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Authentication using Palm Print Recognition System

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Key words: Palm print, Preprocessing, Gray Level Co-occurrence Matrix (GLCM) and Support Vector Machine classification (SVM)

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Abstract: Personal authentication plays a unique role in the public security, access control, forensic and E-banking. Palm print recognition has been recognized as an effective biometric identifier because it is more reliable and user friendly. Existing methods used in palm print recognition lacks in reliability, accuracy and have higher error rate. The proposed scheme implements palm print recognition system using Gray Level Co-occurrence Matrix (GLCM) in feature extraction and Support Vector Machine (SVM) in classification. The proposed method not only uses the orientation features and also includes second order features like energy, correlation, contrast and homogeneity for recognition and comparison. It shows robustness to noise and rotation. It has a simple and effective balancing scheme to improve the precision of the orientation feature of the palm print. Experiments conducted on dataset demonstrate that proposed method give better results than existing orientation methods. The Proposed method enhances the accuracy and also it reduces the average error rate in classification.

INTRODUCTION

Background: Data mining is an interdisciplinary sub field of computer science. Data mining deals with the extraction of knowledge from large amount of observational data sets, to identify unsuspected relationship and patterns hidden in data. It summarizes the data in different behavior to provide understandability to the data users. Digital image processing is the sub category of data mining which analyzes and manipulates digital image in order to improve its quality.

Digital image processing: Digital image processing accords with the use of computer algorithms to implement image processing on digital images. Analog demands high quality processing which requires costly hardware, storage and high power. Digital image processing has more advantages than analog image processing; it acquiesce much wider range of algorithms to be exercised on the input data which can avoid problems such as quality degradation due to noise and signal distortion during processing. It is easy to manipulate the images and has compact storage. Biometrics is a technology used to determine, analyze and measure an individual’s physical and behavioral characteristics. Biometrics is used for authenticating and authorizing a person. Image processing is required for analyzing an individual whose biometric image is collected in the database formerly. Faces, fingerprints, irises, etc. are image-based biometrics which demands image processing and pattern recognition techniques. Of all the biometrics, Palm print biometric system is user-friendly and uses both first order and second order features for authentication. Image processing methods can be classified into three functional categories-image restoration, image enhancement and feature extraction.

Palm print recognition: Palm print composed of geometric features, line features, point features, statistical features and texture features. The palm print geometric features of adults are relatively similar in terms of palm size and palm width. As a result, they are inadequate to identify individuals. Ridges are the fine lines of the palm print. Wrinkles are the coarse line of the palm print while the principle lines are major line that is accessible on most of the palm (headline, lifeline and heart line). These palm print line features are not sufficient to achieve higher accuracy. So, second order features like contrast, energy, correlation and homogeneity are included in proposed scheme to uniquely identify the individuals.

Literature review: In this study, we discuss existing solutions for the palm print authentication and several state of palm print recognition methods are reviewed.

Code based method: In a recent paper, Kong and Zhang[1] proposed a principal orientation-based method, named competitive code which uses six Gabor filters of different orientations to extract the dominant orientation of a palm print. Multiple elliptical Gabor filters with different orientations are engaged to extract the phase information on a palm print image which is then merged according to the fusion rule to produce a single feature called the Fusion Code. Kong *et al*.[2] proposed the fusion code method that encodes the phase of the filtering result with a maximum magnitude among the four filters. The code method uses six Gabor filters[3] with different orientations, $j\pi/6(j = 0, 1, \ldots, 5)$, to extract one dominant orientation feature from a palm print. It is efficient in memory usage but lacks in matching speed.

Binary orientation concurrence vector: Guo *et al*.[4] proposed Binary Orientation Co-occurrence Vector (BOCV) representation that binaries all the filter responses of a palm print image, convolving with Gabor filters on six orientations. To further examine the BOCV, Zhang *et al*.[5] propose the E-BOCV method which involves filtering out the fragile bits of the BOCV. A normalized Hamming distance metric[2] is finally, used to measure the dissimilarity between the code planes of two palm print images. The dominant orientation feature of a palm print alone is extracted, the other orientation features of the palm print will be lost. If all the orientation features of a palm print are preserved equally, the importance of the dominant orientation of the palm print is weakened.

RLOC method: The Robust Line Orientation Code (RLOC) method[6] extracts principal orientation code of a palm print by using a modified finite radon transform. Zuo *et al*.[7] design a sparse multi scale competitive code method which can extract the orientation feature of a palm print more accurately, using a bank of multi scale Gabor filters. The RLOC method designs a set of special convolution templates and the fusion code method uses four orientations of Gabor filters. RLOC extracts the dominant orientation feature of a palm print alone, other orientation features of the palm print are lost.

Motivation: In previously discussed methods, different feature extraction strategies are used, each extracting a various number of code features. Consequently, if the dominant orientation feature of a palm print alone is extracted, the other orientation features of the palm print will be lost. If all the orientation features of a palm print are preserved equally, the importance of the dominant orientation of the palm print is weakened. These methods lacks in accuracy and reliability. It shows the increased error rate. To rectify the disadvantages, the proposed scheme uses GLCM and SVM to provide more accuracy and reliability. It improves the genuine acceptance rate and also reduces the average error rate.

MATERIALS AND METHODS

Proposed scheme

Image acquisition: Image acquisition is the action to get image from any source, especially hardware based any source. It is always first step in the application because, without an image no processing is available. Ten right hand images from 100 different individuals are captured using digital camera. During the image acquisition, no pegs alignment is made. The hand image is taken without any special lighting condition. Dark intensity backgrounds such as black and dark blue are used in this research. The usage of the low intensity background is to ease the hand image segmentation. Users are required to spread their fingers apart and lean their hand against the background during the image acquisition process. The hand image is saved using JPEG format. The hand image has the resolution of 180 dpi (dot per inches).

Preprocessing: Preprocessing images frequently encompasses removing low frequency background noise, normalizing the intensity of the individual particles images, removing reflection and concealed portions of images. Image preprocessing is the approach of enhancing data images former to computational processing. It involves converting the color images to gray level images, image rotation and resolution reduction. The hand images are pre-processed to obtain the Region-of-Interest (ROI). In image preprocessing stage, hand image segmentation,

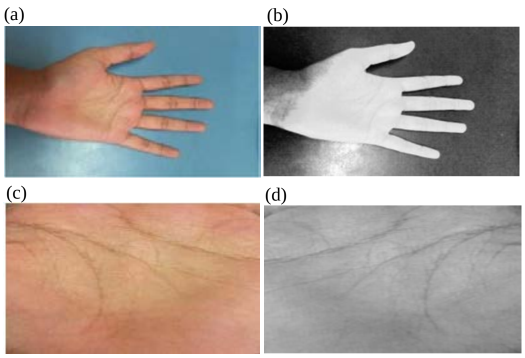

Fig. 1(a-d): (a) Input image of hand, (b) Obtain binary hand image from the input, (c) Extracted palm print image and (d) Palm print image in grayscale intensity format

key point's determination and palm print extraction are done that can be depicted in Fig. 1. The skin has higher red intensity color while the background (black or dark blue color) has lower red intensity color. Thus, by referring to the red component of the hand image, the hand image is segmented (Fig. 2).

Feature extraction using GLCM: Feature extraction is a type of dimensionality reduction that represents the interesting casts of an image as a compressed feature vector. This way is useful when image sizes are large and a reduced feature representation is needed to complete the tasks such as image matching and retrieval.

The second-order statistics like the probability of two pixels having particular gray levels in spatial relationship are used to represent the distribution of pixel gray levels. This information can be outlined as two dimensional Gray Level Co-occurrence Matrices (GLCM)[8] which can be computed for various distances and orientations. To use the information contained in the GLCM, Haralick illustrates the some statistical measures to extract textual characteristics. In this study, the features like contrast, correlation, energy and homogeneity successfully characterized the statistical behavior (experimentally determined) of the palm print. The local variation in the gray level of GLCM is termed as Contrast. Correlation measures the joint probability of occurrence of pixel pairs of GLCM[9]. Energy provides the sum of squared pixel values and Homogeneity defines the closeness of distribution of elements to the GLCM diagonal. Homogeneous textures incorporates the ideal repetitive structures.

Classification using SVM: The standard SVM is a predictive algorithm which takes a set of input data that pinpoints the class to which the input belongs. This accomplish the SVM a non-probabilistic binary linear classifier. When working with an SVM one needs to make a number of decisions: how the data has to be pre-processed what kernel has to be used and finally, setting the parameters of the SVM and the kernel. An SVM Model is a representation of the examples as points in space then they are divided into separate categories by using clear gap and the examples are mapped based on that gap. In addition to performing linear classification, SVM can proficiently perform non-linear classification using the kernel trick[10] in which implicitly leveling their inputs into high-dimensional feature spaces. Support vector machines are based on the concept of decision planes that characterize the decision boundaries. A decision plane separates a set of objects having different class memberships.

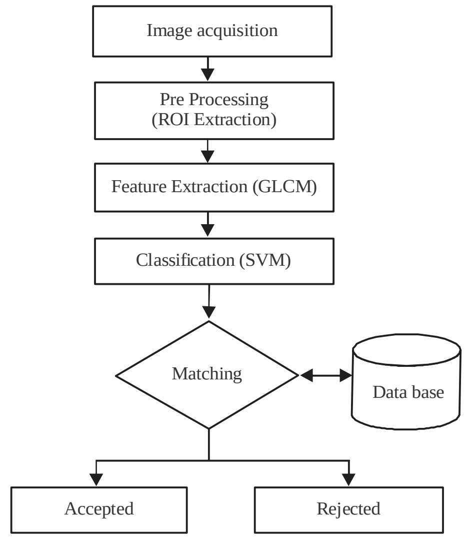

Fig. 2: Over all process of the system

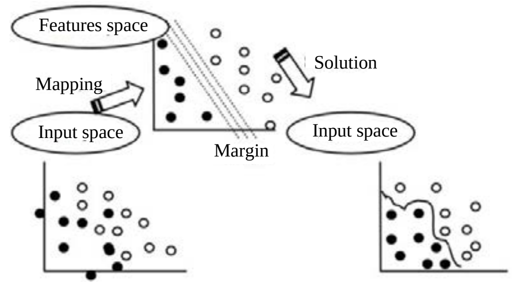

Fig. 3: Over all process of the SVM

Decision trees are commonly used in decision analysis, to figure out a strategy most likely to reach a goal. The original input space is profiled into the high dimensional dot product space known as feature space which achieves better generalization performance in SVM and in the feature space the optimal hyper plane is determined as shown in Fig. 3.

RESULTS AND DISCUSSION

Palm print database: The CASIA database (Version 2) contains 500 palm print images collected from 250 individuals. All palm print images are 8 bit gray-level JPEG files. There are no pegs to restrict postures and position of palm. Subjects are required to put their palm into the device and lay it on a uniform colored background.

Palm print verification: The performance of the proposed system is demonstrated using a MATLAB R2013a platform. A dataset of 250 images are taken from the CASIA dataset. Dark intensity backgrounds, namely black and dark blue are used in this work. The usage of the low intensity back ground is to ease the hand image segmentation. Users are required to spread their fingers apart and lean their hand against the background during the image acquisition process. The hand image is saved using JPEG format in 256×256 pixels. The pre-processing of the Palm print image is performed by ROI extraction. GLCM algorithm is applied on the pre-processed image to extract four second order features like energy, correlation, contrast, homogeneity. Then classification of palm print images are done using the support vector machine method to provide the authentication on a successful classification.

Performance analysis: In this study, we will discuss about the performance analysis in terms of genuine acceptance rate, false acceptance rate, false rejection rate along with equal error rate.

Genuine Acceptance Rate (GAR): The genuine acceptance rate is the degree of the likelihood that the biometric security system will correctly recognize an access attempt by an authorized user. The system's GAR typically is stated as the ratio of the number of genuine acceptances divided by the number of identification attempts:

$$\text{GAR} = \frac{\text{Number of accepted genuine users*100}}{\text{Total number of genuine accesses}}$$

False Acceptance Rate (FAR): This is illustrated as a percentage of false users accepted by the biometric system. In verification of biometric system the user will make claims of their identity and hence the system should not accept an unauthorized user. The number of false acceptance should be kept as small as possible. Thus, false acceptance should be minimized in comparison to false rejection.

False Rejection Rate (FRR): This is characterized as a percentage of genuine users rejected by the biometric system. In verification of biometric system the user will make accusation of their identity and accordingly the system should not reject an enrolled user. The number of false rejections should be kept as small as possible. Thus, false rejection should be minimized in comparison to false acceptance.

Equal Error Rate (EER): This is defined as the point of juncture on the graph on which both FAR and FRR bends are plotted.

The comparison of error rate and acceptance rate of various methods are depicted in Table 1 which shows GLCM has higher GAR than other traditional methods. Figure 4 and 5 depicts the corresponding graphical representation.

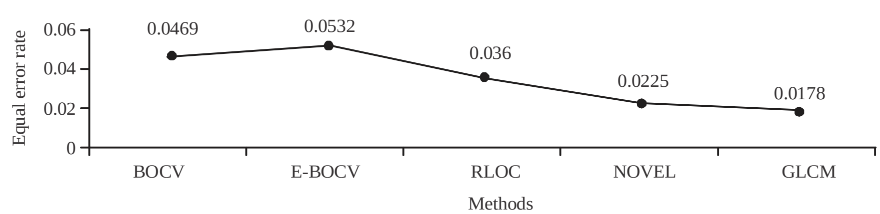

Fig. 4: Comparison of palm print identification error rate

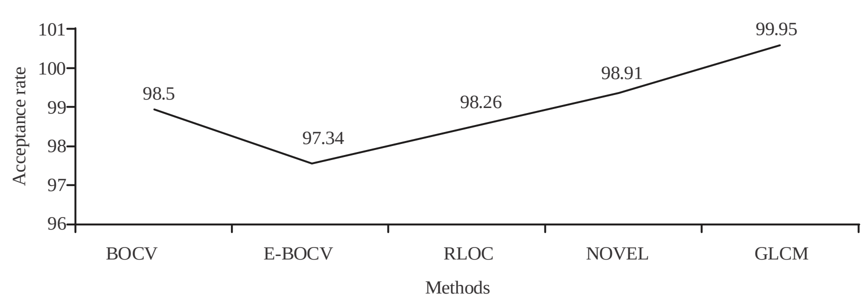

Fig. 5: Comparison of palm print identification genuine acceptance rate

Table 1: Comparison of results

Methods	No. of samples	EER	GAR
BOCV	7752	0.0469	98.50
E-BOCV	7752	0.0532	97.34
RLOC	7752	0.0360	98.26
NOVEL	7752	0.0225	98.91
GLCM	500	0.0178	99.95

CONCLUSION

The proposed system is used to segment the palm print image and to extract features from the palm print images using the Gray Level Co-occurrence Matrix method (GLCM). The classification of palm print images using Support Vector Method (SVM) classification model has been proposed. This study compares well-known classification models with SVM. Also, it compares various feature extraction methods to identify the most suitable method for the extraction of palm print. Neighboring direction indicator using GLCM has less execution time and high accuracy compared to other methods for feature extraction. From the experimental results obtained it is concluded that the threshold interval method is best for the pre-processing, the Gray Level Co-occurrence Matrix is suitable for feature extraction and support vector method is suitable for the classification of the palm print images from normal images. Thus, through these methods less error rate and improved accuracy in authentication has been achieved. This research can be extended to further improve the accuracy and reliability using powerful optimization techniques[11].

REFERENCES

01. Kong, A.W.K. and D. Zhang, 2004. Competitive coding scheme for palmprint verification. Proceedings of the 17th International Conference on Pattern Recognition, August 23-26, 2004, Cambridge, pp: 520-523.
02. Kong, A., D. Zhang and M. Kamel, 2006. Palmprint identification using feature-level fusion. Pattern Recognit., 39: 478-487.
03. Zhang, D., W.K. Kong, J. You and M. Wong, 2003. Online palmprint identification. IEEE Trans. Pattern Anal. Mach. Intell., 25: 1041-1050.
04. Guo, Z., D. Zhang, L. Zhang and W. Zuo, 2009. Palmprint verification using binary orientation co-occurrence vector. Pattern Recognit. Lett., 30: 1219-1227.
05. Zhang, L., H. Li and J. Niu, 2012. Fragile bits in palmprint recognition. IEEE. Signal Process. Lett., 19: 663-666.
06. Jia, W., D.S. Huang and D. Zhang, 2008. Palmprint verification based on robust line orientation code. Pattern Recognit., 41: 1504-1513.
07. Zuo, W., Z. Lin, Z. Guo and D. Zhang, 2010. The multiscale competitive code via. sparse representation for palmprint verification. Proceedings of the 2010 IEEE Computer Society Conference on Computer Vision and Pattern Recognition, June 13-18, 2010, IEEE, San Francisco, California, pp: 2265-2272.
08. Rao, C.N., S.S. Sastry, K. Mallika, H.S. Tiong and K.B. Mahalakshmi, 2013. Co-occurrence matrix and its statistical features as an approach for identification of phase transitions of mesogens. Int. J. Innov. Res. Sci. Eng. Technol., 2: 4531-4538.
09. Mohanaiah, P., P. Sathyanarayana and L. GuruKumar, 2013. Image texture feature extraction using GLCM approach. Int. J. Sci. Res. Publ., Vol. 3, No. 5.
10. Safiya, K.M., S. Bhuvana, P. TamijeSelvy and R. Radhakrishnan, 2012. Genetic algorithm with srm svm classifier for face verification. Int. J. Comput. Sci. Inf. Technol., 4: 151-163.
11. Sun, Z., T. Tan, Y. Wang and S. Li, 2005. Ordinal palmprint representation for personal identification. Comput. Vision Pattern Recognit., 1: 279-284.