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Privacy Preserving Multimodal Biometrics in Online Passport Recognition

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Abstract — The biometric recognition systems rely on a single biometric for authentication for a particular user. Unfortunately these systems having some inevitable problems such as Noisy data, spoof attack, on-universality etc and hence it is not used in online passport registration system. In order to rectify the noise in the image, a novel joint sparsity based feature level fusion algorithm is used for multimodal biometrics recognition. The multimodal multivariate sparse representation method for multimodal biometrics recognition to test the data by a sparse linear combination of training data. It compares the different modalities of the test subject with the templates stored in DB and recognizes the user's authentication; simultaneously take into account correlations as well as coupling information between biometric modalities. The particular multivariate authentication can be used for online passport authentication using multiple biometrics identification system. Here the finger, face and signature are considered as biometrics parameters. These biometric images can be used for authentication in online passport management system. Besides it secure environment of the passport system recognition.

IndexTerms—Multibiometrics, feature level fusion, SVM, Kanade-Lucas-Tomasi, Fuzzy C Mean, Color code.

I INTRODUCTION

Unimodal biometrics system relies on a single source of information such as single iris or fingerprint for authentication. Unfortunately these systems have to deal with some inevitable problems. Online passport user authentication can be based on the public key cryptography, but some particular constraints are not strong in this system, because the biometrics image is not used for the authentication in online passport system and user constraints are not strong in nature and an illegal entries maintained in online passport system because some constraints acceptance based on the user favor.

In recent, the sparse representation[18] have efficient processing of data by using feature level fusion algorithm to remove the noises and occlusion in the images, then the particular secure biometrics image can be used for authentication. In proposed system, the secure biometrics images like fingerprint, iris and signature images can be used for the authentication for the passport system. To overcome the drawbacks of unimodal, a multimodal biometrics is emerged and it's consists of combining two or more biometrics modalities in a single identification system. A threshold determines the degree of similarity required resulting in a match declaration. The acceptance or rejection of biometric data is dependent on the match score fall in above or below the threshold. The integration of biometrics can provide better verification performance than the individual biometrics.

A. Purpose of the study

The primary objective of the study is to produce new knowledge with respect to security of fingerprint; iris and signature techniques in an online passport. The result of the work should be useful for those making design decision with respect to feature level fusion algorithm for recognition the user's.

B. Statement of the Problem

The purpose of biometric passport is to prevent the illegal entry of travelers and to limit the use fraudulent passport document by more accurate identification of individuals. The biometrics identification information into online passport will improve their robustness against identity theft.

II SOFT COMPUTING

Conventional computing requires a precisely stated analytical model and often a lot of computational. Soft computing differ from conventional computing and it is a

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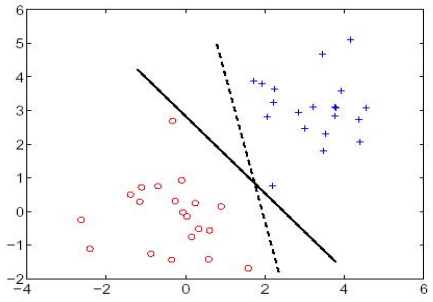
collection of methodologies that aim to exploit the tolerance for imprecision and uncertainly to achieved tractability, robustness and low solution cost. The soft computing tools are Fuzzy System, Support Vector Machine (SVM), Neural Network, Evolutionary Computations etc.

The SVM [7] are based on the concept of decision planes that defines decision boundaries and it separates between a set of objects having different class membership by using of discriminative learning of classifier.

For example, assign $y \in \{-1, 1\}$ to input data x, then the linear classifier is $y=\text{sign}(w.x+w_o)$ and its decision surface is a hyper plane define $w.x+w_o=0$.The linear separable is used to find linear classifier. So that all the training are classified correctly y_i $(w.x+w_o)>0$, i=1, 2……, n. The line that separate input pattern, So that output o=+1 on one side and o = -1 on other side and these match target value y $o(x)$ =sign $(w.x+w_o)$ and adjust weight {w,wo} by perception learning rule to coverage the correct solution in the linear separable case.



III Multimodal Biometrics System

The limitation of unimodal biometric system can be overcome by using multimodal biometric system. A multiple biometric system uses multiple applications to capture different types of biometrics. This allows the integration of two or more types of biometrics recognition and verification system in order to meet stringent performance requirement.

A multiple system could be a combination of fingerprint verification, face recognition, iris pattern and signature or any other combination of biometrics. This enhanced to takes advantage of the proficiency of each user. Biometric technologies are automated method of recognition an individual based on their physiological or behavioral characteristics such as fingerprint, iris and signature. Biometric systems are application of biometric technologies and can be used to verify a person's claimed identity and to establish a person's identity.

Two interesting properties of biometric identification are:

1. The person to be identified is required to physically be present at the point of identification.
2. Identification is based on the biometric technique that does not depend on the user to remember a password or to carry a token.

IV Levels Of Fusions

A biometrics recognition system is a pattern recognition system that recognizes an individual based on his/her biometrics traits [6].Fusion consists of two main categories: pre mapping fusion (before the matching module) and post mapping (after the matching module).The first strategy deals feature vector fusion and not used in result implementation. The second strategy realized fusion at the decision level based on algorithm.

A biometrics system consists of four main modules. They are

(a) Sensor modules that capture samples of a biometric traits in the form of raw biometric data.

(b)Feature extraction module that extract certain features from the biometric samples captured by the sensor.

(c)Matcher module that matches the features extracted from the biometric samples with the features stored in the system database.

(d)Decision module uses the matching scores to determine an identity the multimodal biometric system information.

The figure 1 illustrates the level of fusion in feature level fusion algorithm [6].FU: Fusion Module, MM: Matching Module, DM: Decision Module, A/R: Accept or Reject.

The unimodal limitation can be rectify by using of multimodal biometrics system to integrate multiple source of information system to meet the stringent performance required and examine level of fusion [9] and mode of operation.

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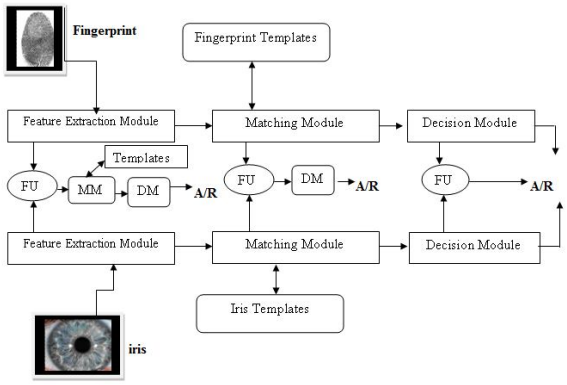

Figure 1: Levels of Fusion in a Multimodal Biometric System

Modes of Operation

Multimodal system operates in any one of the following two modes.

(a) Serial mode: Multiple sources of information is not acquired simultaneously. Decision is made before getting all traits. This reduces the recognition time.

(b) Parallel mode: Multiple source of information is acquired simultaneously.

V BIOMETRIC IMAGE SELECTION AND RECOGNITION

Different region of fringerprint, iris and signature have different qualities, instead of recognizing the entire individual images directly. The recognize of different region separately and combine the result depending on the quality of the region. This reduces the computational complexity, as the size of dictionary is greatly reduced and the recognition of the different region can be done in parallel. Occlusion affects only the local region on the iris, it will lower the quality of certain region and robustness of recognition [12] algorithm is improved. In propose a feature level fusion algorithm in sparse based recognition [1] to combine the recognition result. The figure 2 illustrates the different steps involved in the proposed approach.

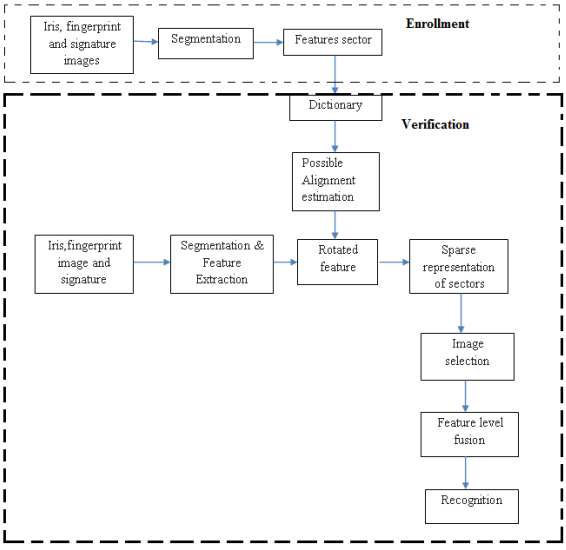

Figure 2: Fusion Based Image Selection and Recognition.

VI PROBLEM

In the existing system, unimodal biometric systems rely on single source of information and it consists of some inevitable problem. In online passport some constraints are not strong due to public key cryptography and biometric image not used for the authentication. The illegal entries maintained in online passport system.

Unimodal biometric had the following disadvantages like

- Online passport system cannot be satisfied the particular maintenance of the system is not proper in nature.
- Biometric system based on a single source of evidence may not be to capture meaningful data from the user.

VII IMPLEMENTATION

In proposed system, the secure biometric image like fingerprint, iris and signature based image can be used for the authentication for the online passport system. The multimodal overcome the inevitable problem of unimodal, then the particular secure biometric can be recognition and noise, occlusion can be removed by the sparse [13] classification in the feature level fusion. A threshold determines the degree of similarity required to result match or non-match user authentication.

Multi biometrics has the following advantages are

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- Secure online passport system to avoid the illegal entries based on the multiple biometric systems.
- Searching is easy and efficiently to recognition the authentication user in large database.

The recognition to testing images using an over complete dictionary[8],[14] of the training, the sufficient samples of the person i, ,$A_i=[v_i1,v_i2\ldots\ldots,v_in]\in R^{m*n}{}_i$, any test sample $y\in R^m$ from the same class to training the samples.

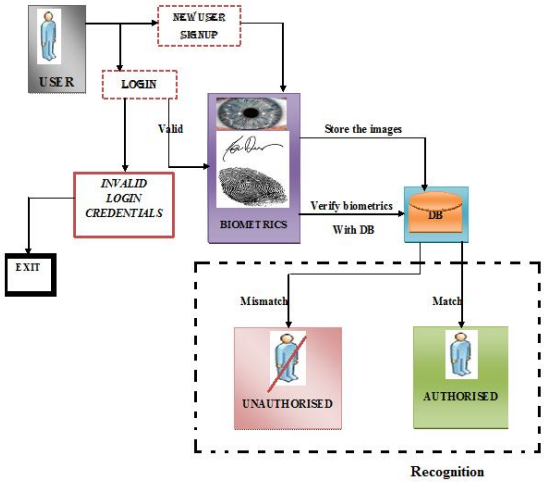

Figure 3: System Architecture

VIII Feature Extraction Module

a. Encrypted Multibiometrics

The encrypted multibiometrics module has improved the accuracy and reliability of biometric systems and it can be compromised in a number of ways, leakage of biometric template information constitutes with a serious security and privacy. The enrolled biometric template in encrypt form and stored into the system database instead of the original template.

b. Feature Level Fusion Algorithm

A novel joint sparsity based feature level fusion algorithm is used to recognition the multimodal biometrics. The user login to the system with the multibiometrics, it should be compare and verify with the database [15] for authorized recognition. The dataset is a comprehensive collection of different biometrics modalities and publicly available dataset [4], allows fusion at image level and the proposed feature level fusion fusion [10] technique can be tested. User each biometric record compared with database using algorithm. User finger print biometric was compared with database using KLT (Kanade-Lucas-Tomasi) algorithm. User Iris [19] biometric was compared with database using FCM (Fuzzy C -Mean) algorithm. User signature biometric was compared with database using color code algorithm.

c. Kanade-Lucas-Tomasi(KLT) Algorithm

KLT algorithm is designed to select good features and track them from one image to the next and customized to track features by changing a set of parameter values. Feature selection [11] in Image Processing deals with extracting attributes is illustrated in figure 3,(i.e.,)result in some quantitative information of data to a form suitable verification. From the image, fingerprint recognition algorithm extracts unique features [2] of each fingerprint and saves them in the database. For fingerprint verification [16], features of an input fingerprint are compared to the features of a specific fingerprint data in the database.

Figure 4. Captured Image Ranges

The tradeoffs between matching speed and discriminating performance in conventional technologies. By comparing similarity between two feature sets, it is decided whether the two fingerprints match or not.

Input fingerprint images captured from the sensors are noisy, in poor contrast. Based on intensive analysis of the image characteristics, powerful image enhancement technique is developed, yielding high quality ridge image. Moreover, a lot of erroneous features are efficiently removed by noisy area reduction technique.

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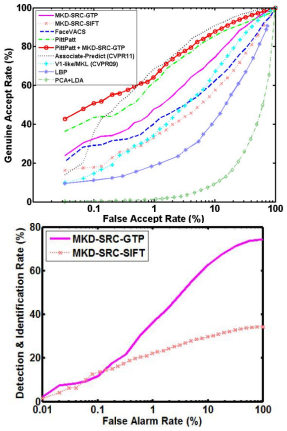

Figure 5. FAR Ratio

d. Fuzzy C –Mean (FCM) Algorithm

Fuzzy c-means[5] (FCM) is a method of clustering which allows one piece of data to belong to two or more clusters and frequently used in pattern recognition. k-means clustering aims to partition n observations into k clusters in which each observation belongs to the cluster with the nearest mean. The algorithm is based on the minutiae, such as ending, bifurcation, and singular points in the fingerprint images, which have been known to be effective clues for fingerprint verification.

The recognition problem with L distinct classes. Let C= {C_1, C2…., CL} be the class labels. Let y be the test vector to identify and divide the vector y into M overlapping region called a sector and it's used to solve the sparse based representation based recognition algorithm[20].The FCM utilizes the distance between the pixels and cluster centers in the spectral domain to compute the membership function.

FCM algorithm

The K-mean is to cluster n object based on attribute into k partition where k<n.An algorithm for portioning N data point into k disjoint subset S_j containing data. So as to minimize the sum square criterion

$J=_{j=1}\Sigma^{k} n\Sigma sj \mid X_n - U_j|^2$

X_n → vector representing the n^{th} data point

U_j → geometric centroid of the data points in S_j

K-Mean Clustering

It classify or to group the object based on attribute into k (positive integer) no. of group and grouping can be done by minimizing the square of distance between data and the corresponding cluster centroid.1) Cluster centre are randomly initialized and data point assigned is to cluster.2) Distance metrics measures to calculate how far away a point in form a cluster center. The spatial function is the summation of the membership function in the neighborhood of each pixel under consideration. The advantages of the new method are the following

1) It removes noisy spots, and
2) It is less sensitive to noise than other techniques.

The FCM technique is a powerful method for noisy image segmentation and works for both single and multiple-feature data with spatial information.

e. Color Code (CC) Algorithm

The color code algorithm is used to recognize the signature. Primarily classify the technique to matching the categorized by using pixel by pixel it is more accurate providing preferences to user verification and achieve 100% accuracy.

The check pattern is obtained from the standard signature will be used for recognition of the signature. The program generates the check pattern, takes the decisions about the validity of the signature depending the values set in the preferences. The values can be edited by observing the program performance and depending on the application. In the preferences we have different values for the radii for generating the check pattern, the threshold value [8] for the Intensity Normalization operation, the decision Thresholds, the threshold for maximum pixel change, the threshold for maximum rotation angle. The figure 6 illustrated for recognition rejection.

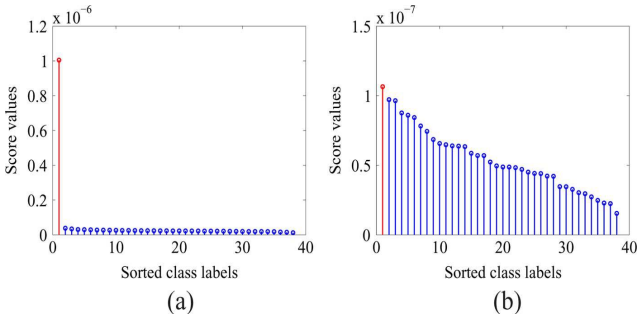

Figure 6: Score values normalized and sorted. Plot (a) corresponds to the test image shown in Fig. 1(a) and plot (b) corresponds to the non test image.

IX EXPERIMENTAL RESULT

The procedure to establish for testing [6] the multimodal biometrics. **Training:** Image per person is used for enrollment in the Fingerprint, iris and signature

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verification system; for each individual biometrics is used for training [3] the fusion classifier. The figure 7 illustrated the multimodal feature level fusion using the Delaunay triangulation performance to recognition the accuracy.

Testing: Samples per person are used for testing, generating the scores recording false acceptance rate (FAR), false rejection rate and accuracy is used to compute the performance threshold by using of following formula.

$$FAR = \frac{\text{Total false Acceptance}}{\text{Total false Attempts}}$$

$$FRR = \frac{\text{Total False Rejection}}{\text{Total True Attempts}}$$

Verify = 1-(1-FTE)(1-FRR)

The Failure to enroll (FTE) gives equal error rate FAR=FRR

Feature fusion	1.12	4.95	96.66

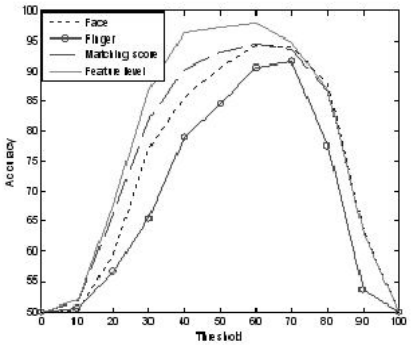

Figure 7: Accuracy fusion at matching score and feature level.

Multimodal biometrics identification system aims to fuse two or more physical or behavioral pieces of biometrics to provide FAR and FRR indexes to improve dependability and accuracy.

X CONCLUSION

Biometrics is essential for human identification and made more secure by combining two or more biometrics known as multimodal biometrics system. The inevitable problem in unimodal biometric, that can be rectifying by using of multimodal to improve the performance for recognition and verification with different types of biometrics. The people with bad intentions are successful in cheating a unidiomatic systems. But multi biometric systems are difficult to be deceived. It is impossible for the criminals to obtain two traits of the same individual. The searching is easy in large databases and in better way to match or non match by using of threshold to determine the degree of similarity required to result in a match declaration by the acceptance or rejection of biometric data.

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