International Journal of Computer Science & Communication (ISSN: 0973-7391)
Volume 13 • Issue 2 pp. 44-52 March- Sept 2022 www.csjournals.com

Multi Instance Finger Knuckle Print for Secure Authentication

Sukhdev Singh[1], Ramesh Kumar[2]

[1]Assistant Professor, Deptt. of Computer Science,D.A.V. College, Ambala City, Haryana,INDIA

[2]Assistant Professor, Deptt. of Computer Science, Pt. CLS Govt College, Karnal, Haryana,INDIA

Abstract:

Biometrics authentication is an effective method for automatically recognizing a person's identity.Most of the conventionalbiometrics modalities are used for security. These biometrics technologies provide proof of the physical and behavioral presence of a person for identification. Privacy and security are one of the most important challenges in biometrics traits. This paper proposed the secure user authentication using multi-instance as a means to improve the performance of finger knuckle print verification. A log-Gabor filter has been used to extract the image local orientation information, it represent the finger knuckle print features. Experiment is performed using the PolyU FKP database. Biometric performance using score level with simple sum rule outperform higher performance than using any single instance.

Keywords:FKP identification,Multi-instances;Log-Gabor, Score Level Fusion.

I. Introduction

Personal authenticationis a very common issue to both academic research and industries.Because it has numerous applications about security for application of networking and mobility etc.; these applications require reliable authentication schemes to confirm the identity of an individual requesting their service for security. Usual personal authentication scheme using passwords and ID cards are commonly used to restrict access to a variety of systems and services. But these systems are helpless to attack and security can be easily breached. The need for reliablecomputerized user authentication techniques has beenimportant for this reason [1].Many researchers and academician have presentthe different biometrics traits like fingerprint, face, ear, iris,palm print, hand geometry, voice, and gait, signature etc. [2].Among all the traits the hand based modalities like palmprint [4], hand geometry [5], hand vein[6],fingerprint [3], finger knuckle [10] and fingervein [13] create attentions for further enhancement. All these traits are highlyaccepted and user friendly for various security purposes.From the survey of different traits

International Journal of Computer Science & Communication (ISSN: 0973-7391)
Volume 13 • Issue 2 pp. 44-52 March- Sept 2022 www.csjournals.com

it has beenseenthat researcher have less concentration on the finger knuckle print which is actually provide high level security toidentifier for personal authentication. Fingerknuckleprint provides the image patternof skin present on the back surface of finger. The outer surfaces of finger joints have more understandable line features and smaller area than other biometric traits. Due to this we have motivate for research and improve the performance on this biometric technique fingerknuckleprint (FKP). It is refers to the image of the outer surface of the finger phalangeal joint [14]. Finger knuckle is contactless, user centric andopen access control. As it is contactless hence no chance of proof of physical presence i.e. anti spoofing.So there are some advantages in security applications: (a) it is hard to be abraded since people hold stuffs with inner side of their hands. (b) Unlike fingerprint, there is no disgrace of criminal investigation associated with finger knuckle print. So FKP has a high user acceptance rate [9]. (c) People rarely leave FKP on stuff surface, creation the loss of private data less possible. Hence finger knuckle print is considered to be one of the most secure biometric techniques for personalauthentication in future.

Multi-instance biometrics means the use of the same type of raw biometric sample and processing on multiple instances of similar body parts, (such as two fingers, or two irises) also been referred to as multi-unit systems in the literature [9]. These systems can be cost-effective since a single sensor is used to acquire the multi-unit data in a sequential fashion, and these systems generally do not necessitate the introduction of new sensors nor do they entail the development of new feature extraction and matching algorithms. Multi-instance systems are especially beneficial to users whose biometric traits cannot be reliably captured due to inherent problems. Due to this reason we take FKP with multi instance by fusing the data at score level using simple sum rule to improve the performance of biometrics.

II. RelatedWork

Lin Zhang et al.[4] proposed an effective FKP recognition scheme by extracting and assembling local and global features of FKP images. Specifically, the orientation information extracted by the Gabor filters is coded as the local feature. The proposed scheme exploits both local and global information for the FKP verification. The authors experimental results conducted on FKP database indicate that the proposed scheme could achieve much better performance in terms of EER and the decidability index than the other state-of- the-art competitors.

T.C. Faltemier et al. [6] proposed a multi-instance enrollment for face recognition as a means to improve the performance of 3D face recognition. The authors show that using multiple images to enroll a person in a gallery can improve the overall performance of a biometric system. The authorsdem- onstrated that when using multiple images to enroll a person, sampling from different expressions improves performance over sampling only the same expression.

M. Vatsa, et al. [7] proposed a generalized biometric match score fusion framework using belief function theory. Multi- instance iris verification and multi-unit iris verification are used as the two case. Experimental results show that the pro- posed fusion framework with PCR rule can effectively fuse the match scores even when the individual biometric classifiers provide highly conflicting match scores

Tobias Scheidat, et al. [8] proposed a fusion of two in- stances of the same semantic, where semantics are alternative handwritten contents such as numbers or sentences, in addition to commonly used signature. The fusion is carried out by the combination of the matching scores of two instances of one handwritten semantic. The authors demonstrated that when using three semantics and fusion strategies, improvements can be observed in comparison to the best individual results.

2 MultibiometricsFusion

FusionCategories:

In multibiometrics there are five categories under fusion ways [11]

- Single trait and multiple sensors.
- Multi biometric trait.
- Single trait and multiple units.
- Single trait and multiple classifiers.
- Single trait and multiple instances or multi-instance.

Fusion can be done at any four possible levels namely sensor level, feature extraction level, matching score level, and decision levels. Each level of fusion has its own advantages and disadvantages. In feature level fusion the problem is the choice of best classifier for high dimensional joint feature vectors. In matching score level fusion the biometric score into similar domain we make use of normalization techniques.Due to less complexity matching score level fusion is used widely by the researchers.

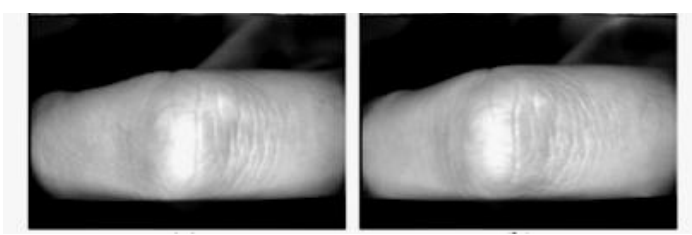
In experiment, the data have been fused at score using different simple sum rule for two instances combination out of four fingers.

III. Proposed Work

To reduce the above problem the propose authentication has a scope to use database with multi instances and improve the quality of images using pre processing techniques so that it affect on the performance parameter EER. The proposed system focuses on personal authentication using finger knuckle print , including the specifically designed FKP data acquisition device , FKP feature extraction and pattern matching algorithms. The experiments are developed for personal authentication using DZhang FKP data base. FKP images were collected from 165 volunteers, including 125 males and 40 females. The database contains FKPs from two different fingers, right index, right middle. The DZhang database is available at the website of Biometrics Research Centre, the Hong Kong Polytechnic University.

A. Finger Knuckle Print Identification

Each finger has three joints .There are three bones in each finger called the proximal phalanx, the middle and distal phalanx.The first joint is where the finger joins the hand called the proximal phalanx. The second joint is the proximal interphalangeal joint. The usage of Finger knuckle images for personal identification has shown hopeful results and generated a lot of interest in biometrics [15]. Finger knuckles of the human hand are characterized by the creases on them. These creases differ from person to person. In the FKP identification system, after collecting the FKP images then apply preprocessing techniques on all the training images then extract the feature from the finger images[16].Knuckle crease patterns and stray marks as a means ofphotographic identification. Such features are unique andcan use for identification.



International Journal of Computer Science & Communication (ISSN: 0973-7391)
Volume 13 • Issue 2 pp. 44-52 March- Sept 2022 www.csjournals.com

Fig. 1: Finger Knuckle Features

B. FKP Recognition System Design

The FKP recognition system is composed of anFKP image acquisition device and a data processingmodule. Below device in figure is composed of afinger bracket, a ring LED light source, a lens, a CCDcamera and a frame grabber. The captured FKP image isinputted to the data processing module, which comprisesthree basic steps: ROI (region of interest) extraction, featureextraction and coding, and feature matching. Refer to Fig. 2;a basal block and a triangular block are used to fix theposition of the finger joint. Fig. 3-a and3-d show twosample images acquired by the developed device.

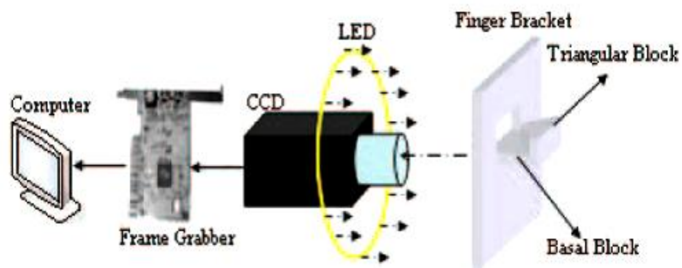


Fig. 2: FKP image acquisition device.

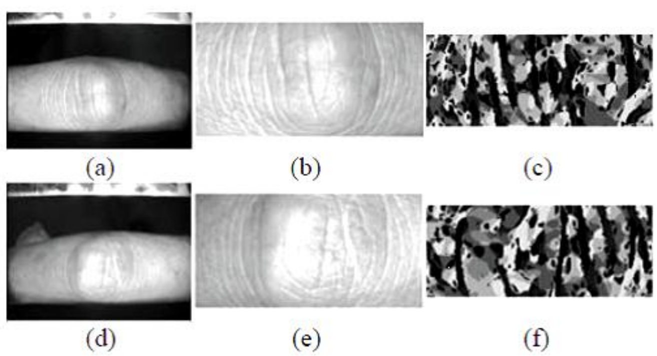


Fig. 3: (a) and (d) are two FKP images; (b) and (e) are the ROI images of (a) and (d); (c) and (f) are the competitivecode maps generated

C. Region of Interest Extraction

It is necessary to construct a local coordinate system for each FKP image. With the help of this, region of interest can be cropped from the original captured image for reliable feature extraction and matching through different feature techniques. Thecomplete steps for setting upsuch a coordinate system are as follows.

Step 1: determine the X-axis of the coordinate system. The bottom boundary of the finger can be easily extractedby a Sobeledge detector. This bottom boundary is nearly consistent to all FKP images because all the fingersare put perfectly on the basal block in data acquisition. By fitting this boundary as a straight line, the X-axis of the localcoordinate system is determined.

Step 2: crop a sub-image SI. The left and right boundaries of SI are two fixed values evaluated empirically.

Step 3: Sobeledge detection. Apply a Sobel edge detection to SI to obtain the edge map EI.

Step 4: convex direction coding for EI. There will be ideal model for FKP iscurves. In this ideal model an FKP curve is either convex leftward or convex rightward. We code the pixels on convex leftward curves as 1 and pixels onconvex rightward curves as -1 and the other pixels a 0.

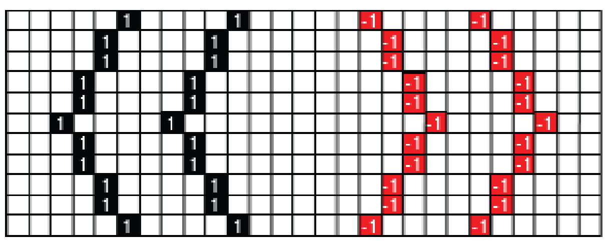


Fig. 4: Convex Direction Coding Scheme.

Step 5:now determine the Y-axis of the coordinate system. For an FKP imagecurveson the left part of phalangealjoint are mostly convex leftward and those on the right part are mostly convex rightward. In between curves in asmall area around the phalangeal joint do not have obvious convex directions. Based on this observation, at a horizontalposition x of an FKP image, we define the convexity magnitude.

Step 6: Crop the ROI image according to respective axis. As we have fixed the X-axis and Y-axis, the local coordinate system can then bedetermined and the ROI subimage ROI can be extracted with a fixed size. Fig. 3(b) and 3(e)presented two examples of theextracted ROI images.

D. FKP Feature Extraction

Log Gabor has been used as feature extraction algorithm; it eliminates the limitations in Gabor filters. Log-Gabor functions, by definition, always have no DC component, and, the transfer function of the log Gabor function has an extended tail at the high frequency end. Log-Gabor function proposed by Field [17], Field suggests that natural images are better coded by filters that have Gaussian transfer functions when viewed on the logarithmic frequency scale.

IV. Result and Discussion

These phase represent consequences comparisons of combining multi instance of finger knuckle print at score level fusion to measure the performance of multi instance system. In the experiment, performance is measured in terms of False Acceptance Rate (FAR in %) and corresponding Genuine Acceptance Rate (GAR in %). First the performance of a single instance biometric system is measured and later the results for multi instance biometric system fusion with simple sum rule at score level are evaluated. The results obtained from single instance biometric system are tabulated in Table-II.

Table II:Single Instance performance

FAR (%)	**GAR (%)**	
	Right- Index	**Right-Middle**
0.009	70.00	73.00
0.099	76.00	80.00
0.990	84.00	87.33

Next experimental results of the fusion of two instances with simple sum rule fusion at score level are shown. Table-III shows the fusion result of two instances. From Table-III it can be observed that the fusion of two in-stances finger at score level; simple sum rule has a significant improve score over the single instance. Whereas at score level; simple sum rule does not have performance improvement over a single instance. For this reason the performance will be like the best matcher.

Table-III: The Fusion Result of Two Instances

FAR (%)	GAR (%) Score level Simple Sum Rule Fusion
	Right-Index+Right-Middle
0.009	74.00
0.099	84.00
0.990	91.00

5. Conclusion

This paper presented a new identifier for personal authentication using multi instance finger knuckle print, which has distinctive line features. A cost-effective FKP system, including a novel image acquisition device and the associated data processing algorithms, was developed. Extensive experiments demonstrated the efficiency and effectiveness of the proposed technique. Compared with other existing finger back surface based systems, the proposed multi instance FKP authentication has merits of high level security with less EER, high speed, small size and cost-effective.

References:

[1]A.K. Jain, P.J. Flynn, A. Ross, "Handbook of Biometrics", Springer,2007.

[2] S.Z. Li (Ed.), "Encyclopaedia of Biometrics", Springer, 2009.

[3] L. Hong, Y. Wan, A. Jain,"Fingerprint image enhancement:algorithm and performance evaluation", IEEE Transactions on PatternAnalysis and Machine Intelligence 20 (8) (1998) 777–789.

[4] C. Han, H. Cheng, C. Lin, K. Fan, "Personal authentication usingpalm-print features", Pattern Recognition 36 (2) (2003) 371–381.

[5]Z. Feng, B. Yang, Y. Chen, Y. Zheng, T. Xu, Y. Li, T. Xu, D. Zhu,"Features extraction from hand images based on new detectionoperators", Pattern Recognition 44 (5) (2011) 1089–1105.

[6]Michael K.O. Goh, Connie Tee, Andrew B.J. Teoh "BI-modal PalmPrint And Knuckle Print Recognition System", *Journal of IT in Asia, Vol3 (2010)*

[7]Lin Zhanga, Lei Zhanga, David Zhanga and HailongZhubOnlineFinger-Knuckle-Print Verification for Personal Authentication",Biometrics Research Center, Department of Computing

[8]Ajay Kumar, *and Ch. Ravikanth*, "Personal Authentication Using Finger Knuckle Surface", IEEE Transaction on Information ForensicsAnd Security, VOL. 4, NO. 1, March 2009

[9]S.S. Kulkarni ,Dr.Mrs.R.D.Raut ,"Identification System using Finger Knuckle Features",UACEE International Journal of Advances inElectronics Engineering Volume 2: Issue 2 ISSN 2278 - 215X (Online)

[10]G .S.Badrinath, A.Nigam,Phalguni Gupta, "An Efficient Fingerknuckle-print based Recognition System Fusing SIFT and SURFMatching Scores"

[11]H.B.Kekre,V.A,Bharadi,"Finger-Knuckle-Print verification using Kekre's wavelet transform",ACM 2011

[12]Nanni Loris, Alessandra Lumini, "A multi-matcher system based on knuckle-based features", Neural Compute and application 2009,87-91

[13]A.Ushapriya, M.Subramani, " Highly Secure and Reliable UserIdentification Based on Finger Vein Patterns", Global Journal of Researchin Engineering,Volume 11 Issue 3 Version 1.0 April 2011

[14]fingerchip.pagespersoorange.fr/biometrics/types/fingerknuckles.htm

[15] A. Kumar and C. Ravikanth, "Personal authentication using finger knuckle surface", IEEE Trans. Info. Forensics & Security, vol. 4, no. 1, pp. 98-110, March 2009

[16] H. Yu and J. Yang, "A direct LDA algorithm for high dimensional data with application to face recognition," Pattern Recognition, September 2001.

[17] D.J. Field."Relation between the statistics of natural images and the response properties of cortical cells". J. Opt. Soc. Am. A, 4(12):2379_2394, 1987.