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Miscellaneous Survey on Biometric Authentication System Based on Palmprint and Face Recognition

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Abstract: 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. have been suggested for the securityin access control. Palmprint and face recognition has been investigated critically in this paper. Many different algorithms for recognition have been addressed in this paper along with its advantages and disadvantages. This paper provides an overview of current palmprint and face research, describing in particular capture devices, preprocessing, verification algorithms. Finally some advantages of multimodal biometric fusion are stated.

I. INTRODUCTIONS

Biometric is the science of measuring human's characteristics for the purpose of authenticating or identifying the identity of an individual based on specific physiological or behavioral characteristics. The design of a biometric system takes account of five objectives: cost, user acceptance and environment constraints, accuracy, computation speed and security. Reducing accuracy can increase speed. Typical examples are hierarchical approaches. Reducing user acceptance can improve accuracyA biometric system installed in PDA (personal digital assistant) requires low power and memory consumption but these requirements may not be vital for biometric access control systems.Biometric has gained much attention in the security world recently. Many types of personal identification systems have been developed and palmprint verification is one of the emerging technologies because of its stable, unique characteristics, low-price capture device, fast execution speed also it provides a large area for feature extraction.In this paper a wide range of survey is carried on face and palmprint recognition technique.

Starting with palmprint, it recognizes a person based on the principal lines, wrinkles and ridges on the surface of the palm. The recognition process consists of image acquisition, preprocessing, feature extraction, matching and result[2] and[34]. The different techniques are used for the preprocessing, feature extraction, classifiers.In personal authentication, palmprint employs either high resolution or low resolution images. The high resolution images refer to 500 dpi or more and suitable for forensic applications such as criminal detection while low resolution images refer to 100 dpi or less and suitable for civil, commercial applications such as access control. Palmprint consists of principal lines, wrinkles and ridges. The principal lines are the major lines existing in most of people palmprint. The three main principal lines are heart line, headline and lifeline. Wrinkles and ridges are the coarse and fine lines of the palmprint respectively. The high resolution images can generally extract all the features while in low resolution only principal lines, wrinkles can be extracted. Algorithmic surveyed is carried out on palm from [1-16].

In face recognition literature, many researchers design algorithms based on prior knowledge of the face.However, facial images can be easily obtained with a couple of inexpensive fixed cameras. Good face recognition algorithms and appropriate preprocessing of the images can compensate for noise and slight variations in orientation, scale and illumination. Finally, technologies that require multiple individuals to use the same equipment to capture their biological characteristics potentially expose the user to the transmission of germs and impurities from other users. However, face recognition is totally non-intrusive and does not carry any such health risks.Algorithmic surveyed on face is carried out from [17-33].

In this paper after a brief introduction the remaining section is divided into four sections. Section 3 gives brief overview on palmprint recognition followed by face recognition technique in section 4. Section 5 gives brief discussion on multimodal biometric system. Finally conclusion is stated in section 6.

II. PALMPRINT RECOGNITION

Definition

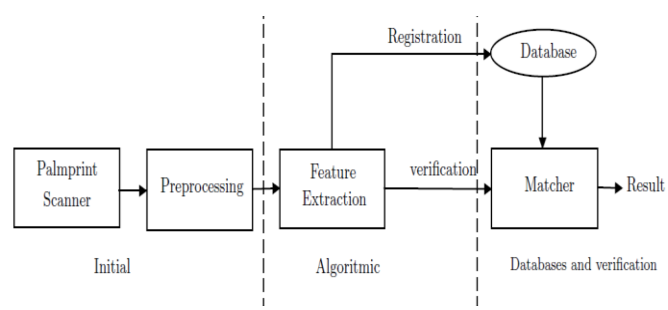

Fig. 1. An illustration of a typical palmprint recognition system

A typical palmprint recognition system consists of five parts: palmprint scanner, preprocessing, feature extraction, matcher and database illustrated in Fig. 1. The palmprint scanner collects palm- print images. Preprocessing sets up a coordinate system to align palmprint images and to segment a part of palmprint image for feature extraction. Feature extraction obtains effective features from the preprocessed palmprints. A matcher compares two palmprint features and a database stores registered templates.

In this paper survey of palmprint is divided into three categories Initial stage, algorithmic and database/verification stage which are briefly discussed in following sections.

Palmprint scanners and preprocessing

1. Palmprint scanners

Researchers utilize four types of sensors: CCD-based palmprint scanners, digital cameras, digital scanners and video cameras to collect palmprint images. Fig. 2 shows a CCD-based palmprint scanner developed by The Hong Kong Polytechnic University. Zhang et al. and Han were the first two research teams developing CCD-based palmprint scanners [1,2]. CCD-based palmprint scanners capture high quality palmprint images and align palms accurately because the scanners have pegs for guiding the placement of hands [1,2].Collection approaches based on digital scanners, digital cameras and video cameras require less effort for system design and can be found in office environments. These approaches do not use pegs for the placement of hands. Some researchers believe that this increases user acceptance. Digital and video cameras can be used to collect palmprint images without contact [3], an advantage if hygiene is a concern.

Fig. 2.A CCD-basedpalmprintscanner

2. Preprocessing

Preprocessing is used to align different palmprint images and to segment the center for feature extraction. Most of the preprocessing algorithms employ the key points between fingers to set up a co- ordinate system. 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. The point of interest is detecting key points it can be carried out by tangent, bisector and finger based to detect the key points between fingers.The tangent-based approach [1] considers the two boundaries one from point finger and middle finger and the other from ring finger and last finger as two convex curves and computes the tangent of these two curves. The two intersections are considered as two key points for establishing the coordinate system. Bisector-based approach constructs a line using two points, the center of gravity of a finger boundary and the midpoint of its start and end points. The intersection of the line and the finger boundary is considered a key point. Han and his team propose two approaches to establish the coordinate system, one based on the middle finger and the other based on the point, middle and ring fingers [2].

3. *Algorithmic Stage of Plamprint*

This stage discussed an efficient algorithm used for feature extraction developed by various researchers

4. Line-based approaches

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. Wu etal use Canny edge operator [4] to detect palm lines [5]. The orientations of the edge points are passed into four membership functions representing four directions. For each direction, the authors compute following equation.

$$E_{R,i} = \sum_{(x,y)\epsilon R} (Mag(x,y) \times \mu_i(x,y)^2)$$

Where $\mu_i$represents one of the membership functions; *Mag* represents the magnitude of the lines and R is a local region. The feature value$E_{R,i}$is normalized. Finally, Euclidean distance is used for matching. Wu etal. designed two masks to compute the vertical first- order derivative and the second-order derivative of palm print images [6]. The directional first-order and second-order derivatives can be obtained by rotating the two standard marks. They use the zero- crossings of the first-order derivatives to identify the edge points and corresponding directions. The magnitude of the corresponding second-order derivative is considered as the magnitude of the lines. They retain only the positive magnitude because palm lines are valleys. The weighted sum of the local directional magnitude is regarded as an element in the feature vector. This feature is normalized by its maximum and minimum components. As with [5], Euclidean distance is used for matching.

5. Subspace-based approaches

Subspace-based approaches also called appearance-based approach in the literature of face recognition.They use principalcomponent analysis(PCA),linear discriminant analysis(LDA)andindependent component analysis(ICA) [8].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 [7]. Fig. 3 illustratesthe architecture of subspace approach.Some researchers have developed new subspace approaches and examined them onpalmprints [8]. Generally speaking,subspace-basedapproaches donot make use of any prior knowledge of palmprints.

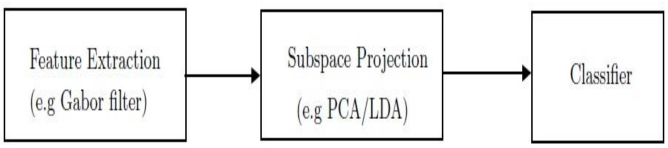

Fig. 3.The architecture of subspace approach

6. Statistical approaches

Statistical approaches are either local or global statistical approaches. Local statistical approaches transform images into anotherdomain and then divide the transformed images into several smallregions [9]. Local statistics such as means and variances of each small region are calculated andregarded as features. Gabor,wavelets and Fourier transforms have been applied. The small regions are commonly square but some are elliptical and circular [10]. In addition to directly describingthe local region by statistics, Wang et.al.use histograms oflocal binary pattern as features.Global statistical approaches [11] compute global statistical features directly from the whole transformed images.Moments,centers of gravity and densityhave been regarded as the global statistical features.

7. Symbolic aggregate approximation

Chen et al. extract a series of local features (e.g. average intensity) along a spiral [12] and use a time series method called symbolic aggregate approximation to represent the features and minimum distance to compare two feature vectors.

8. Root mean square deviation

Doi et al. regard the intersection points of finger skeletal lines and finger creases and the intersection points of the extended finger skeletal lines and principal lines as feature points [13]. In addition to position information, the tangential angles between the principal lines and the extended skeletal lines are also considered as features. They used root mean square deviation to measure the differences between two features.

9. Optimal positive Boolean function

Han extracted seven specified line profiles from preprocessed palmprints and three fingers and used wavelets to compute low frequency information [2]. This information is formed as a new feature vector, whose dimensionality is reduced by PCA. Finally, generalized learning vector quantization and optimal positive Boolean function are used to make final decision. This work may be the first paper employing feature-level fusion for palmprint recognition

10. Correlation approach

Koichi et al. also propose a correlation approach [14]. The amplitude spectrum of two segmented images is used to estimate their rotational and scale differences. One of the images is rotated and scaled and then their amplitude information in the frequency domain is removed. Finally, band-limited phase-only correlation (BLPOC) is used to compute the similarity of two images. BLPOC only considers low to middle frequency information.

11. Wavelet structural similarity

Zhang et al. used complex wavelets to decompose palmprint images and propose a modified complex-wavelet structural similarity (CW-SSIM) index for measuring the local similarity of two images [15]. The overall similarity of two palmprints is estimated as the average of all local modified CW-SSIM. CW-SSIM is originally proposed for evaluating image quality [16].

III. FACE RECOGNITION

Definition

Face recognition appears to offer several advantages over other biometric methods, a few of which are outlined here: Almost all these technologies require some voluntary action by the user, i.e., the user needs to place his hand on a hand-rest for fingerprinting or hand geometry detection and has to stand in a fixed position in front of a camera for iris or retina identification. However, face recognition can be done passively without any explicit action or participation on the part of the user since face images can be acquired from a distance by a camera. This is particularly beneficial for security and surveillance purposes. The block diagram remains same as that of Fig. 1only palm scanner can be replaced by face scanner or camera. In the following section the algorithmic stage is broadly classified.

Algorithmic Stage of face recognition

1. Featured based

Feature-based approaches first process the input imageto identify and extract (and measure) distinctive facial features such as the eyes, mouth, nose, etc., as well as other fiducial marks, and then compute the geometric relationshipsamong those facial points, thus reducing the input facialimage to a vector of geometric features. Standard statisticalpattern recognition techniques are then employed to matchfaces using these measurements.Early work carried out on automated face recognitionwas mostly based on these techniques. One of the earliestsuch attempts was by Kanade [17], who employed simpleimage processing methods to extract a vector of 16 facialparameters - which were ratios of distances, areas and angles (to compensate for the varying size of the pictures) - and used a simple Euclidean distance measure formatching to achieve a peak performance of 75% on adatabase of 20 different people using 2 images per person(one for reference and one for testing). Brunelli and Poggio [18], building upon Kanade's approach computed a vector of 35 geometric features Fig. 4 from adatabase of 47 people (4 images per person) and reported a90% recognition rate. However, they also reported 100%recognition accuracy for the same database using a simpletemplate-matching approach.

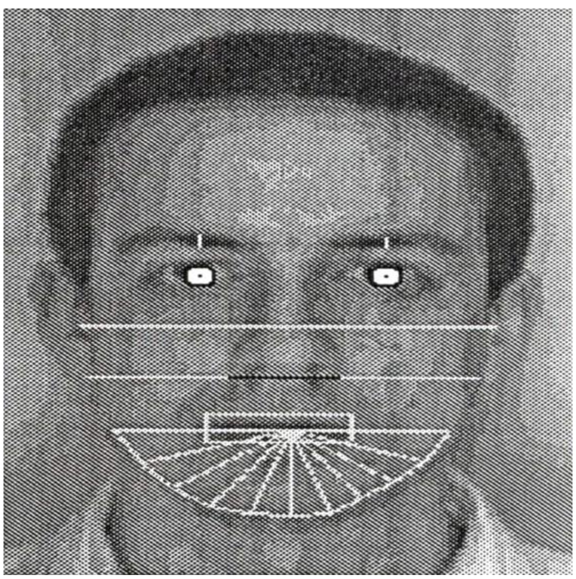

Fig. 4.Geometrical features (white) used in the face recognition

Cox et al. [19] reported a recognition performanceof 95% on a database of 685 images (a single image foreach individual) using a 30-dimensional feature vectorderived from 35 facial features Fig. 5. However, thefacial features were manually extracted, so it is reasonableto assume that the recognition performance would havebeen much lower if an automated, and hence less precise,feature extraction method had been adopted.

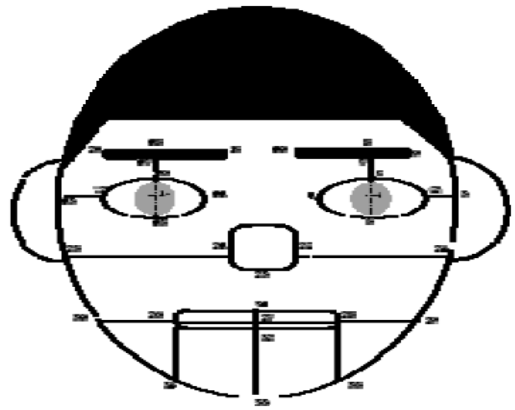

Fig. 5.35 manually identified facial features

2. Holistic

Holistic approaches attempt to identify faces using global representations, i.e., descriptions based on the entire image rather than on local features of the face. These schemes can be subdivided into two groups: statistical andAI approaches

3. Statistical

The image is represented as a 2D array of intensity values and recognition is performed by direct correlation comparisons between the input face and all the other faces in the database. Though this approach has been shown to work [20] under limited circumstances (i.e., equal illumination, scale, pose, etc.), it is computationally very expensive and suffers from the usual shortcomings of straightforward correlation-based approaches, such as sensitivity to face orientation, size, variable lighting conditions, background clutter, and noise. Sirovich and Kirby [21] were the first to utilize PrincipalComponents Analysis (PCA) to economicallyrepresent face images. They demonstrated that anyparticular face can be efficiently represented along the eigen pictures coordinate space, and that any face can beapproximately reconstructed by using just a small collection of eigen pictures and the corresponding projections('coefficients') along each eigen picture.

Turk and Pentland [22, 23] realized, based on Sirovichand Kirby's findings, that projections along eigen picture scould be used as classification features to recognize faces.They employed this reasoning to develop a face recognition system that builds eigen faces, which correspond to theeigenvectors associated with the dominant eigenvalues ofthe known face (patterns) covariance matrix, and thenrecognizes particular faces by comparing their projections along the eigen faces to those of the face images of theknown individuals. The eigen faces define a feature spacethat drastically reduces the dimensionality of the originalspace, and face identification is carried out in this reducedspace.Though no implementation has been reported,it has however been suggested in [81] that variation inscale be dealt with by employing multi-scale eigen faces orby rescaling the input image to multiple sizes and using thescale that results in the smallest distance measure to theface space.

4. Artificial Intelligence

AI approaches utilize tools such as neural networks and machine learning techniques to recognize faces. Some examples of methods belonging to this category are given below. In [24], 50 principal components were extracted and an auto-associative neural network was used to reduce those components to five dimensions. A standard multi-layer perceptron was exploited to classify the resulting representation. Though favorable results were received, the database used for training and testing was quite simple: the pictures were manually aligned, there was no lighting variation, tilting, or rotation, and there were only 20 people in the database. Eleyan and Demirel [25] used principal components analysis to obtain feature projection vectors from face images which were then classified using feed forward neural networks. Some tests on the ORL database using various numbers of training and testing images showed that the performance of this system was better than the eigenfaces [22, 23] one in which a nearest neighborclassifier was used for classification.

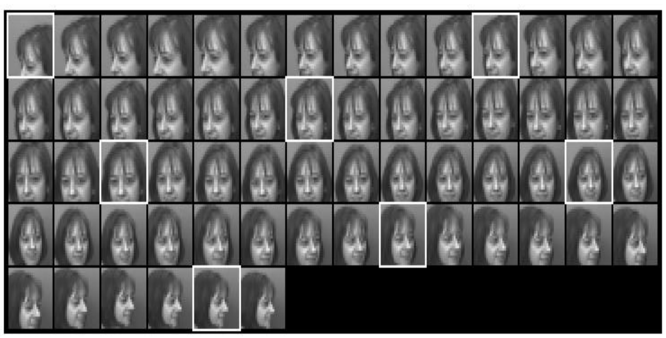

Fig. 6.A complete Primary sequence for the class Carla, after segmentation but before preprocessing

5. From Video sequences

Howell and Buxton [26] employed a two-layer RBF network [27, 28] for learning/training and used Difference of Gaussian (DoG) filtering and Gabor wavelet analysis for the feature representation, while the schemewas utilized for face detection and tracking. Training and testing were done using two types of image sequences: 8 primary sequences taken in a relatively constrained environment, and a secondary sequence recorded in a much more unconstrained atmosphere Fig. 6 and 7. The image sequences consisted of 62 to 94 frames. The use of Gabor wavelet analysis for feature representation, as opposed to DoG filtering, seemed to yield better recognition results. The recognition accuracies reported varied quite a bit, ranging from 99%, using 278 images for training and 276 for testing, to 67%, using 16 training and 538 testing images.

Fig. 7.A complete Secondary sequence for the classSteve, after segmentation but before preprocessing

6. From Sensor input

In recent years some attention has nevertheless been directed towards exploiting other sensing modalities, such as 3D or range data and infra-red imagery, for this purpose.

7. 3D model based

The main argument in favor of using 3D information for face recognition appears to be that it allows us to exploit features based on the shape and the curvature of the face (such as the shape of the forehead, jaw line, and cheeks) without being plagued by the variances caused by lighting, orientation and background clutter that affect 2D systems [29]. The technique used are (i) Scanning systems: Laser face scanners produced by companies like Cyberware Inc. [30] and 3D Scanners Ltd. [31] seem to be producing highly accurate results. (ii) Structured light systems: These systems make use of the principles of stereo vision to obtain the range data. Their main advantage is that the only equipment they require is cameras and some kind of projection system. (iii)Stereo vision systems: These are systems that attempt to extract 3D information from two or more 2D images of the same object taken from different angles.

8. Infrared based

R. Cutler [32] stated an argument that since infrared facial images reveal the vein and tissue structure of the face which is unique to each individual (like a fingerprint), some of the face recognition techniques for the visible spectrum should therefore yield favorable results when applied to these images. However, there exist a multitude of factors that discourage the exploitation of such images for the face recognition task, among which figure the substantial cost of thermal sensors,

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the low resolution and high level of noise in the images, the lack of widely available data sets of infra-red images, the fact of infra-red radiation being opaque to glass the fact that infra-red images are sensitive to changes in ambient temperature, wind and metabolic processes [33].Selinger and Socolinsky [33] used the same database of 91 subjects and tested the performance of four face recognition algorithms (PCA, LDA, LFA and ICA) under the afore-mentioned conditions and reached the same conclusion, although they did concede that the apparent superiority of the infra-red approach may stem from the fact that their data did not contain sufficiently challenging situations (i.e., changes in temperature, wind, etc.) for the infra-red imagery, whereas it did so for the visible images.

IV. FUTURE SCOPES

One of major research difficulties of Biometric Authentication is the single sample biometrics recognition problem. We often face this problem in real-world applications. It may lead to bad recognition result. To solve this problem, we may to feature level biometrics fusion. We can combine two kinds of biometrics: one is the face feature as a contactless and another is the palmprint feature which is a typical contact biometrics as shown in Fig. 8. We can extract the discriminant feature using Gabor-based image preprocessing and principal component analysis (PCA) techniques. And then design a distance-based separability weighting strategy to conduct feature level fusion. Using a large face database and a large palmprint database as the test data, the approach significantly improves the recognition effect of single sample biometrics problem.

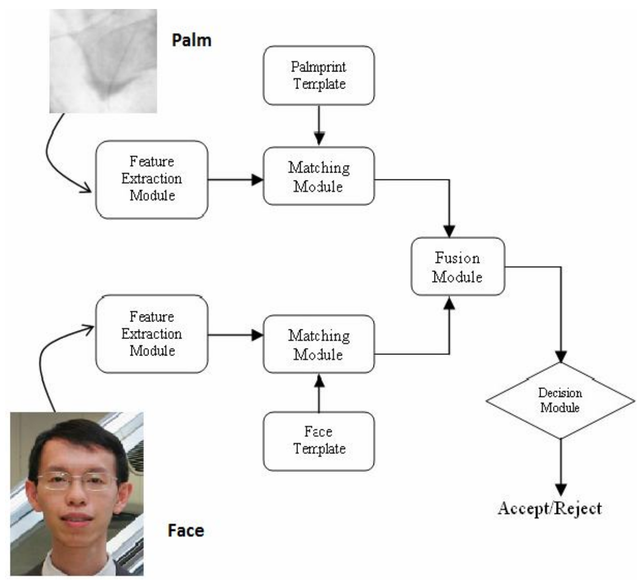

Fig. 8.Block diagram of face and palmprint multimodal biometric system

V. CONCLUSION

In this paper a survey of palmprint and face recognition has been carried out vigorously. Wide range of survey will convey reader different methods of face and palm recognition along with its advantages and disadvantages. Moreover various permutation and combination can be done by this survey which provides an easy platform to research on fusion based technique for better accuracy.

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