for text detection, bounding box method for text segmentation and template matching method for character recognition. Their algorithm overcomes the problem of challenge like complex background, different font styles, size, and orientations [3]. In 2016, M. Sayed and S. A. Angadi presented a mobile application for capturing display boards having Kannada text and further giving its English meaning. The character recognition accuracy of this paper is 89.94% on 13 images [6]. In 2017, Ahmed, Saad Bin, et al presented Arabic scene text recognition using Convolutional Neural Networks (ConvNets) as a deep learning classifier. They evaluated on the dataset of 2700 characters of 27 classes and reported the encouraging results on recognition of Arabic characters from segmented Arabic scene images [8]. In 2017, K. P. Zaw and Z. M. Kyu proposed a method of segmentation for Myanmar character recognition using blocked based pixel count and aspect ratio. The segmented characters are classified using feature matching method. In this system, only printed character from the text images can be segmented and recognized by training 98 Myanmar typed-face characters [5].

Most of the above related papers focus on only the printed character recognition system or only the handwritten character recognition system. Therefore, their accuracy is very good. It is rarely found the recognition system on both printed and handwritten text with different font size and different text styles. In our proposed system, 150 warning text boards that have various styles, fonts, size and colors. Unlike previous research papers, this system is investigated on both handwritten warning text and printed warning text. Although the system classified the characters by two methods, only the KNN classifier achieves the more accuracy and takes short time.

III. DATASET AND NATURE OF MYANMAR SCRIPT

In the proposed system, training dataset of 349 Myanmar connected characters with Zawgyi One 64 points is created using snipping tool. Here, Myanmar characters may be consonants or vowels or compound (i.e. combination of basic consonants and vowel modifiers or consonant modifiers. In this system, 150 warning text signboard images are collected from various environments since there is no available standard dataset for Myanmar text extraction and recognition system, where the signboard images are captured with the resize range of 300x200 to 600x400.

Myanmar characters can be divided into two types: basic characters and extended characters. The basic characters

(consonants) may stand as single character or may be combined with one or more extended characters. The extended characters may be at left or right or top or bottom of the basic character as shown in Fig. 1.

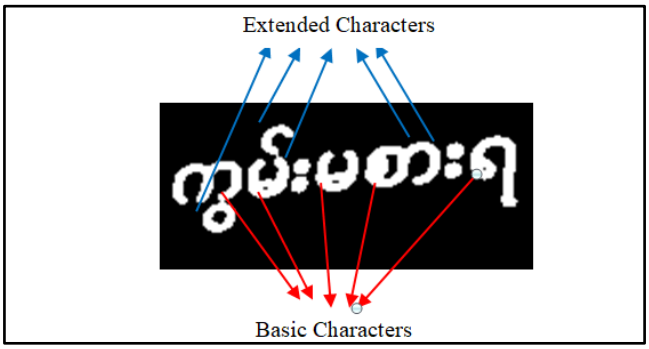


Fig.1 Styles of Myanmar Characters

IV. PPROPOSED SYSTEM

The proposed system consists of two main processes: the training and the recognition processes. In the training process, 349 printed characters are used for creating a database with the chain code features and block based density features extracted from each character. In the recognition process, there are many steps such as text extraction, segmentation, features extraction and classification to accomplish the warning board recognition process. Before any processing is done, all the signboard images are pre-resized to fix the identified region area range of connected component object and binaries that image. Therefore, the size of signboard images may not be uniformed according to the distance from the phone camera, character size, the number of horizontal text lines, number of characters, etc.

In the binary images, there may be found very large and very small objects which are not actually text in the warning board as shown in Fig. 2.

Fig 2. Input warning text image (left) and binary image (right)

These objects are removed by size of character and size of text region. After removing the noise, the text region area is extracted, and the segmentation step is going to perform. In the segmentation step, it can be easily to segment the lines, words and characters by using horizontal projection profile method, vertical projection profile method and labeling methods for non-skewing images. After segmentation step, chain code normalization features and pixel density features are extracted from each character or word.

In this paper, Myanmar characters from warning text signboards are recognized using the proposed features. In this character recognition system, the following four main steps are performed.

A. Text Extraction and Noise Filtering

In this system the text regions and non-text regions are identified based on region area of connected component objects as in the following condition:

If Region_area less than 10 OR
Region_area greater than 800

Then Region is assumed as non_text region

If Region_area greater than 10 OR
Region_area less than 800

Then Region is assumed as text region

And then, the system dilates the text regions and uses median filter operations to get the significant text regions. After dilation and median filtering are done, some background objects such as brick, window, tree, etc. may miss with text regions. Therefore, the region areas that less than 700 are further identified as non-text regions. And then, localization is done by using bounding box. Even localizing the text-regions, non-text regions still remain. Therefore, we also remove that non-text region by using the following condition:

If Row_of_Region greater than the sum of Column_of_Region and (0.05*Column_of_Region) OR (Row_of_Region less than 25 AND Column_of_Region greater than 6*(Row_of_Region)

Then Region is assigned as Non_Text_Region;

Finally, the text line regions are extracted by using imcrop() and save as a file. In the resulted text line region, noise objects may also contain. Therefore, the noise objects from the text line regions are removed by the following condition:

If (row less than 10 AND col greater than 3*row) OR (col less than 15 AND row less than 15) OR (col greater than 65) OR (row greater than 65)

Then Object = noise;
The final text grouping image and the localized image is shown in Fig. 3.

Fig. 3 Final text grouping image and localization on original images

B. Segmentation

In this character recognition system for warning text signboard, segmentation phase is an important phase and accuracy of any OCR heavily depends upon segmentation phase. In the segmentation step, vertical cropping method and bounding box method are used to segment the characters from the cropped text line region.

The vertical cropping (character or vertically connected word segmentation) steps are as follow:

1. Count the black pixel in each column of the image [11].
2. Find the columns containing no white pixel [11].
3. Crop each character
4. Input the cropping character image to feature extraction step.

The illustration of word segmentation is shown in Fig 4.

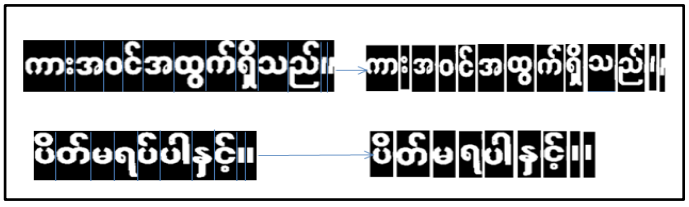


Fig. 4 Illustration of word segmentation

The illustraion of horizontally non-connected character segmentation using bounding box is shown in Fig. 5 and the character segmentation accuracy of 150 warning signboard image is shown in TABLE I.

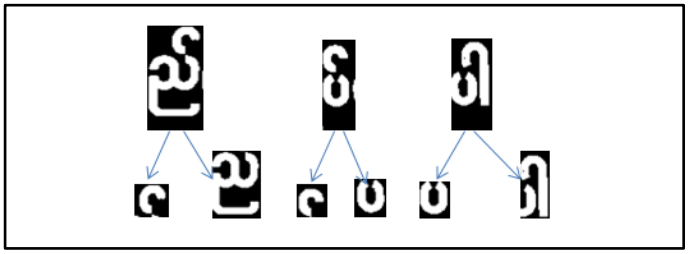


Fig. 5 Illustration of character segmentation

TABLE I. SEGMENTATION PERFORMANCE

Number of Tested Images	Detected Characters in Images	Truly (detect) Segmented Characters	Miss Characters	Segmentation Accuracy
150	**2233**	**2088**	**145**	**93.51%**

C. Feature Extraction

The feature extraction is described about the characteristics of an image. It is one of the most important components for any recognition system, since the classification/recognition accuracy is depending on the features. In this character recognition system, 8-direction chain code features on the whole character and sixteen blocks based pixel count are extracted from each character [5]. The illustration of 8-direction chain code extraction is shown in Fig. 6 and described as algorithm in the sub-section. These extracted features are given for training the classifier.

1) Eight Direction Chain Code Algorithm

Begin
Input : Image Boundary.
Output : Chain Code.
Step1. Define sp of Image Boundary.
Step2. Let sp_x=0, sp_y=0.
Step3. cp_x = sp_x and cp_y= sp_y.

Step4. If np_x==1 and np_y==0, cc = 0.
Elseif np_x==1 and np_y==1, cc=1.
Elseif np_x==0 and np_y==1, cc=2.
Elseif np_x==-1 and np_y==1, cc=3.
Elseif np_x==-1 and np_y==0, cc=4.
Elseif np_x==-1 and np_y==-1, cc=5.
Elseif np_x==0 and np_y==-1, cc=6.
Elseif np_x==1 and np_y==-1, cc=7.
Endif

Step5. Repeat step 3 and 4 until ep of Image Boundary.
End

Where,

sp = start point
cp= current point
np_x= x coordinate of next point
np_y= y coordinate of next point
cc= chain code
ep= end point

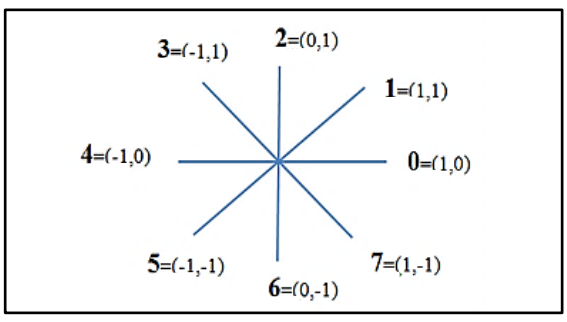


Fig. 6 Eight-direction chain code

2) Feature Extraction Algorithm

Begin
Input : Pre-processed (100x100) size normalized character image as shown in the left of Fig. 7.
Output: 24 features

1. Find the chain code frequency of eight directions on the whole character by (1) and outcomes 8 features as shown in the right of Fig. 7.

2. Divide the input character into 16 non-overlapping blocks as in Fig. 8(a).

   a. Find the chain code frequency of eight directions on each block as in step 2.

   b. Sum the frequencies of eight directions by (2) and these total frequency value is assumed as one feature for one block. Therefore, 16 features are obtained for 16 blocks as in Fig. 8(b).

3. Finally, 24 features are extracted from step 1, 2. End

Note that, C_i = Count of i direction and F_i = Frequency of i direction on the whole character; where, i = 0, 2, 3,…., 7.

$$F_i = C_i \quad (1)$$

Note that, B_n = Total frequency of eight directions on Block n of character, where n= 1, 2, 3, …, 16

$$B_n = \sum_{i=0}^{7} F_i \quad (2)$$

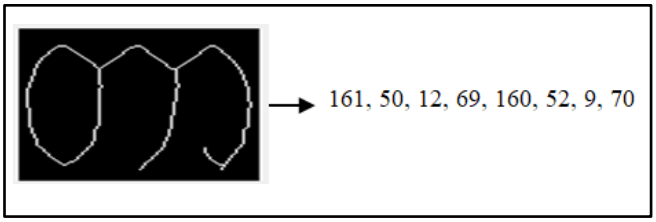
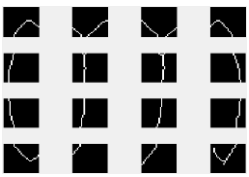


Fig. 7 Preprocessing scene character "tar" (left) and eight direction chain code features (right)



42	14	26	40
48	50	53	48
48	48	48	48
42	16	34	59

(a) (b)

Fig. 8 (a) Character with sixteen blocks and (b) pixel count in each block

D. *Classification*

This character recognition system is tested by the two ways of KNN classification learner and feature based approach of template matching. After the classifier is trained it is checked for the accuracy of classifying the new images. Unlike other system, this system trains 349 printed character images and tests the various font style characters extracted from real world warning text images.

The purpose of this paper is to successfully recognize Myanmar characters from the warning text image and store them with ease. Samples of warning text images that are tested in this system are shown in Fig. 9.

Fig. 9 Sample tested images of the system

V. EXPERIMENTAL RESULTS AND COMPARISON

In this experiment, 349 Myanmar Printed characters that contain 72 single characters, 171 two-connected component characters, 94 three-connected component characters, 10 four-connected component characters and 2 five-connected component characters are trained and correctly segmented 2088 characters from 150 warning text signboards are tested. In this system, character classification is tested by the two methods of KNN classifier and feature based approach of template matching. The results of classification performance are shown in TABLE II.

TABLE II. PERFORMANCE OF CHARACTER CLASSIFICATION

No of Images	Correctly Segmented characters	KNN	Template Matching
150	**2088**	**71.84%**	**69.44%**

VI. ERROR ANALYSIS

There are a few limitations in this system such as:

1) The present work cannot be applied for cursive writing because between each consecutive character a space (column width all white pixels) is considered for segmentation.

2) Although the segmentation rule for dis-connected single characters (wasapout and potema) is identified, if it is not equal to the rule, these characters may be frequently miss-segmented as shown in Fig. 10.

3) Although only one sample for one character are used in training dataset, the classification accuracy is acceptable in this character recognition system.

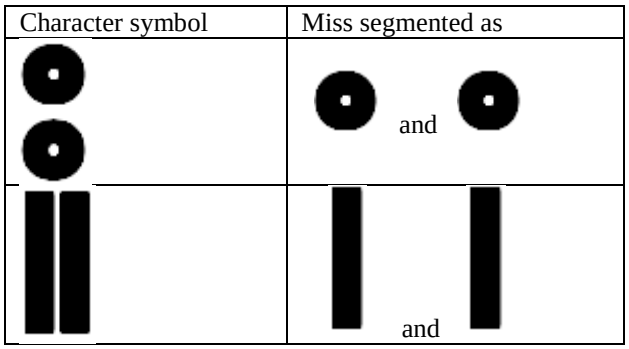


Fig. 10 Formation of miss segmented characters

VII. CONCLUSION

This paper has presented Myanmar character recognition from warning text signboard using number of pixel on 16-blocks character and eight direction chain code features on the whole character. KNN classifier and feature based approach of template matching are used to classify 2088 characters extracted from 150 warning signboard text images. After passing through all these stages, the recognized Myanmar characters are written on a notepad. By using KNN classifier and feature based approach of template matching, the system achieves 71.84% and 69.44% classification rate respectively. The proposed eight direction chain code features and 16-blocks based pixel count features can overcome the various font styles of the text, size of the text and orientation of the text on the cropped warning signboard images. And also the feature extraction method can also be used in character recognition of other languages such as Arabic, Kannada, Malayalam.

VIII. DECLARATION

Authors have disclosed no conflicts of interests and the study was self-funded.

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