Review of Hand Feature of Unimodal and Multimodal Biometric System

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ABSTRACT
In this age of digital impersonation, biometric techniques are being used increasingly for authentication technique to prevent unauthorized access. As only biometrics, the authentication of individuals using biological identities, can offer true proof of identity. The increasing interest of biometrics is related to security, forensics and remote managing. Extensive research has been conducted in this area with different techniques. In this paper, unimodal, multimodal and fusion techniques are reviewed for authentication.

General Terms
Security

Keywords
unimodal, multimodal, score level fusion, FAR, FRR

1. INTRODUCTION
The need for trustworthy user authentication techniques has increased in the commercial society which concerns about security. A most of applications require reliable authentication schemes to confirm the identity of an individual requesting their service to different applications. A long-established authentication technique such as the ubiquitous username password method are insufficient for personal identity since they can only provide proof of ownership either of proof of knowledge. Only biometrics, the authentication of persons using biological traits, can offer true proof of identity. The emergence of biometrics technologies is replacing the traditional methods as it has addressed the problems and improves the reliability of authentication. Biometrics refers to the authentication techniques that depends on measurable physiological and entity characteristics that can be automatically verified. Biometric-based solutions are capable to provide for confidential transactions and personal data confidentiality. Multibiometric integrates dissimilar biometric systems for verification in making a individual identification. This system takes help of the capabilities of each individual trait. These systems can anticipate more accuracy due to the fact that they use multiple biometric traits where each trait presents independent proof to make a more informed decision. Multimodal biometric systems confine two or more biometric traits and use fusion to combine their analyses to produce a better match decision because of which there is improvement in the FAR and FRR. All unimodal biometric systems can be used with mixture of others to form a multimodal biometrics.

Multi-biometric identification technology is valued widely and becomes the focus of studies. [30].

The review is organized in following way, In section 2 unimodal and multimodal system. In section 3 multimodal system and d different Fusion techniques. In section 4 observation about different schemes studied. Review is concluded in section 5.

2. UNIMODAL AND MULTIMODAL SYSTEM
As we have main concern is to use image processing technique to develop unimodal and multimodal biometric systems for authentication. In this section we will review research in the field of biometrics. We present different biometric traits along with the findings of different researchers in pre-processing, feature extraction, matching, and classification of biometric acknowledgment. In this paper the research, focused on hand as a biometric trait using Fingerprint & palm print features.

Biometric identification based on human characteristics for personal recognition has become of great importance .In general system of single biometric identification is based on single traits, such as fingerprints identification, face identification and iris identification etc. They have unicity and restrictions [30]. So multi-biometric identification technology came in existance and becomes the focus of studies.

Unimodal biometric systems have to contend with a number of problems such as noisy data, intra-class variations, non-universality, spoof attacks, restricted degrees of freedom and unacceptable error rates [6]. Some of these shortcomings can be addressed by deploying multi modal biometric systems that combines evidence presented by multiple sources of information.

2.1 Palm Print Authentication
Palm print recognition is commonly studied in the past years and many efforts are done to use it as a biometric trait for various applications. Existing research work on palm prints is based on low resolution images and hence matching is based on the creases present on the palm prints. Recently it was analysed that ridge son palm prints can be used for matching since it is unique and constant for humans and can be used for large forensic applications. The ridges are very reliable as they are unaffected against distortion hence used for palm print matching. The problem in existing systems are that those algorithms for palm print matching followed the fingerprint algorithms and hence speed and matching accuracy and was inefficient.

In this paper [2], They develop a new feature extraction method based on low resolution palmprint images. A 2-D Gabor filter is used to get the texture information and two palmprint images are compared in term of their hamming distance.

Twins having the closest genetics based relationship are probably having maximum similarity between their biometrics. Classifying identical twins is a not easy problem for some automatic biometric systems. In this paper [3], they summarize the results about identical twins' biometrics which includes face, iris, fingerprint and also voice verification.

In this paper [5], they suggest a feature-level fusion technique for improving the efficiency of palmprint identification. Multiple elliptical Gabor filters with different orientations are employed to find out the phase information on a palmprint image, which is then combined according to a fusion rule to produce fusion code. Normalized hamming distance is used for comparison of two Fusion Codes. A dynamic threshold is used for the final decisions. Comparing non-fusion approach and the proposed method, improvement in verification and identification are ensured.

It has recently been found that, perfect accuracy, having zero equal error rates (EER) for faces, fingerprints and palm prints can be achieved along with its variants, BioHashing, a new technique that combines biometric trait and a tokenized (pseudo-) random number (TRN) [7].

In comparison to the existing methods, in online palmprint identification system uses low-resolution palmprint images to achieve effective personal identification. The system is divided in two parts: a novel device for online palmprint image acquisition and well-organized algorithm for fast palmprint recognition. For feature extraction a robust image coordinate system is defined to facilitate image alignment. In addition for palmprint feature extraction and representation, a 2D Gabor phase encoding scheme is proposed [8].

A novel method for palm print recognition, called Fisher palms. In this method, each pixel of a palmprint image is measured as a coordinate in a high-dimensional image space. A linear projection based on Fishers linear discriminant is used to convert palmprints from high-dimensional original palmprint space to a significantly lower dimensional feature space (Fisher palm space), in which the palmprints from the different palms can be discriminated much more efficiently [9].

In this paper [11], they propose a palmprint recognition method based on eigen space technology. The original palm print images are transformed into a small set of feature space, called eigenpalms, by means of the Karhunen–Loeve transform, which are the eigenvectors of the training set and can represent the principle components of the palmprints quite well. Then, the eigenpalm features are extracted by projecting a new palmprint image into the subspace spanned by the eigenpalms, and applied to palmprint recognition with a Euclidean distance classifier.

In image processing and recognition, discrete cosine transforms (DCT) [37] and linear discrimination are two widely used techniques. Based on them, paper [13] present a new face and palmprint recognition approach. It first uses a two dimensional separability decision with favourable linear separability. Then from the selected bands, an improved Fisher face is used extracts the linear discriminative features and performs the classification by the near neighbour classifier. It detailed analyse theoretical advantages of our approach in feature extraction. It can considerably improve the recognition rates for face and palmprint data and effectively reduce the dimension of feature space.

This paper [26] proposes different wavelet transforms based a palm print identification system using the textural information. The transforms employed have been analysed for their individual as well as combine performances at feature level. The wavelets used for the analysis are Bi orthogonal, Symlet and Discrete Meyer.

2.2 Finger Print Authentication

Finger print is one of the most widely used biometric trait. Fingerprint biometric is the most proven technique to identify the individual. The fingerprint is basically consisting of features like ridges and valleys on the finger. The use of minutiae feature for single fingerprint classification has been introduced in [10]. A system on fingerprint classification is discussed in [10] [11] [22].

A evaluation rough-set based approach for binarization of fingerprint image is presented. Based on the rough set theory maximization of rough entropy and minimization of roughness of the image lead Image binarization is obtained. Otsu's algorithm of binarization which is regarded as most popular has also been applied on the same set of images. The result of the proposed method is compared with the conventional Otsu's thresholding method for binarization. [11]

In paper [42] proposes two methods for fingerprint image enhancement. The first one is carried out using local histogram equalization, Wiener filtering, and image binarization, also using a unique anisotropic filter for direct greyscale enhancement. The binarization process is applied by adaptive thresholding based on the local intensity mean. Local histogram equalization for contrast expansion and Wiener filtering are used for noise reduction

In a fast fingerprint image enhancement algorithm which can adaptively improve the clarity and valley structures of input fingerprint image based on the estimated local ridge. This paper evaluated the performance of the image enhancement algorithm using the goodness index of the extracted minutiae and accuracy of an online fingerprint verification system. To quantitatively assess the performance of our fingerprint enhancement algorithm they have used the goodness index (GI) of the extracted minutiae .Gabor filters have both frequency-selective and orientation- selective properties and have optimal joint resolution in both spatial and frequency domains.

A critical step in studying the statistics of fingerprint minutiae is to consistently extract minutiae from the fingerprint images. As quality of fingerprint images are rarely perfect as it may be ruined and corrupted due to changes in skin and impression conditions and aging. Thus, image enhancement techniques are used prior to minutiae extraction to obtain a more reliable estimation of minutiae locations [15].

An effective fingerprint matching algorithm based on error propagation consist, Ridge information and Hough transformation are adopted to find a number of pairs of matching minutiae. The initial correspondences, which are used to estimate the common reason of two fingerprints and the alignment parameters. Then the correspondence and its surrounding matched minutiae pairs established using Matched Set. The matching process is depends upon a error propagation. [43].

In paper [44] presented the study of fingerprint verification based on local ridge discontinuities features (minutiae) only using grey scale images, in which They extract minutiae using two algorithms those following ridge lines and then recording ridge endings and bifurcations. Moreover they use a third algorithm are used for a minutiae verification processing a local area using a neural network (multilayer perception). Fingerprint distortion is filtered using a minutiae whole representation based on regular invariant moments. Here they propose a new method of matching for the problem of different numbers of minutiae extracted from the algorithms

that use fuzzy operator to bypass. Sequential method and reactive agent is used in verification process of fingerprint matching.

One of the open issues in fingerprint verification is the lack of robustness against image-quality degradation. If quality of image captured is poor that creates problem of unauthentic and lost features, which degrades the performance of the overall system. Therefore, in fingerprint recognition system it is important to estimate the quality and validity of the captured fingerprint images from sensors [25].

In paper [38] introduces a novel fingerprint matching algorithm using both ridge feature and the usual minutiae feature to increase the recognition performance against non linear deformation in fingerprints [38, 40]. Ridge count, ridge type, ridge length, rcd are the elements of the ridge features. They are representing the topology information in entire ridge pattern existing between two minutiae. Before extracting features, Gabor filter are used to enhance the fingerprint image. For extracting ridge features, ridge based coordinate system is defined in skeletonised image.

Fingerprint matching is based on finding the Euclidean distance between the corresponding Finger Codes [29]. A global and local details in fingerprint is captured using a bank of Gabor filters . The fingerprint matching is based on the Euclidian distance between the two corresponding finger codes and hence is extremely fast. Fingerprints with scale, translation, and rotation invariant are mostly available then filter based feature extraction is desirable. AAD features and NIST 9 database are used to matching the fingerprints.

In this paper [41] introduce a novel algorithm based on global comprehensive similarity with three steps. In first step a minutia-simplex that contains a pair of minutiae as well as their associated textures, with its transformation-variant and invariant relative features, which is used for the broad similarity measurement and parameter estimation. To represent features among minutiae usually the ridge-based nearest neighbourhood is used. The Euclidean space-based and ridge-based relative features among minutiae support each other in the image representation of a fingerprint.

3. MULTIMODAL SYSTEM AND DIFFERENT FUSION TECHNIQUES

Multimodal biometrics has emerged as a choice for secure authentication systems. Cost effective hardware and faster processing make multimodal biometrics an attractive option. Multimodal biometrics involves fusion of two or more biometric traits or algorithms. We discuss different combinations to form multimodal systems and fusion technologies

The issue of multi-modal biometrics has become focus of interest in recent years. This paper [35] categorizes approaches to multi-modal biometrics based on the biometric source, the type of sensor and the depth of collaborative interaction in the processing. It also addresses some of the challenges and issues that confront research in multimodal biometrics Multimodal biometric could overcome the drawbacks of single biometric by combining two or more biometric modalities for individual identity verification. The lot of research and experiments of multimodal biometric are going based on hand vein, iris and fingerprint. The following techniques were discussed, Simple Average and Weighting Average fusion algorithm, the classical information fusion methods, for improving the recognition accuracy [29]. It is large scope for future research on multimodal biometric and provides basis for developing multibiometric systems using different algorithms as well as combining different traits.

The features of singular creature, are used for multibiometric identification technology based on finger shape and palmprint [30].

It is difficult problem in biometric authentication of a real legitimate trait in contrast to a fake self-manufactured synthetic or reconstructed sample, which requires the additional efforts develop a new and efficient protection measures. In this paper [32], for detection different types of fraudulent access attempts. They present a novel software-based fake detection method that can be used in multiple biometric systems .The aim of the proposed system is to improve the security of biometric recognition frameworks, by adding liveness assessment in a fast, user-friendly, and non-intrusive manner, through the use of image quality assessment.

This paper [31] GUI interface is used to develop a multibiometric based authentication system. An extraction algorithm is used to extract features from finger print and a palm print feature. Then an integration of these two algorithms to perform a multi biometric authentication was done. By comparing the test image of a person, the identity of the person is displayed with his/her own image. To reduce computation time and memory space a fingerprint and palm print algorithm can be used to the existing algorithms.

3.1 Different Fusion Techniques

It is generally known that a performance of good fusion algorithm is better or at least equal to the individual classifiers. Considerable research in the pattern recognition field is focused on fusion rules that combined the outputs of the first level experts and make a final decision. They are broadly classified in two types Fusion prior to matching and after matching.

3.1.1 Fusion Prior To Matching

Fusion before matching can be obtained by two different ways [36].One is sensor level fusion and other is feature level fusion.

Multimodal biometric identification systems the fusion of two or more physical or behavioural modalities to get optimum False Acceptance Rate (FAR) and False Rejection Rate (FRR), that gives improvement in system accuracy and dependability. In this paper [28], novel multimodal biometric identification system suggested based on iris and fingerprint traits. The paper is a modern advancement of multi biometrics, offering an innovative perspective on features fusion. A homogeneous biometric vector is obtained by integrating iris and fingerprint data using frequency-based approach, also a hamming-distance-based matching algorithm deals with the fused homogenous biometric vector.

3.1.2 Fusion After Matching

It is possible by three different ways [36], matching score level fusion, rank level fusion, decision level fusion.

3.1.2.1 Matching Score Level Fusion

This paper [21] presents a multimodal biometric identification system based on the features of the human hand. It describes a innovative biometric approach for fusion applied at the matching-score level to individual identification using eigenfinger and eigenpalm features. The recognition process can be divided into the following phases: capturing the image; pre processing; extracting and normalizing the palm and strip-

like finger sub images; the K-L transform is used for extracting the eigenpalm and eigenfinger features; matching and fusion; and, finally, a decision based on the (k, l)-NN classifier and thresholding.

This work presents in paper [23] a innovative weighting algorithm is discussed score-level multi-biometric system. Those weights are used in the effective and widely used weighted sum fusion rule to produce multi-biometric decisions. The characteristic of the overlap region between the genuine and imposter scores distributions is used to decide solution. It also integrates the performance of the biometric source represented by its equal error rate.

3.1.2.2 Rank Level Fusion

In order to obtain a consensus rank of each identity rank level fusion consolidates the ranks output by the individual subsystems. Rank level fusion gives less information in comparison with match score level fusion. The rank level fusion is mostly used for the identification of an individual rather than verification.

3.1.2.3 Decision Level Fusion

Individual authentication results coming from several traits (e.g., still image, speech), are combined by using fuzzy k-means (FKM) and fuzzy vector quantization (FVQ) algorithms, and median radial basis function (MRBF) network. The modifications based on a novel fuzzy vector distance definition, are proposed to handle the fuzzy data and utilize the quality measure. Fuzzy clustering algorithms is better performance compared to the classical clustering algorithms as well as other known fusion algorithms [19]. MRBF has improved performance especially when two modalities are combined.

This paper [24] presents a multimodal biometric identification system based on the mixture of geometrical, palm and finger print features of the human hand. The hand images are captured by a commercial scanner with a 150 dpi resolution. Binariesed images are used to obtain the geometrical features. A Support Vector Machines is used as classifier. Palm print and finger texture are obtained using different 2D Gabor phase encoding. Hamming distance and threshold are used for verifying the identity. An improvement in accuracy is obtained with combined scheme with feature, score and decision level fusion.

4. OBSERVATION

In [30] the features of hand geometry & palm print can have complementary advantages so that the process of matching will be fast and highly active. In [24] the palm & finger print texture is obtained by means of 2D Gabor phase encoding scheme. The result with different combination rules at feature, score and decision levels have been given. The best results are obtained combining three systems at decision level.

It is observed that the scheme in [19] that is Fuzzy clustering algorithm for decision level data fusion has better performance with classical K-mean & other known fusion algorithm. In [21] it is found that this system achieves better result expressed in terms of total error rate or equal error rate.

In [27] sequential fusion which does not increase compounded cost. In [28] finger print matching using segmented region of interest surrounding singularity points, which overcomes the drawback related to the fingerprint minutiae information. In [31] shown that the proposed scheme has less computation time and occupies less memory space.

In [32] shows that multimodal system improves accuracy rate than single biometric system.

In [45] GMM can used to handle situation where a single parametric family is unable to provide a satisfactory model for local variation in observed data.

5. CONCLUSION

Even though biometric technology flourishing very rapidly, biometric authentication have not come much in use due to number of reasons.

To recapitulate different biometric authentication method has been reviewed from above discussion it was seen that there are two types of biometric authentication technique i.e. unimodal & multimodal. We also review the different palm print & finger print techniques & its various transform methods already implemented.

Review of different fusion techniques of two or more than two traits is discussed. The review of same normalization technique is also discussed.

To increase accuracy & the reliability of biometric authentication multimodal biometric may be used. Finding the most effective way to fuse independent subsystem opinions into a more accurate decision to improve system accuracy is a significant research challenge.

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