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3D Palm Print Classification using Global Features

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Abstract: Three dimensional palm print has proved to be significant biometric for personal authentication. Personal authentication plays a key role in application of public security, access control, forensics and e-banking etc. 2-D palm print has been recognized as an effective biometric identifier in past decade. 3-D palm print system develops to capture the depth information of palm print. The previous work of 3-D palm print recognition done using local features such as line, texture, wrinkles, point but, in this we are using the global features such as width, length and area of the palm. This paper provides an overview of current palmprint research, describing in particular capture devices, preprocessing, verification algorithms, palmprint-related fusion, algorithms especially designed for real-time palmprint identification in large databases. Most of the previous studies are based on two dimensional (2D) image of the palmprint.2D images are easily affected by noise, such as scrabbling and dirty in the palm. To overcome these shortcomings, we develop a three dimensional (3D) palm print identification system.

Keywords: 3D palm print identification, Palmprint, Biometrics, Preprocessing, Feature extraction, matching.

I. INTRODUCTION

Palm print recognition has now been a topic of research for over ten years. The commonly used biometric characteristics include fingerprint, face, iris, signature, gait, etc. In the past decade, palm print recognition has grown rapidly, starting from the inked palm print-based off line methods and developing to the charge-coupled device (CCD) camera-based online methods. Almost all the current palm print-recognition techniques and systems are based on the 2-D palm images (inked images or CCD camera-captured images). Although 2-D palm print recognition techniques can achieve high accuracy, the 2-D palm print can be counterfeited easily and much 3-D palm structural information is lost in the 2-D palm print acquisition process. Palm print images are cheaper to collect and more acceptable than iris. Palm prints can distinguish between individuals more accurately than face and can also identify monozygotic twins. The texture-based methods include Palm Code, Competitive Code and Ordinal Code. These methods use a group of filters to enhance and extract the phase or directional features which can represent the texture of the palm print. Line-based methods use line or edge detectors to explicitly extract line information from the palm print that is then used for matching. The representative methods include Derivative of Gaussian based line extraction and Modified Finite Radon transform (MFRAT) based line extraction. Some of them use different edge detection methods to extract palm lines, and match them directly or after some feature transformations. Other approaches first extract some features like Gabor filter or wavelets, then use a subspace projection like principal component analysis or linear discriminant analysis to reduce their dimensionality and adopt distance measures or classifiers to compare the reduced features. Dai and Zhou proposed a multi-feature based palmprint recognition system, where minutiae, orientation field, density map, and major creases are extracted and compared to achieve higher accuracy.

A. Why palm print recognition?

The reliability of personal identification using face is currently low as the researchers today continue to grapple with the problems of pose, lighting, orientation and gesture. Fingerprint identification is widely used in personal identification as it works well in most cases. However, it is difficult to acquire fingerprint features i.e. minutiae, for some class of persons such as manual laborers, elderly people, etc. Reliability in the personal authentication is key to the security in the networked society. Many physiological characteristics of humans, i.e. biometrics, are typically time invariant, easy to acquire, and unique for every individual. Biometric features such as face, iris, fingerprint, hand geometry, palmprint, signature, etc.

As a result, other biometric characteristics are receiving increasing attention. Moreover, additional biometric features, such as palmprints, can be easily integrated with the existing authentication system to provide enhanced level of confidence in personal authentication. Widely used by many security agencies, Cost effective, Non intrusive, Possible to build highly accurate biometric system.

B. What is palm print recognition?

Palm print refer to image acquired of the palm region of the and. It can be either online image of offline image. Palmprint recognition techniques have been grouped into two main categories, first approach is based on low-resolution features and second approach is based on high-resolution features. First approach make use of low-resolution images, where only principal lines, wrinkles, and texture are extracted. Second approach uses high resolution images, where in addition to principal lines and wrinkles, more discriminant features like ridges, singular points, and minutiae can be extracted. Palm prints can be used for criminal, forensic, or commercial applications.

Methods for recognition:

Transforming the input data into the set of features is called *feature extraction.* There are three groups of marks which are used in palm print identification:

1) *Geometric features*, such as the width, length and area of the palm. Geometric features are a coarse measurement and are relatively easily duplicated. In themselves they are not sufficiently distinct.

2) *Line features, principal lines and wrinkles*. Line features identify the length, position, depth and size of the various lines and wrinkles on a palm. While wrinkles are highly distinctive and are not easily duplicated, principal lines may not be sufficiently distinctive to be a reliable identifier in themselves; and

3) *Point features or minutiae*. Point features or minutiae are similar to fingerprint Minutiae and identify, amongst other features, ridges, ridge endings, bifurcation and dots.

C. Difference between 2D and 3D image

2D and 3D refer to the actual dimensions in a computer workspace. 2D is "flat", using the horizontal and vertical (X and Y) dimensions, the image has only two dimensions and if turned to the side becomes a line. 3D adds the depth (Z) dimension. This third dimension allows for rotation and visualization from multiple perspectives. It is essentially the difference between a photo and a sculpture. 2D image can be easily affected by noise, such as scrabbling and dirty in the palm. To overcome these shortcomings, we use a three dimensional (3D) palmprint identification system.

D. Global and Local Features

Most local features represent texture in an image patch. For example, SIFT features use histograms of gradient orientations. Global features include contour representations, shape descriptors, and texture features. Such features are attractive because they produce very compact representations of images, where each image corresponds to a point in a high dimensional feature space. As a result, any standard classifier can be used. Global texture features and local features provide different information about the image because the support over which texture is computed varies. We expect classifiers that use global features will commit errors that differ from those of classifiers based on local features.

II. Literature Survey

Early researches on fast palmprint identification can be roughly classified into two categories, hierarchical matching and palmprint classification. Hierarchical matching approaches typically involve first extracting multiple kinds of features and then searching in a layered fashion.

Dai and Zhou introduces high resolution approach for palmprint recognition with multiple features extraction. Features like minutiae, density, orientation, and principal lines are taken for feature extraction. For orientation estimation the DFT and Radon-Transform-Based Orientation Estimation are used. For minutiae extraction Gabor filter is used for ridges enhancement according to the local ridge direction and density. Density map is calculated by using the composite algorithm, Gabor filter, Hough transform and to extract the principal line features Hough transform is applied. SVM is used as the fusion method for the verification system and the proposed heuristic rule for the identification system.

D. Huang, W. Jia, and D. Zhang proposed a novel algorithm for the automatic classification of low-resolution palmprints. First the principal lines of the palm are defined using their position and thickness. Principal lines are defined and characterized by their position and thickness. A set of directional line detectors is devised for principal line extraction. By using these detectors, the potential line initials of the principal lines are extracted and then, based on the extracted potential line initials, the principal lines are extracted in their entirety using a recursive process. The local information about the extracted part of the principal line is used to decide a ROI and then a suitable line detector is chosen to extract the next part of the principal line in this ROI. After extracting the principal lines, some rules are presented for palmprint classification. The palmprints are classified into six categories considering the number of the principal lines and their intersections. From the statistical results in the database containing 13,800 palmprints, the distributions of categories 1–6 are 0.36%, 1.23%, 2.83%, 11.81%, 78.12% and 5.65%, respectively. The proposed algorithm classified these palmprints with 96.03% accuracy.

Cappelli, Ferrara, and Maio proposed high resolution palmprint recognition system which is based on minutiae extraction. Pre-processing is formed by segmentation of an image from its background. To enhance the quality of image, local frequencies and local orientations are estimated. Local orientation is estimated using fingerprint orientation extraction approach and local frequencies are estimated by counting the number of pixels between two consecutive peaks of gray level along the direction normal to local ridge orientation. Minutiae feature is extracted in feature extraction phase. To extract the minutiae features contextual filtering with Gabor filters approach is applied. Minutiae cylinder code has been used for matching the minutiae features.

Dong Han, Zhenhua Guo, David Zhang introduces to improve the existing palmprint systems, the proposed system, which is the first on-line multispectral palmprint recognition system ever designed before, uses multispectral capture device to sense images under different illumination, including Red, Green, Blue and Infrared. We adopt Competitive Coding Scheme as matching algorithm, which performs well in on-line palmprint recognition. Wavelet-based image fusion method is used as data-level fusion strategy in our scheme. Fused verifications show better effort on motion blurred source images than single channel. Experimental results of fusion images are also useful references for future work on multispectral palmprint recognition.

Prasad, Govindan and Sathidevi, have proposed Palmprint Authentication Using Fusion of Wavelet Based Representations. Features extracted are Texture feature and line features. In proposed system pre-processing includes low pass filtering, segmentation, location of invariant points, and alignment and extraction of ROI. OWE used for feature extraction. The match scores are generated for texture and line features individually and in combined modes. Weighted sum rule and product rule is used for score level matching.

However, in palmprints the creases and ridges often overlap and cross each other. Therefore, Funda et al. have suggested the extraction of local palmprint features , i.e., ridges by eliminating the creases. However, this work is only limited to the extraction of ridges, and does not go beyond its usage to support any success of these extracted ridges in the identification of palmprints. Have attempted to estimate palmprint crease points by generating a local gray level directional map. These crease points are connected together to isolate the crease in the form of line segments, which are used in the matching process.

Several researchers have looked at using features from the ear's appearance in 2D intensity images, whereas a smaller number of researchers have looked at using 3D ear shape. Our own previous work that compared ear biometrics using 2D appearance and 3D shape concluded that 3D shape matching allowed greater performance. In another previous work, we compared recognition using 2D intensity images of the ear with recognition using 2D intensity images of the face and suggested that they are comparable in recognition power. Also, ear biometric results can be combined with results from face biometrics. There are two major parts of the system ear biometric using 3D: automatic ear region segmentation and 3D ear shape matching.

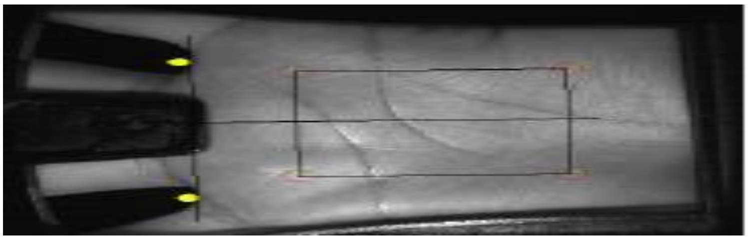
Eryun Liu, Anil K. Jain introduces the problem of efficient recognition of highly similar 3D objects in range images using indexing techniques. Various techniques have been proposed for 3D object recognition and indexing, for instance, geometric hashing and surface descriptor matching. However, most of the research has focused on the recognition of 3D dissimilar objects using a small database. It is desirable to design a scalable and efficient 3D object recognition system. In this research work, present a new framework which handles the recognition of highly similar 3D objects with a good scalability performance on large databases.

The use of projected fringes for the measurement of surface profile is a well-developed technique. Parallel fringes are projected onto the object surface, either by a conventional imaging system or by coherent light interference patterns.

III. PROPOSED SYSTEM

A. Preprocessing

Researchers utilize four types of sensors, CCD-based palmprint scanners, digital cameras, digital scanners and video cameras to collect palmprint images. Preprocessing is used to align different palmprint images and to segment the centre for feature extraction. Preprocessing involves five common steps, 1) binarizing the palm images, 2) extracting the contour of hand and/or fingers, 3) detecting the key points, 4) establishing a coordination system and 5) extracting the central parts. Fig.1(a)shows key points and coordinate system, fig.1(b) shows ROI extraction.



(a)

(b)

(c)

(d)

Fig. 1. The ROI extraction of 3D palmprint from its 2D counterpart. (a) The 2D palmprint image, the adaptively established coordinate system and the ROI (i.e. the rectangle); (b) the extracted 2D ROI; (c) the 3D palmprint image, whose cloud points have a one-to-one correspondence to the pixels in the 2D counterpart; (d) the obtained 3D ROI by grouping the cloud points corresponding to the pixels in 2D ROI.

ROI Extraction use tos extract the image. before feature extraction it is necessary to perform some preprocessing to align the palmprint and extract the central area of it, which is called the Region of Interest (ROI) extraction. By using the developed structured-light based 3D imaging system, the 2D and 3D palmprint images can be obtained simultaneously, and there is a one-to-one correspondence between the 3D cloud points and the 2D pixels.

B. Verification Algorithms

Once the central part is segmented, features can be extracted for matching. There are two types of recognition algorithms, verification and identification. Verification algorithms must be accurate. Identification algorithms must be accurate and fast (matching speed). Verification algorithms are line-based, subspace-based and statistic-based. Some algorithms in this section can support a certain scale of identification. However, most of the researchers do not report matching speed.

Line based approach:

Line-based approaches either develop edge detectors or use existing edge detection methods to extract palm lines. These lines are either matched directly or represented in other formats for matching. The magnitudes of the palm lines are projected in x and y coordinates forming histograms. After this, the first and second order derivatives of the palm images are calculated. The first order derivative is used to identify the edge points and corresponding directions. The second order derivative is used to identify the magnitude of lines. Then the Euclidian distance is used for matching.

Subspace-Based Approaches:

Subspace-based approaches also called appearance-based approach. They use principal component analysis (PCA), linear discriminant analysis (LDA) and independent component analysis (ICA). The subspace coefficients are regarded as features. Various distance measures and classifiers are used to compare the features. In addition to applying PCA, LDA and ICA directly to palmprint images, researchers also employ wavelets, Gabor, discrete cosine transform (DCT) and kernels in their methods . Fig. 2 illustrates the architecture of subspace approach.

Fig. 2. The architecture of subspace approach.

Statistical Approaches:

There are two types local and global. The local approaches transform images into another domain and divide the transform into several regions such as mean and variance of each small region. Researchers compute global statistical features like moments, centre of gravity and density directly from the whole transformed images. Yong et al. method for feature extraction divides the palm print image into a set of n small regions and then calculates the mean and S.D of sub regions. Euclidian square norm is employed for matching.

Other approaches:

Some approaches are difficult to classify because they combine several image-processing methods to extract palmprint features and employ some standard classifiers such as neural networks to make the final decision.

Fusion:

Fusion is a promising approach that may increase the accuracyof systems . Many biometric traits including fingerprint, palm vein, finger surface, face, iris, and hand shape have been combined with palmprints at score level or at representation level. Combining other hand features such as hand geometry and finger surface with palmprints allows these features and palmprints to be extracted from a single hand image. Only one sensor is needed. Researchers have examined various fusion rules including sum, maximum, average, minimum, support vector machines and neural networks.

C. Identification in Large Databases

Classification and Hierarchical Approaches:

The problem of real-time identification in large databases has been addressed in three ways: through hierarchies, classification and coding. Hierarchical approaches employ simple but computationally effective features to retrieve a sub-set of templates in a given database for further comparison. These approaches increase matching speed at the cost of accuracy. Classifiers can remove target palmprints by using simple features. Classification approaches assign a class to each palmprint in a database.

Coding approaches:

Palm code uses a single Gabor filter to extract the local phase information of palm print. Kong et al. introduced a fusion code method to encode the phase of the filter responses from a bank of Gabor filters with different orientations. A practical palmprint recognition algorithm using 2D phase information (i) reduces the registered data size by registering quantized phase information and (ii) deals with nonlinear distortion between palmprint images by local block matching using Phase-Only Correlation.

IV. Conclusion

Several existing methods have been reviewed for palmprint recognition. Palm print acquisition using CCD based scanner is recommended. Palm code, fusion code, competitive code and the theory of coding method are recommended. Palm print recognition is an emerging field and only limited works were carried out which paves way for the researchers to invent new methods to reduce the error rates and to improve the accuracy and speed of the system. In face recognition literature, many researchers design algorithms based on prior knowledge of the face. To optimize the recognition performance in terms of speed and accuracy, we expect that more algorithms are designed based on the prior knowledge of palmprints. Different template formats may require different measures for template protection. More research should be put into security and privacy issues. For biometric fusion, the authors recommend combining IrisCode − the commercial iris recognition algorithm and Competitive Code or other coding methods for high-speed large-scale personal identification because these algorithms share a number of important properties (e.g. high speed matching). Even though IrisCode does not accumulate false acceptance rates when the number templates in database increases, it’s false reject rate still increases. Some issues in using palmprints for personal identification have not been well addressed. For instance, we know that ridges in palmprints are stable for a person’s whole life but the stability of principal lines and wrinkles has not been systemically investigated. The future work can be extended to apply global features to extract the high resolution images and the KNN classifier on the database where multiple features can be extracted.

References

1. A. K. Jain and J. J. Feng, “Latent palmprint matching,” IEEE Trans Pattern Anal. Mach. Intell., vol. 31, no. 6, pp. 1032–1047,Jun. 2009.
2. D. Zhang, A. W. K. Kong, J. You, and M. Wong, “On-line palmprint identification,” IEEE Trans. Pattern Anal. Mach. Intell., vol. 25, no. 9, pp. 1041–1050, Sep. 2003.
3. C. Samir, A. Srivastava, and M. Daoudi, “Three-dimensional face recognition using shapes of facial curves,” IEEE Trans. Pattern Anal. Mach.Intell., vol. 28, no. 11, pp. 1858–1863, Nov. 2006.
4. P. Yan and K. W. Bowyer, “Biometric recognition using 3D ear shape,” IEEE Trans. Pattern Anal. Mach. Intell., vol. 29, no. 8, pp. 1297–1308, Aug. 2007.

5. H. O. Saldner and J. M. Huntley, “Temporal phase unwrapping: Application to surface profiling of discontinuous objects,” Appl. Opt., vol. 36, no. 13, pp. 2770–2775, May 1997.

6. D. Zhang, G. Lu, W. Li, L. Zhang, and N. Luo, “Palmprint recognition using 3-D information,” IEEE Trans. Syst., Man, Cybern. C, Appl. Rev.vol. 39, no. 5, pp. 505–519, Sep. 2009.

7. X. Q.Wu, D. Zhang, K. Q.Wang, and B. Huang, “Palmprint classification using principal lines,” Pattern Recognit., vol. 37, no. 10, pp. 1987–1998, 2004.

8. A. Lumini, D. Maio, and D. Maltoni, “Continuous vs. exclusive classification for fingerprint retrieval,” Pattern Recognit. Lett., vol. 18, no. 10, pp. 1027–1034, Oct. 1997.

9. H. Chen and B. Bhanu, “Efficient recognition of highly similar 3D objects in range images,” IEEE Trans. Pattern Anal. Mach. Intell., vol. 31, no. 1, pp. 172–179, Jan. 2009.

10. Jifeng Dai, Jianjiang Feng, Member, IEEE, and Jie Zhou, Senior Member, IEEE,” Robust and Efficient Ridge-Based Palmprint Matching”, VOL. 34, NO. 8, AUGUST 2012.

11. W. Kong, D. Zhang, and W. Li, “Palmprint Feature Extraction Using 2-D Gabor Filters,” Pattern Recognition, vol. 36, no. 10, pp. 2339-2347, 2003.

12. A. Kong and D. Zhang, “Competitive Coding Scheme for Palmprint Verification,” Proc. 17th Int’l Conf. Pattern Recognition, vol. 1, 2004.

13. A. Kong, D. Zhang, and M. Kamel, “Palmprint Identification Using Feature-Level Fusion,” Pattern Recognition, vol. 39, no. 3, pp. 478-487, 2006.

14. A. Kumar and D. Zhang, “Personal Recognition Using Hand Shape and Texture,” IEEE Trans. Image Processing, vol. 15, no. 8, pp. 2454-2461, Aug. 2006.

15. X. Wu, K. Wang and D. Zhang, “Wavelet based palmprint recognition”, in Proceeding of the First International Conference on Machine Learning and Cybernetics, vol. 3, pp.1253-1257, 2002.

16. Wei Li, Lei Zhang and David Zhang,”Three dimension palm print recognition”, 978-1-4244-2794-9/09/$25.00 ©2009 IEEE.

17. A. Kong, D. Zhang and G. Lu, “A study of identical twins palmprint for personal verification”, Pattern Recognition, vol. 39, no. 11, pp. 2149-2156, 2006.

18. W. Jia, D.S Huang and D. Zhang, “Palmprint verification based on robust line orientation code”, Pattern Recognition, vol. 41, no. 5, pp. 1504-1513, 2008

19. A. Kong, D. Zhang and M. Kamel, “Three measure for secure palmprint identification”, Pattern Recognition, vol. 41, no. 4, pp. 1329-1337, 2008