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Machine Learning Based Robust Access for Multimodal Biometric Recognition

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Abstract: ***For organizations requiring high security clearance, multimodal sources of biometric scans are preferred. Computational models for the unimodal biometric scans have so far been well recognized but research into multimodal scans and their models have been gaining momentum recently. For every biometric we used separately feature extraction techniques and we combined those features in efficient way to get robust combination. In this paper, a novel method for fusion of the scan images from the different modes has been introduced. The method is based on representation of data in terms of its sparsity. Feature coupling and correlation information are obtained from the biometric images. The images from each mode are fused by taking into account a quality measure. The algorithms are kernelised so as to handle nonlinear data efficiently. The result of the proposed system is compared to already existing image fusion methods to show its advantage over them.***

Index Terms: ***Machine Learning, Multimodal Biometric, Coupling and correlation, high security, fusion of features.***

I. INTRODUCTION

Many institutions such as banks, colleges, government and military organizations, businesses and, so on, have some form of Identity and Access Management (IAM) systems in place to ensure that only authorized people will be permitted to make use of their services or information. Some forms of IAMs commonly seen are passwords, ID cards, security token, biometric scans and so on. When security is very critical, institutions include at least one form of biometric identification (unimodal biometrics) along with other IAMs, because passwords can be acquired and IDs can be duplicated or stolen but biometric scans are unique to a person and cannot be replicated. There have been instances of fraudulent activities wherein unauthorized people managed to get pass a unimodal biometric scan by spoofing, due to which there has been an increasing need to perfect multimodal biometric scans. The various modes of biometrics are fingerprint, voice, ear shape, hand vein, iris, retina, signature, palm print, gait of walk, DNA, hand or finger geometry, face, shape of tooth and odor. Out of these different modes of scanning, a lot of data is available for fingerprint, iris and face scans due to their continual usage since many years and hence, they were selected for this paper. The data from the three modes of biometric scans are then fused and classified. Fusion of information can be done in four different levels namely, sensor, feature, score and decision level. In sensor level fusion, data is converted to vector form after it is collected, processed and combined from multiple sensors. In feature level fusion, features extracted from the three modes of biometric scans are combined and formed into a vector. Score level fusion classifies the features based on the counts of matches obtained which are called scores. In decision level fusion classifier, Boolean type of decision making strategy is used to combine the outputs from classifiers. In rank level fusion, the biometric features matched are ordered in ranks. Feature level fusion takes a long time and are complex for features having large dimensions. The method commonly employed for fusion of multimodal biometric images is feature concatenation but it is neither efficient nor robust for images having very high dimensional vectors of features that were extracted. There is a much efficient algorithm for higher dimensions, namely, Multiple Kernel Learning (MKL), but in this method there is no capability to reject any data sample that might have been corrupted. There is a kernel method available which uses a single Reproducing Kernel Hilbert Spaces (RKHSs) that quickly converts supervised algorithms into semi-supervised and multi-view learners. But this technique is not fully supervised and hence is not very suitable for classification of data. Canonical Correlation Analysis (CCA) is applied on unlabeled data which decreases the complexity of the multi-view samples. It is supposedly an improvement over kernel learning method but it turns into MKL type of a framework in supervised classification setting. SVM-2K combines CCA and SVM (Support Vector Machine) techniques for classification of data from two views but it's efficiency for multiple views is not known. Apart from all these different methods, Fisher Discriminant Analysis (FDA) technique was also considered but its performance is similar to MKL method. In the last few years, few useful object recognition theories in image processing have emerged, such as Sparse Representation (SR), Dictionary Learning (DL) and Compressed Sensing (CS). It is observed that the commonly used techniques such as Linear Discriminant Analysis (LDA) and Principal Component Analysis (PCA) have an improved result in classification when used with these concepts. There is also an algorithm for face recognition which is Sparse Representation –based Classification (SRC). The artifacts that seep into face recognition data due to occlusion, lighting variation, random pixel corruption and disguise can be reduced and the quality of the recognized face image can be improved by using the sparsity information contained in a data.

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The new theories have been tested on iris recognition, facial recognition independent of the expression of face and also on recognition of face under different lighting conditions and poses.

II. LITERATURE SURVEY

A. Klausner et.al., proposed an image data fusion method for the multi-sensor(audio and infrared sensors) smart camera unit using feature based techniques of classification and SVM. Moreover, feature extraction of audio and visual feeds is done.

A. Rattani et.al., explore and study the problems and solutions related to dimensionality when features of biometric scans are extracted from two modes, namely, face and fingerprint. They proposed a method of feature concatenation.

X. Zhou and B. Bhanu introduced a novel recognition technique in which a person who is side way to the video camera can be recognized. In this study, gait and side face was used and features were extracted and a high-resolution image of the side face was constructed from many frames of video that were captured. Multiple Discriminant Analysis(MDA) and PCA were used.

A.A. Ross and R. Govindarajan presented a study of feature level fusion method for biometric images captured from multiple sources in three situations, namely, facial feature extraction and fusion from face recognition scans using LDA and PCA coefficients both in RGB scale and grayscale and lastly in hand and face images fusion.

V.M. Patel and R. Chellappa reviewed the theories of SR, CS and DL in detail and discussed their advantages and limitations when applied to object recognition. The importance of sparsity of representation and features' dimensions was stressed. It was concluded that these methods give a credible solution in areas like tracking, clustering, object detection and matrix factorization.

III. RELATED WORK

3.1 Facial Features

Face acknowledgment, implies checking for the nearness of a face from a database that contains numerous countenances and could be performed utilizing the diverse highlights which can't be recognized easily. The face pictures with different features considered for acknowledgment experience huge varieties because of changes in the enlightenment conditions, seeing bearing, outward appearance as well as maturing. The face pictures have comparative geometrical highlights which can be used for face classification. Thus, it is a testing errand to segregate one face from the other in the database which contains multiple face images.

3.2 Iris Features

Human iris is one of the available biometric which can be used for identification. The human iris as of now plays major role as it pulled in the consideration of biometrics-based ID and confirmation innovative work network. The iris is unique to the point that no two irises are similar when compared with status, even among indistinguishable twins which looks like same, in the whole human populace. Mechanized biometrics-based individual ID frameworks can be grouped under basic two fundamental classifications: distinguishing proof and check. In a procedure of confirmation (1-to1 correlation), the biometrics data of a person, who guarantees certain character, is contrasted and the biometrics on the record that speak to the personality that this individual cases. The examination result for given biometric decides if the character claims will be acknowledged or dismissed depending on matching features. Then again, usually alluring to most likely find the birthplace of certain biometrics data to demonstrate or refute the relationship of that data with someone in particular.

3.3 Fingerprint Features

A unique mark which is present an example of bending line structures called ridges, where the skin has a higher profile than its environment, which are mostly known as the valleys. In most unique mark pictures or in given images, the edges or we can say it as ridges are dark and the valleys are white. Because of a wide range of clamor and mutilations, fingerprints can't be coordinated basically by taking the cross-relationship or the Euclidean separation of the dim scale pictures.

IV. PROPOSED WORK

Proposed work consists of robust multimodal biometric recognition based on sparse representation of the data from 3 different biometric viz. face, iris, and fingerprint.

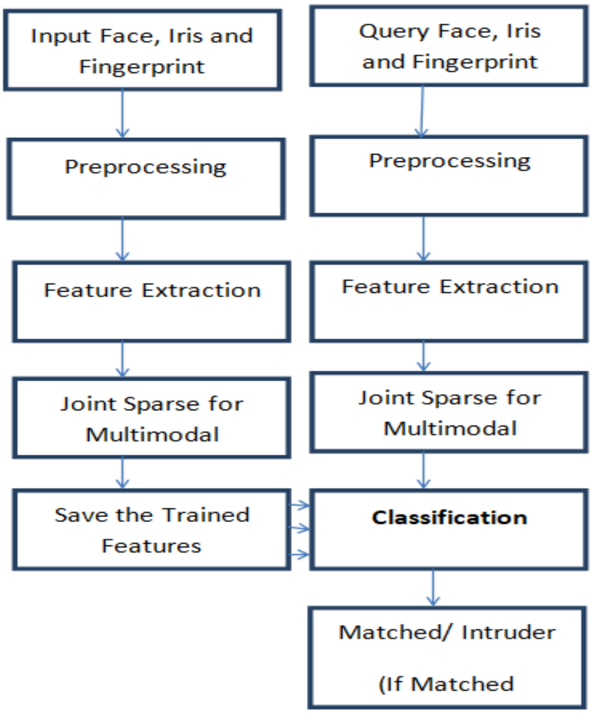

Fig.1 Block Diagram for Proposed Work

Block diagram in the above figure shows the robust joint sparse representation for multimodal biometric recognition. Joint sparse is nothing but the joining of the different biometrics for efficient combination. This is machine learning algorithm which will work on three different biometrics.

Those three biometrics are face, iris and fingerprint. All of them are having different features. Feature extraction is performed on all the biometrics to get improved robust features.

For face detection we used viola jones and for facial feature extraction we used PCA (Principle component analysis).

Viola Jones algorithm is having four stages as,

a. Haar Feature Selection
b. Creating an Integral Image
c. Adaboost Training
d. Cascading Classifier

Face recognition is proposed by using PCA (Principle component analysis).PCA is calculating Eigen values and Eigen vectors for selected face part which is further used for classifier as we used supervised classification algorithm. Eigen value represents the variation and Eigen vector represents the direction of that variation.

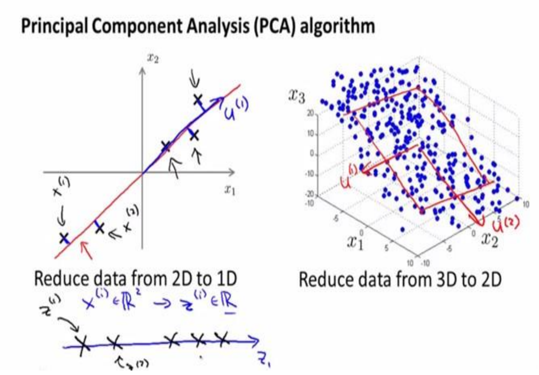

Fig. Principle Component Analyzed Data

For fingerprint the interesting thing is it becomes constant biometric thought the lifetime. We never find two fingerprints of similar features even in twins also. The problem we will face with fingerprint is because of sweat and other deformations fingerprint may not match with database fingerprint. The ridges and furrows may affect due to deformations or distortion in finger-print. We used 'ridge segment' function which identifies ridges region of the fingerprint image and returns the mask identifying this region of rides. The main aim is to make ridge regions to zero mean, unit standard deviation. This function divide image into blocks and evaluate the standard deviation of the each region block. For iris data scans it is having unique features for biometric authentication also the advantages for iris selection is unique data characteristic and its very difficult to duplicate as well as it is constant for lifetime.

Iris recognition feature extraction is proposed because of its uniqueness as it is cumulative sum based change analysis. To get iris features first iris image is normalized and it is divided into basic cells. Implemented iris for biometric is relatively simple than state of art methods as well as efficient as it using cumulative sum. In future we should consider the different conditions for occlusion and deformations with different attacks to check the performance and robustness of system.

V. RESULTS AND ANALYSIS

A.Train the data

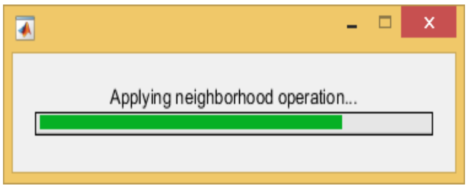

Fig.2Training the Iris data

From Face data we calculated the features and we trained those features and saved in '.mat' format.

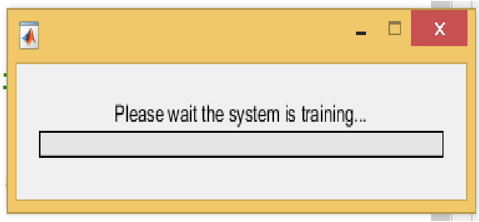

Fig.3 From Iris data we calculated the features and we trained those features and saved in '.mat' format.

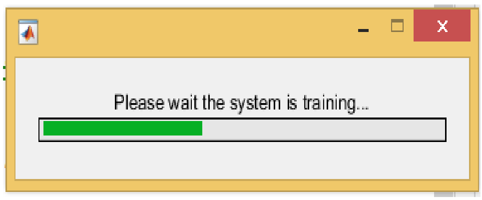

Fig.4 From Fingerprint data we calculated the features and we trained those features and saved in '.mat' format.

B. Testing the data

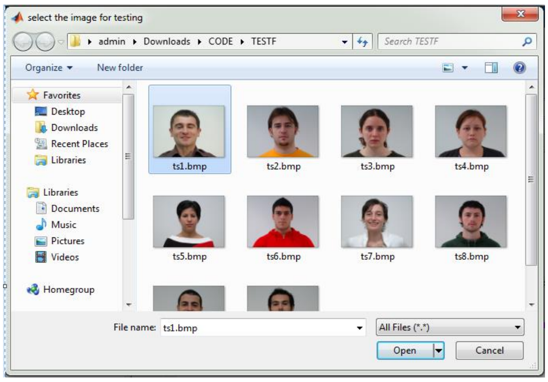

Fig.5 Given an option to select a face image from user, from the selected face part we calculated the facial features.

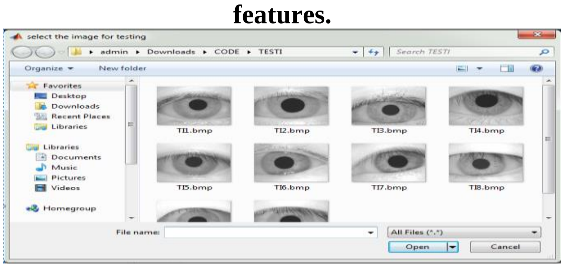

Fig.6 Given an option to select an iris image from user, from the selected face part we calculated the facial features.

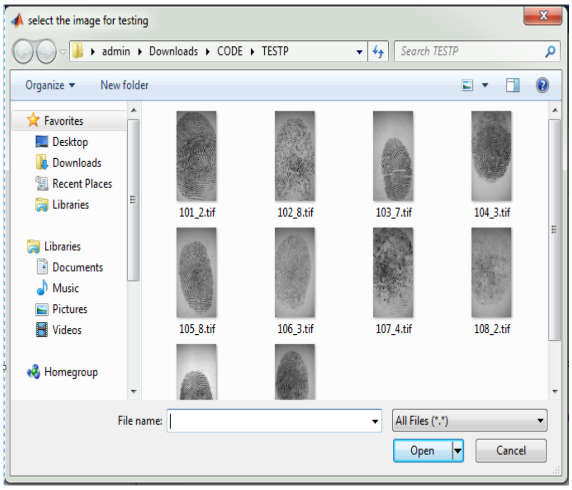

Fig.7 Given an option to select a iris image from user, from the selected face part we calculated the facial features.

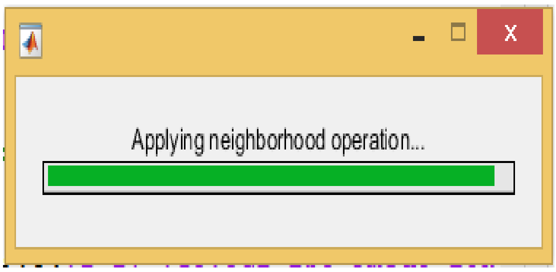

Fig.8 All the features are combined to get the robust combined features.

Further the combined features are compared to get efficient and robust features which will be compared with available features from trained data.

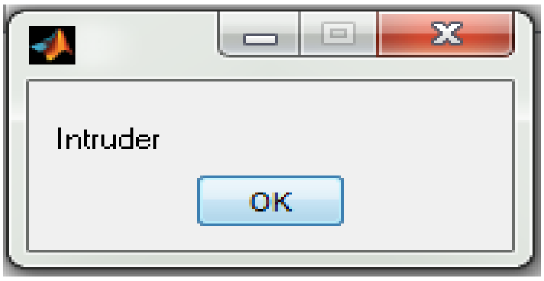

Fig.9 Detected as correct person or an intruder

Finally those features obtained from testing image are matched with trained features which will tell us the features are matched means that is correct person who is available in database otherwise we will say that the person is an intruder.

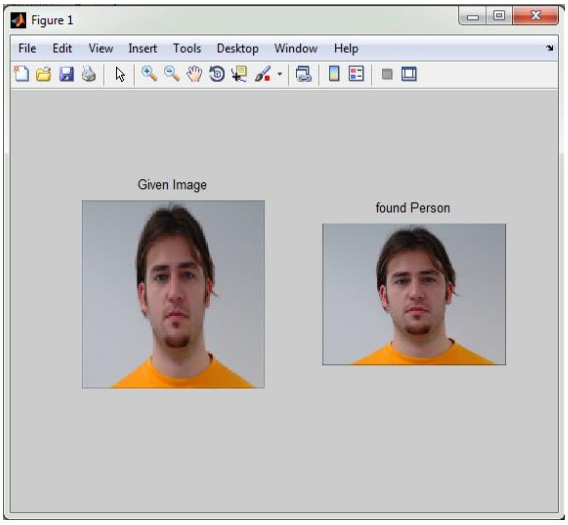

Fig.10 The matched person face is retrieved from the database if he is correct person and matched to features of database.

VI. CONCLUSION AND FUTURE SCOPE

For multimodal biometric scan images, a sparse-representation based fusion of the features is proposed. The algorithm takes into consideration, artifacts that can occur in biometric recognition like occlusion and image noise. A solution for the optimization problem is proposed based on the alternative direction based algorithm. Moreover, a quality measure for multimodal image recognition was proposed. In previous studies of sparse representation of data, there are theoretical reviews of the special cases, but they haven't been explored in a multimodal case. This can be further investigated in the future.

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