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Recognition of Characters by using GLSM and EDMS Feature Extraction Methods

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Abstract
In this paper we are implementing a method to recognize the characters. For the extraction of features two techniques are used. The first one is Gray Level Co-occurrence Matrix (GLCM) and Edge Direction Matrixes (EDMS). The most important step in the character recognition is selection of best feature extraction technique. In the dataset different images are taken like binary images and feature extraction techniques are applied on those characters. By seeing the results we can say that EDMS and GLCM are giving better results compared to the neural network, bayes network and decision tree classifiers.

Keywords— feature extraction, character recognition, image processing, OCR

1. Introduction

Optical character recognition (OCR) that firstly has been proposed by Gustav Tauschek in 1929 is one of the most important fields in pattern recognition world which is able to recognize handwritten characters, not well-organized characters and machine printed characters andconvert the handwritten or printed character image to the machine encoded text [1]. Generally character recognition system consists of five major tasks which are involved pre-processing, segmentation, feature extraction, classification and recognition. Pre-processing includes thresholding and determining the size and aspect ratio of images that has been normalized. Thresholding is applied to the images for removing the noises and separating background and foreground [2] Image segmentation is the next critical step which is used to cluster the pixel of image in order to provide information for the surface of the image [3, 4].

Feature extraction that comes after image segmentation has been applied in order to extract all the useful characteristic of character features and reduce the number of errors in character recognition process. The number of feature extraction methods which are available is considerable but identifying the best feature extraction technique for the purpose of character recognition is an important issue in image processing in order to achieve to the high accuracy in character recognition although the feature extraction method performance depends on the classifier that has been applied for the specific application [1, 5].Some global feature extraction methods that produces less discriminative features [6, 7] leads to reduce in

recognition rate. Edge Direction Matrix (EDMS) is a novel global feature extraction method [8, 9] that produces a set of global features.

The most important problem of EDMS is the number of produced features with this method which is just 18 features and is not enough for feature extraction purpose and it causes reducing the recognition rate. The aim of this research is improving the recognition rate of EDMS by combining with a global feature extraction method in order to increase the number of extracted feature and produce better recognition rate. Among the statistical feature extraction methods, Gray Level Co-occurrence Matrix (GLCM) is the most common statistical approach to global feature extraction techniques and is based on the spatial distribution of the values in image [6, 7] which has the most in common with EDMS comparing to other feature extraction methods. Some features of GLCM such as contrast, homogeneity, mean and correlation can affect the recognition rate of EDMS, when combine with the existing features of EDMS. By combining two global feature extraction methods the recognition rate can be improved and more discriminative features is extracted. High dimensionality of data in proposed combinatory method is the other problem which leads to higher processing time. Feature selection eliminates the features that reduce the recognition rate and also decrease the dimensionality of feature vector which speed up the recognition process.

2. Global Feature Extraction

Gray Level Co-occurrence Matrix (GLCM) method is a statistical feature extraction method for global feature extraction that has been proposed by [6, 7]. This method has been applied in various texture feature extraction. GLCM is based on a matrix that shows the distribution of occurrences in selected image. This method involves a statistical approach with a co-occurrence matrix which is able to describe a second order statistics for texture images. A gray-level co-occurrence matrix (GLCM) involves a two-dimensional histogram that i,j indicates the frequency of i occurs with event j. P(i, j, d, θ) indicates the co-occurrence matrix frequency and d is the distance for a pair of pixels. The direction is specified by θ which is with gray level i and j and angle θ can be 0°, 45°, 90°, and 135.The area of the texture is considered rectangular and has N_c pixels in the horizontal direction and Nr resolution cells in the vertical direction. In each resoulution cell the gray tone is defined by Ng levels. The horizontal spatial domain is defined by $L_c = \{1,2,\ldots,N_c\}$ and vertical spatial domain is defined by $L_r = \{1,2,\ldots,N_r\}$and the set of Ng quantized gray tones is defined by $G = \{1,2,\ldots,N_g\}$. The set of $(L_r \times L_c)$ is defined as the set of resolution cells of the image which are ordered by their row-column description. The image I can be represented as a function which assigns some gray tone in G to each Resolution cell of $L_r \times L_c$. The representations of un-normalized frequencies with different angles are as follows:

3. Spatial Feature Descriptor

Spatial feature extraction techniques commonly extract the spatial information such as texture, size, shape, orientation, position and so on. This type of feature extractor considers the spatial relationship between pixels and is based on a moving window or kernel [23]. Robinson compass mask is one of the gradient edge detection filters which determine the direction of a pixel by applying the template that matches the best local area of the pixel and can be considered as a spatial feature extraction technique [24]. These operators consists of eight kernels for each pixel which produced by rotating one kernel based on its coefficients circularly. Robinson filter coefficients consist of 0, 1, and 2, and while zeros corresponds to the line

direction. Robinson mask is defined by taking a single kernel and rotating it to the eight directions which are North, Northwest, West, Southwest, South, Southeast, East, and Northeast respectively.

4. Literature survey

[1] Optical character recognition (OCR) is a very active field for research and development, and has become one of the most successful applications of automatic pattern recognition. To avoid the curse of dimensionality and improve the recognition performance, an optical character recognition system based on image preprocessing technologies combined with Least Square Support Vector Machine (LS-SVM) has been developed, which first uses dynamic thresholding operation and robust gray value normalization to segment characters and extract features respectively, and then uses LS-SVM to classify characters based on features. The proposed method has been evaluated by carrying out recognition experiments on the optical characters of electronic components. The results show that the proposed method has a better recognition performance, and holds a lot of potential for developing robust recognition learning.

[2] Thresholding is one of the critical steps in pattern recognition and has a significant effect on the upcoming steps of image application, the important objectives of thresholding are as follows, separating objects from background, decreasing the capacity of data consequently increases speed. Handwritten recognition is one of the important issues, which have various applications in mobile devices. Peak signal noise ratio (PSNR) is one of the methods for measurement the quality of images. Our proposed method applies peak signal noise ratio (PSNR) as one of the indicator to segment the images. We also compare our proposed method with other existing methods and the results are comparable. This algorithm can be optimized to increase the performance. The result indicates that the proposed method works in average handwritten images because the PSNR value of proposed method is better than other methods.

[3] The objective of this paper is to propose an adaptive multi threshold for image segmentation precisely in object detection. Due to the different types of license plates being used, the requirement of an automatic LPR is rather different for each country. The proposed technique is applied on Malaysian LPR application. It is based on Multi Layer Perceptron trained by back propagation. The proposed adaptive threshold is introduced to find the optimum threshold values. The technique relies on the peak value from the graph of the number object versus specific range of threshold values. The proposed approach has improved the overall performance compared to current optimal threshold techniques. Further improvement on this method is in progress to accommodate real time system specification.

5. Proposed method

Gray Level Co-occurrence Matrix (GLCM) method is a feature extraction method for global feature extraction that has been proposed by Haralick et al [7]. This method has been applied in various texture feature extraction. GLCM is based on a matrix that shows the distribution of occurrences in selected image. As it is observable in the formula c is identified as a GLCM and I is a n × m image and (x, y) is a pixel pair that indicate the gray level value of i and j. Consequently the final result is a matrix which explains the occurrence of any pair of two pixels which are gray scale. The number of feature that has been derived from the matrix is 36.

$$C\ \Delta x, \Delta y\ (i,j) = \sum_{p=1}^{n} \sum_{q=1}^{m} \begin{cases} 1, if\ I(p,q) = iandI(p\Delta x, q+\Delta y) = j \\ 0, otherwise \end{cases}$$

One of the techniques that has been applied in this paper which named EDMS, discussed about a feature extraction method for optical font recognition that is Arabic calligraphy script image proposed by Bilal Bataineh et al [8]. The result of the proposed method had been compared with the Gray Level Co-occurrence Matrix (GLCM) method.

The proposed technique is based on generating two matrix which named EDM 1 and EDM2. In the first matrix each cell contains a position based on pixel neighborhood association and the position is 0 to 315 degree. By calculating the occurrence of EDM 1 values the relationship of pixel values can be determined, while we must consider that in edge image each pixel is related to two pixels. The second matrix which is 3 × 3 considered as a edge direction matrix and contains the relationship presentation of each pixel. By measuring the occurrence of each value in EDM2 the most important pixel relationship were identified. By using these two matrixes, various features can be extracted such as Homogeneity, Contrast, Angular Second Moment (ASM), Entropy, Energy, Correlation with 0°, 45°, 90° and 135° angles which are 28 features. Three different classifiers were used for the purpose of classification. The algorithm that has been used in this method is as follow: $EDM_1(2, 2)$.

For each pixel in Iedge(x, y)

If Iedge(x, y) is black pixel at center then

Increase number of occurrence at

$EDM_1(2,2)$ by 1.

If Iedge(x +1, y) is black pixel at 0° then

Increase number of occurrence at EDM1(2,3)

by 1.

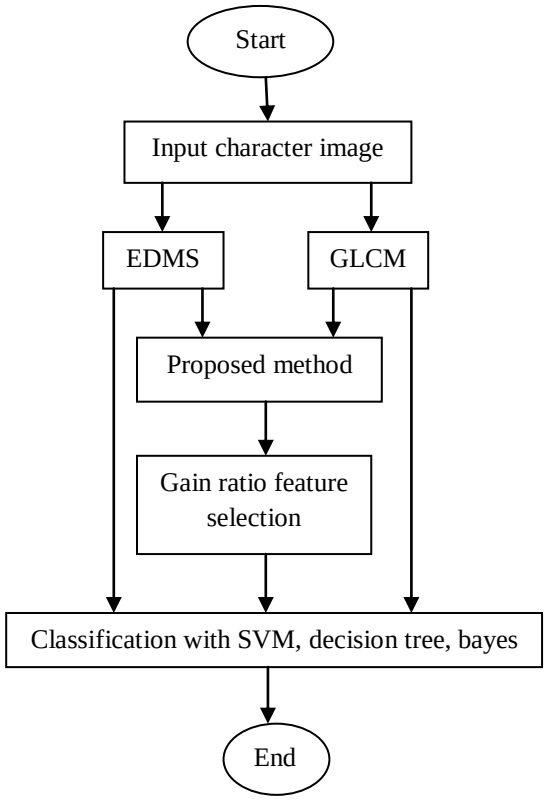

Fig. 1.The proposed framework.

If Iedge(x +1, y −1) is black pixel at 45° then

Increase number of occurrence at EDM_1 (1,3)

by 1

If Iedge(x, y −1) is black pixel at 90° then

Increase number of occurrence at EDM_1 ((1,2)

by 1.

If Iedge(x −1, y −1) is black pixel at 135°then

Increase number of occurrence at EDM_1 (1,1)

by 1.

According to the experimental results EDMS performed better than the GLCM method and reach to the considerable performance which was 97.85% with applying the decision tree as the classifier.

The EDMS method which was applied to the Arabic calligraphy script image shows a considerable improve in compared to the GLCM, so in for the purpose of performing comparative study on the feature extraction methods.

We applied GLCM and EDMS methods to a set of binary character in order to develop a new technique for feature extraction which is the combination of these two methods. The original features were 58 but after performing the feature selection reduces it to 34 and the new method with 34 features has been developed. As we can observe in Table I, selected feature has been highlighted. We used the gain ratio attribute reduction and ranker search for selecting these 34 features (Fig 1).

6. Results

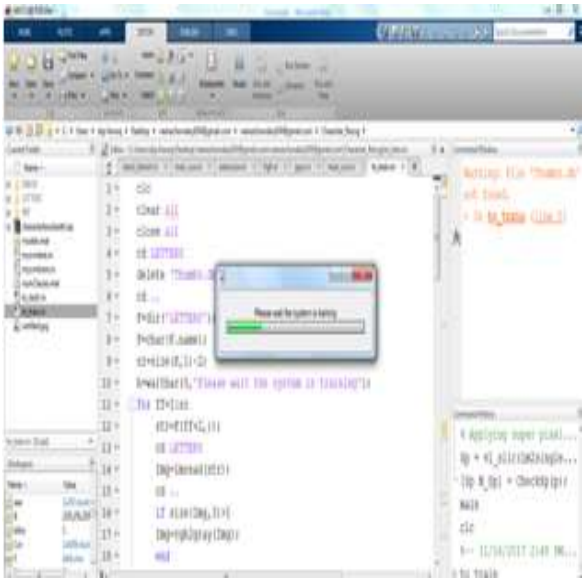

Fig.1 Training the system

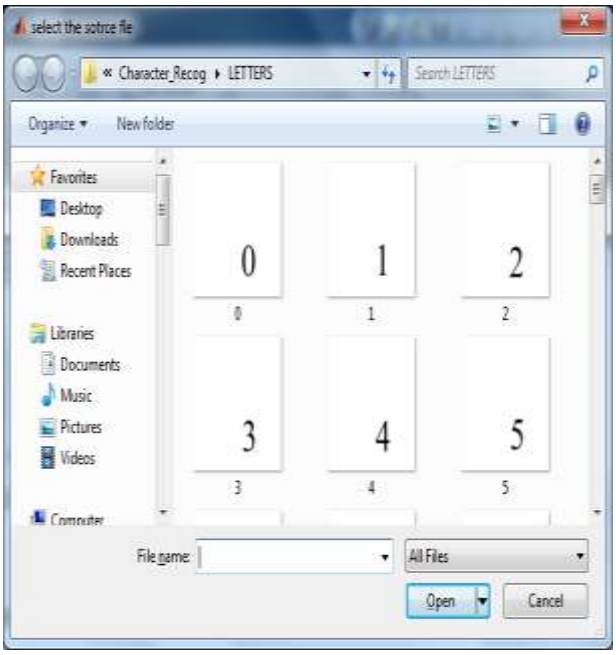

Fig.2 Select the Character for recognition

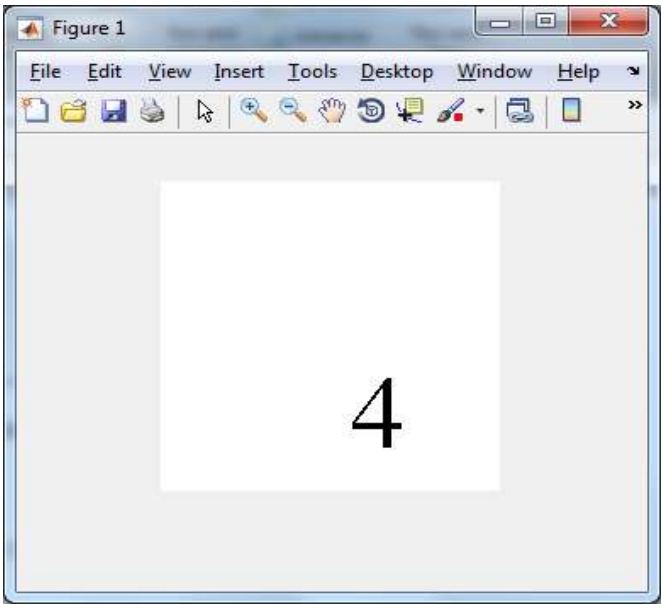

Fig.3 selected character among the data base

Fig.4 Recognized character result by proposed work

7. Conclusion

In this we proposed a method to extract the feature of a character. Mainly we are using Gray level Co-occurrence Matrix (GLCM) and EDMS which is proposed by Bilal Bataineh. By seeing the experimental results we can say that our proposed method is giving better results compared to the existing methods

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