Palmprint based verification System Robust to Occlusion using Low-order Zernike Moments of Sub-images

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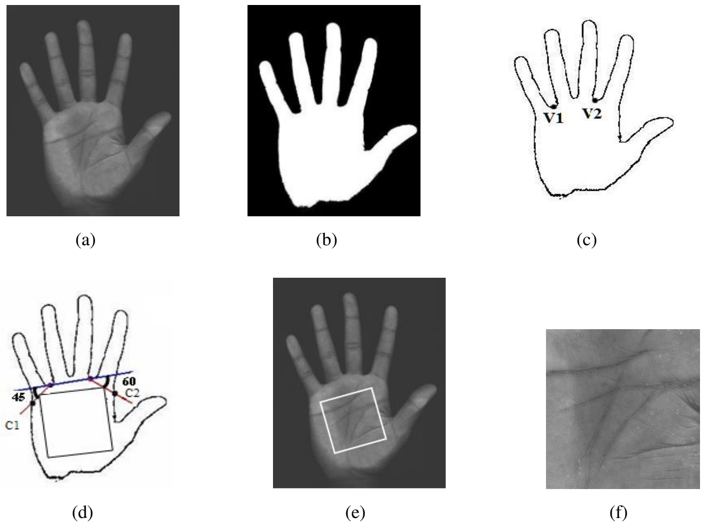

Figure 1: (a) Scanned Image. (b) Binarised Image (c) Hand Contour and reference points. (d) Relevant points and Region of interest (palmprint). (e) Region of interest in gray scale hand image (f) Extracted Region of interest (palmprint)

Biometric based identification / verification systems has found its application widely in commercial and law enforcement applications. Systems based on fingerprint features are most widely used and systems based on iris features are considered to be most reliable [1]. Palmprint also has features like texture, wrinkles, principle lines, ridges, and minutiae points that can be used for its representation [2]. Limited work has been reported on palmprint based identification/verification despite of its significant features.

In this paper a novel method is proposed to extract features of the palmprint which can be used for personal verification. The features are extracted from small partitions (sub-images) of the palmprint using Zernike moments [3]. The matching scores of sub-images are fused using weighted sum rule for decision. The hand images for feature extraction are acquired using low cost flat bed scanner. The following characteristics are also incorporated in the proposed palmprint based verification system.

- Constraint free image acquisition: The device used for acquiring hand image from user should be constraint free. So that physically challenged or injured people can provide biometric sample.
- Robust to translation of hand image on the scanner: The system should be able to extract palmprint independent of translation, rotation or placement of hand on scanner surface.
- Robust to occlusion (partially exposed) of hand image: If user exposes partial palmprint to scanner due to injuries or physical challenge, system should be able to verify the user.

Hand image from users are obtained in gray scale at spatial resolution of 200 dots per inch using a flat-bed scanner. Typical gray level image obtained from the scanner is shown in Fig. 1(a). The acquired hand image is binarised 1(b) using global thresholding. Two valley points $(V1, V2)$ between fingers are detected on the contour of the hand image as shown in Fig. 1(c). Square area as shown in Fig. 1(d) with two of its adjacent points coinciding the mid-points of line segments $V1-C1$ and $V2-C2$ is considered as region of interest or palmprint. The region of interest in gray scale hand image and extracted region of interest in gray scale is shown in Fig. 1(e) and Fig. 1(f) respectively.

Since the extracted region of interest is relative to the valley points and which are stable for the user, The extracted palmprint region with different orientation of placement for the same user remains the unchanged. Hence the proposed palmprint extraction procedure of the system makes the system robust to rotation. The extracted palmprint is subjected to enhancement procedure to obtain uniform brightness and contrast enhanced image. The enhanced palmprint portioned into equal sized sub-blocks of size $m \times m$ and zernike moments of each block is extracted as their features. The zernike moments of corresponding blocks of live and enrolled palmprint are matched (as shown in Fig. 2) using Euclidean distance and weighted based on average discrimination level of the sub-block relative to other blocks. The matching score of each block is fussed using summation rule and decision of acceptance rejected is made based on predefined threshold.

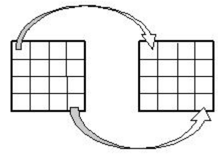

Figure 2: Schematic diagram of corresponding sub-image matching

	IITK		CASIA		PolyU	
	N-Wgt	Wgt	N-Wgt	Wgt	N-Wgt	Wgt
ACC(%)	**88.65**	**98.74**	**98.66**	**98.74**	**99.29**	**99.31**
FAR(%)	**4.27**	**1.81**	**0.74**	**0.58**	**0.24**	**0.28**
FRR(%)	**18.42**	**1.93**	**1.93**	**1.93**	**1.16**	**1.08**

Table 1: Performance of the proposed system of the proposed system

Palmprint has rich texture. so each sub-image can be classified into into occluded / non-occluded based on its randomness (Entropy). Since the extracted Zernike moment of a sub-image is independent of other sub-images, ignoring the features of the occluded sub-images makes the system robust to occlusion.

The system is evaluated on Indian Institute of Technology Kanpur (IITK) database of 549 hand images from 150 users, The Hong Kong Polytechnic University (PolyU)database of 7,752 images from 193 users and The Chinese Academy of Sciences Institute of Automation (CASIA) database of 5,239 images from 302 users. Performance of the proposed system for weighted and non-weighted fusing the score of sub-images is shown in Table 1. The performance of the system for various occlusion sizes is shown in Table 2. The systems performs with accuracy of 98.74%, 98.75% and 99.31% for IITK , CASIA and PolyU databases. The proposed system is found to be performing better than the best known system [4] in literature for IITK, PolyU and CASIA databases.

[1] Independent testing of iris recognition technology final report, 2005. International Biometric Group.

[2] W. Shu and D. Zhang. Automated personal identification by palmprint. *Optical Engineering*, 37(8):2359–2362, 1998.

[3] P. Ying-Han, T.B.J. Andrew, N.C.L David, and F. S. Hiew. Palmprint verification with moments. *Journal of Computer Graphics, Visualization and Computer Vision (WSCG)*, 12(1-3):325–332, Febuary 2003.

[4] D. Zhang, A. W.K. Kong, J. You, and M. Wong. Online palmprint identification. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 25(9):1041–1050, September 2003.

Database	$0.2W \times 0.2H$	$0.4W \times 0.4H$	$0.6W \times 0.6H$
IITK	88.04%	87.14%	84.0%
CASIA	98.34%	97.97%	95.91%
PolyU	99.18%	96.81%	82.63%

Table 2: Accuracy for different sizes of occlusions