The major lines are also affected, but they are prominent. These are then used for feature extraction.

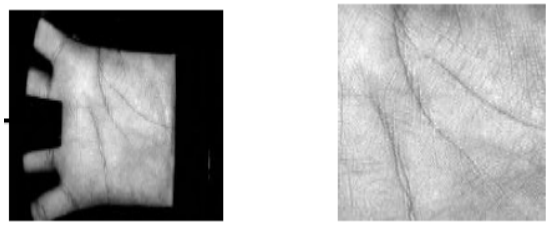

Figure 3: ROI extraction

C. Feature Extraction and Matching

For matching the palmprints, we need to extract some features first. The extracted features are then used for matching. Some of the feature extraction and matching algorithms are line based, subspace based, statistical and coding based approaches.

1) Line based approach*:* This approach develops edge detectors and makes use of the magnitude of the palm lines. 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 Euclidiandistance is used for matching.

2) Subspace based approach: This approach makes use of Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA) and Independent Component Analysis (IDA). The spatial coefficients are considered as the features used for matching. This approach does not need any prior knowledge of the palmprints.

3) Statistical approach*:* These are of two types, local and global. The local approach transforms the image in another domain. This transformed image is then divided into several regions such as mean and variance of each region. The global features include moments, center of gravity and density. The global approach is applied on the whole palmprint image. This is the only difference between the local and global approach. The local approach is applied on the segments of the palmprint image whereas the global approach is applied on the whole image.

4) Coding approaches: This approach uses a single Gabor filter to extract the local phase information of palmprint. This extracted phase information is used by the palmprint recognition systems to reduce the registered data size and to deal with non-linear distortion between palmprint images. This approach has very low memory requirement and fast matching speed.

D. Accept / Reject

The users are authenticated by the palmprint recognition systems. These accept the users, who are authenticated, i.e. whose palmprint match with a palmprint present in the database. If the user is not authenticated, then the user is rejected. This process of accepting and rejecting the user is done on the basis of the matching algorithm. This matching is done on the basis of the extracted features. Classification is the basis for the palm images to be accepted or rejected. Similar samples are grouped in the same class. Some of the similarity measures are Mahalanob is, Euclidean and Manhattan distances. Another classification approach is the construction of decision boundaries. This can be achieved by the use of techniques such as Artificial Neural Networks (ANN).

2. Other Approaches for Palmprint

Some approaches are difficult to classify because they combine several image processing methods to extract palmprint features such as neural network to make final decision, two dimensional dual-tree complexes transform on preprocessed palmprint to decompose the images, phase only correlations etc.

1) Fusion

Fusion means combining other biometric traits with palmprints such as face, fingerprints, palm veins and iris. Combining hand geometry and finger surface with palmprint allows these features and palmprint to be extracted from a single hand image i.e. only one sensor is needed. Researchers have examined fusion rules like sum, maximum, average, minimum, support vector machine (SVM) and neural networks. Fusion increases accuracy, computation costs and template sizes and reduces false acceptance.

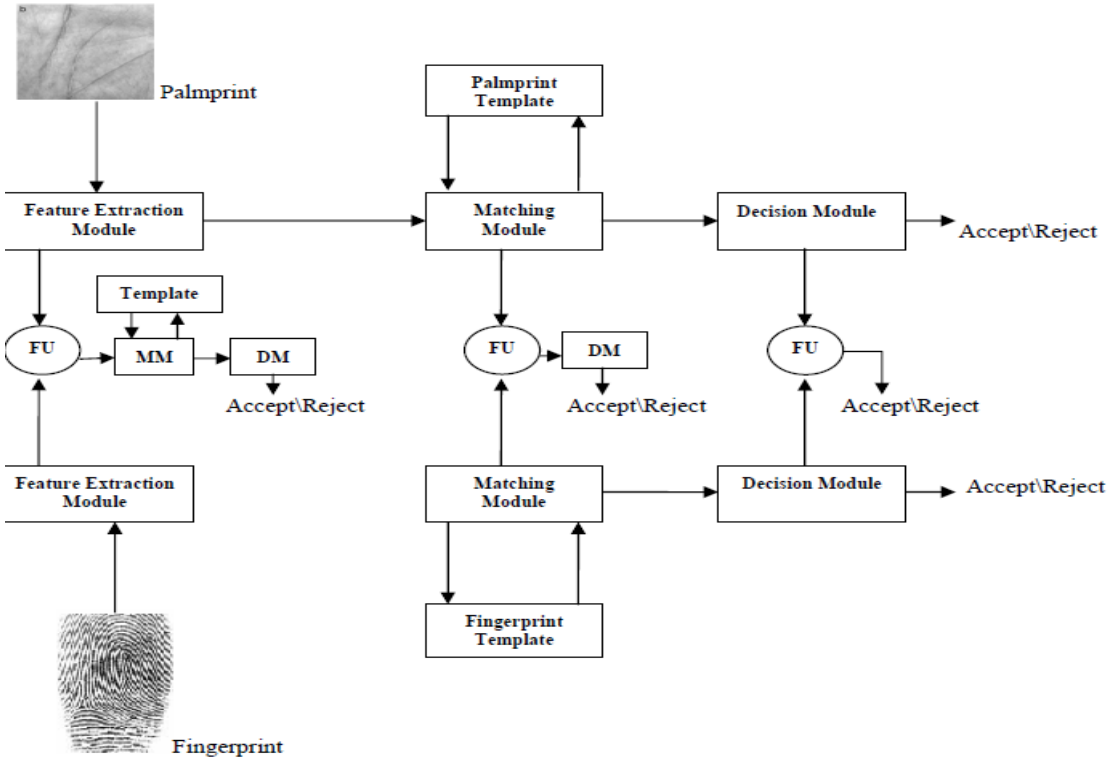

Figure 4: Levels of fusion in a bimodal biometric system

FU: Fusion Module, MM: Matching Module, DM: Decision Module.

1.1 Levels of fusion

Based on the type of information available in a certain module, different levels of fusion can be defined as shown in fig 4.

a. Fusion at the data or feature level: Either the data itself or the feature sets originating from multiple sensors/sources are fused.
b. Fusion at the match score level: The scores generated by multiple classifiers pertaining to different modalities are combined.
c. Fusion at the decision level: The final output of multiple classifiers is combined

3. Palmprint Acquisition Literature Review

There are various ways to capture palm print image. Researchers utilize CCD-based scanners, digital scanners, video camera and tripod to collect palm print images. A CCD-based scanner developed by Hong Kong Polytechnic University. Rafa Kozik and Michal Choras were made a special tripod to capture palm images. Its shape and proportion minimize errors caused by camera movements and rotation. A CCD-based scanner captures high resolution images and aligns palms accurately because it has pegs for guiding the placement of hand. Digital scanners produces low quality image and requires large time for scanning, Jiwen Lu et al proposes an efficient palmprint recognition method using locality preserving projections (LPP) andextreme learning machine (ELM) neural network. Firstly, two-dimensional discrete wavelet transformation (DWT) is applied in the region of interest (ROI) of each palmprint image and then principal component analysis (PCA) and LPP are used for dimensionality reduction [1].Followed by the same author Leqing Zhu, proposed a novel palm print recognition algorithm based on principal lines: anew irregular geometrical shape was employed to get valid palm print region, which decreased the influence of large noises; not only structure feature, but also intension in formation were included in the final extracted principal lines, which provides much sufficient clues for palm print recognition; the probability feature image (PFI) was used in order to suppress random noises in feature image; features from several training samples were merged into one template, which guaranteed the integrity of feature; fuzzy logic was employed in matching algorithm [2].As mentioned in [5], different neural network based approaches are evolved for palm print recognition by using some other domain method like wavelet transform etc. for training purpose. Different stage classifications can also be useful in such cases for optimum classification of appropriate features. Various proposed system is based on geometrical features and texture features extracted using kernel principal components analysis (KPCA).In the coarse-level stage, the hand geometrical features are applied in the SOMNN to select a small set for further matching, and in the fine-level matching, texture features are input into the BPNN for final identification. Since, Palm print-based personal identification, as a new member in the biometrics family, has become an active research topic in recent years. The rich texture information of palm print offers one of the powerful means in the field of personal recognition. Hence, many researches proposed, a novel approach for handprint identification.

4. Conclusion

Several existing methods have been reviewed for palmprint recognition. Palm print acquisition using CCD based scanner is recommended. Palm print recognition is a good field and only limited works were carried out researchers to invent new methods to reduce the error rates and to improve the accuracy and speed of the system. The future work can be extended to apply gaussianization, the feature normalization method on the high Resolution Images Where Multiple features can be extracted.

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