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Fusion of Face and speech for Multi-modal Person Identification System

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Abstract *— **A proposed new technique for person identification using fusion of both face and speech which can essentially improve the recognition rate as compared to the single biometric human identification. The proposed system uses Principal component analysis technique for face feature extraction. The PCA calculates the eigen vectors and eigen values which are used in fusion. The Singular spectrum analysis is used to extract speech features and the values of power spectrum are used in the fusion. The fusion of face and speech is done by simple sum rule fusion technique and normalization of feature values are done before the fusion. Person identification is depending on the fused results so that a Euclidean distance measures is used to find the variations in fused results.***

Keywords- Eigen faces, Euclidean distance measure, fusion technique, Principal component analysis, singular spectrum analysis.

I. INTRODUCTION

Human biological characteristics are one of kind. [1] So it is not easy to duplicate. The physiological characteristics are Face, ear, iris and behavioral characteristics are speech, hand writing. The fusion of face speech is popular technique to identify the person [2]. Now so many researches are going on face credible to give more security places like military, banks and research centers.

A small number of variables are obtained by transforming a number of possibly correlated variables is called principle components [10].A mathematical principles are used in the technique called Principle Component Analysis .The PCA is used to obtain the smaller intrinsic dimensionality from the larger dimensionality of the observed variables. The smaller dimension variables are needed to explain the data economically [11]. This is the case when there is a strong correlation between observed variable. The PCA can do removing of redundancy, extraction of feature ,compression of data and prediction .The PCA do something un the linear domain that what it is called classical technique the linear model application s such as Image processing, Speech processing ,Control theory and system and communication.

A singular spectrum analysis (SSA) used as powerful technique [3] in time series analysis is been developed and applied to many practical problems. In this paper speech feature extraction can be done by using SSA technique .To fusion speech signal we take power spectrum of it. For effective combining a data a multimodal system is considered. In this paper by using Euclidean distance measures the data fusion algorithm is carried out. A comparison with database of image and speech signals for face speech recognition of a person can be done by the output of Euclidean distance measure.

II. METHODOLOGY

Fig 1 indicates flow of proposed apparatus which will be useful to understand the system performance. At the first a template of image, speech and captured image and recorded speech is given to the feature extraction techniques such as PCA technique for image features extraction and singular spectrum analysis technique for speech feature extraction. The stored fusion results are compared with the fusion results of input face and speech. Fusion of face and speech is simply done by considering weights of face image and power spectrum values of voice, which uses sum rule as the fusion technique. A Euclidean distance is used to find the variations in fusion results. If results are matched person would identify, otherwise rejected.

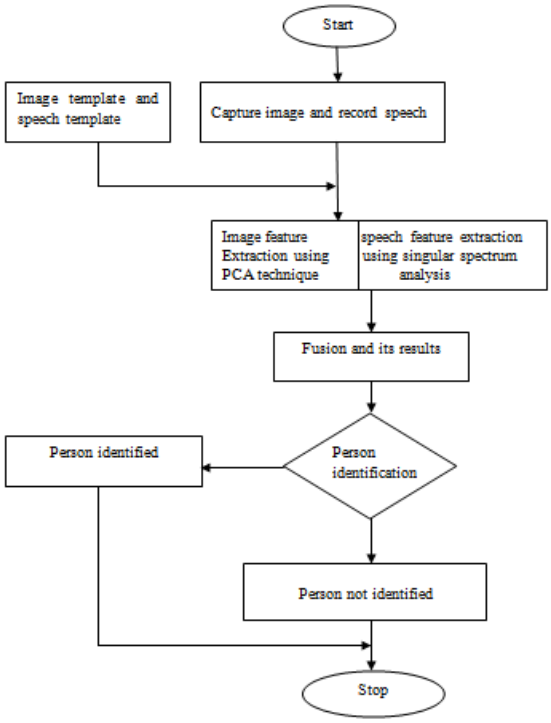

Figure 1 Step by step approach for fusion of face and speech

III PROPOSED SYSTEM

The proposed system is real time based system. A single biometric characteristic are not enough to meet matching performance. A multimodal biometric recognition technique is used to overcome the limitation of single biometric recognition.

A. Face Feature Extraction

To identify the person and to recognize face needed to extract the features of face image. Face feature extraction is the best technique in any face recognition system. To recognize the pattern and a data mining technology, face feature extraction plays very good role by considering original data, reducing the dimensionality leads to reduce the space complexity and time of machine training. A set of feature values are obtained from input data. A new reduced data containing most of original data values .The transform of data from primary space to feature space is done by feature extraction technique. A lower dimensional space has characters which are less effective.

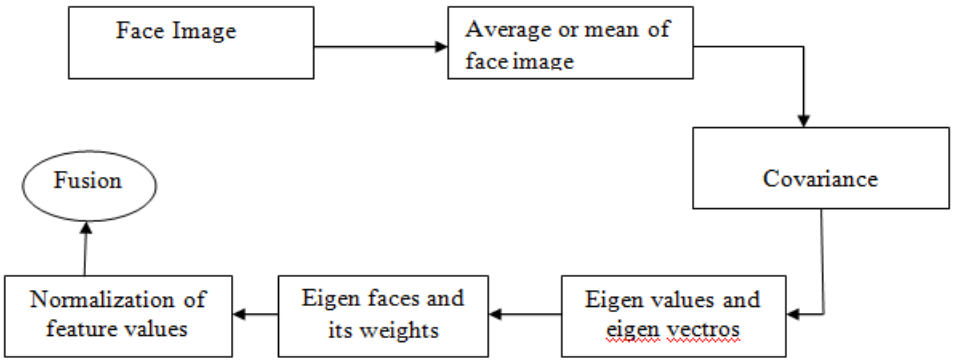

Fig 2 Block diagram of face features extraction

1. Principal component analysis

To solve the problems of data compression and recognition are solved by the PCA by reducing dimensional to the low. The amount of variance among the images is obtained by considering the orthogonal dimension of the subspace. The subspace is obtained by transforms of original data space, which is performed by PCA. To recognize the face PCA has been worked successfully. Eigen face technique is used in face recognition by projecting a face spaces which are defined by the eigen face[15].

a) Mean or Average

The values of the variables which is thoroughly representative of the distribution as a whole is c. Average or mean is also known as a measure of central tendency the other measure of central tendency is median & made. But we define only mean here. Let Z1, Z2 Zm denote the random variables for a sample of size m. The mean of the data set is a random variable defined by

$$\text{Mean}(\bar{z}) = \sum_{i=1}^{m} \bar{z} \tag{1}$$

Fig 3 Average of all faces

b) Standard deviation and Covariance

The degree of scatter can be described by the standard deviation which comes under the title of dispersion measure. The spreading out of data can be measured by Standard deviation. Covariance Standard deviation and variance .Operate on one dimension .The dimension vary in mean can be found by taking use of S.D covariance is such a measure .It is used to measure values between 2 dimension .To get variance must calculate covariance between 1 dimension And its self. So, if we had a 3-dimensional data

$$\text{S.D} = \sqrt{\frac{1}{m}\sum_{i=1}^{m}(z - \bar{z})^2} \tag{2}$$

$$\text{Cov}(E, D) = \sum_{i=1}^{m} \frac{(z_i - z)(y_i - y)}{m} \tag{3}$$

d) Eigen values and Eigen vectors

In linear algebra, the eigenvectors of a linear operator are non-zero vectors which, when operated on by the operator result in a scalar multiple of them. The scalar is then called the eigen value (**λ**) associated with the eigen vector

(V) [9]. Eigen vector is a vector that is scaled by a linear transformation. It is a property of a matrix. When a matrix acts on it, only the vector magnitude is changed not the direction.

Where, B is a Vector function In linear algebra, the eigenvectors of a linear operator are non-zero vectors which, when operated on by the operator result in a scalar multiple of them. The scalar is then called the Eigen value (**λ**) associated with the eigen vector (V). Eigen vector is a vector that is scaled by a linear transformation. It is a property of a matrix. When a matrix acts on it, only the vector magnitude is changed not the direction.

$$BV=\lambda V \tag{4}$$

Where, A is a Vector function By using (1), we have the equation,

$$(B-\lambda I)\ V=0 \tag{5}$$

Where, I is the n x n Identity matrix.

This is a homogeneous system of equations, and from fundamental linear algebra, we know that a nontrivial solution exists if and only if

$$\det (B-\lambda I) = 0 \tag{6}$$

Where, det ( ) denotes determinant.

When evaluated, becomes a polynomial of degree n. This is known as the characteristic equation of B, and the corresponding polynomial is the characteristic polynomial. The characteristic polynomial is of degree n. If B is n x n, then there are n solutions or n roots of the characteristic polynomial. Thus, there are n eigen values of B satisfying the equation,

$$Bvi=\lambda Bi \tag{7}$$

2. Speech Feature Extraction

Singular Spectrum analysis will divide the original series into sum of a small number of independent and interpretable components such as slowly [7]. The application of SSA are various, economics and financial and from mathematics to physics.

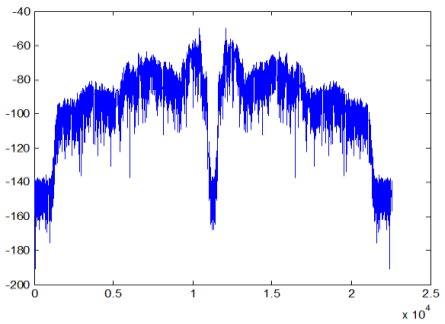

Figure 4 Power spectrum of voice signal

A calculated number of sample values in terms of frequency of the recorded voice signal gives the length of speech .An encryption of voice signal is done by "Fast Fourier Transform, which make data encrpted from the hackers[8]. Then voice signals power spectrums are used in the fusion algorithm a calculation of power spectrum.

$$P_s = 10 \log 10\ p(t)^2 \qquad \text{in dB} \tag{8}$$

Where,

P_s = Power Spectrum.

p(t) = Fast Fourier Transform of voice signal.

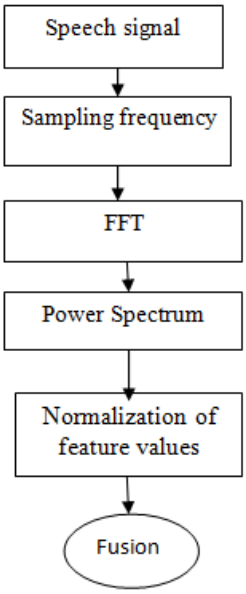

Figure 5 shows speech feature extraction

a) Fast Fourier Transform

A discrete Fourier Transform is made faster by using Fast Fourier Transform. The Fast Fourier Transform uses some good algorithms. It also takes a lot of less time. It finds the discrete signal values of time signal then converted into its discrete frequency signal delegation. The computation of Fourier Transform is depending on these discrete frequency values (signal).The spectrum of a signal can be given by the Fast Fourier transform. It is depending on the number of periods and number of points of signal and FFT respectively [8].
FFT is given as

$$Xj = \sum_{n=0}^{N-1} x_m \, e^{-j2\pi kn/M} \qquad (9)$$

b) Power Spectrum

In a signal process power spectrum discloses the occurring or absence of repeating patterns and structure of correlation .An applications such as data prediction, signal finding, radar identification, signal coding, pattern identification and decision based making system. A fast Fourier Transform is responsible for the power spectrum gives good results. It also proposes a less variance and good resolution of frequency. The period gram technique estimates the power spectrum.

IV. ARCHITECTURE OF PROPOSED SYSTEM

Fig 4 Considering the template images and template speech. Extracting the face feature, unique variation of intensity or pixel will be unique. Here we have taken PCA Base feature extraction technology for identifying the unique behavior of single person and also we are extracting the speech feature of a single person in different vibrations (Pitch) by using Singular Spectrum analysis. Both face and speech features will be fused using fusion technique then it is stored in the data base. Take an input image and input speech from testing inputs, Fusion results of training inputs are compared with fusion results of testing inputs. If the results are matched a person is identified, otherwise rejected [6].

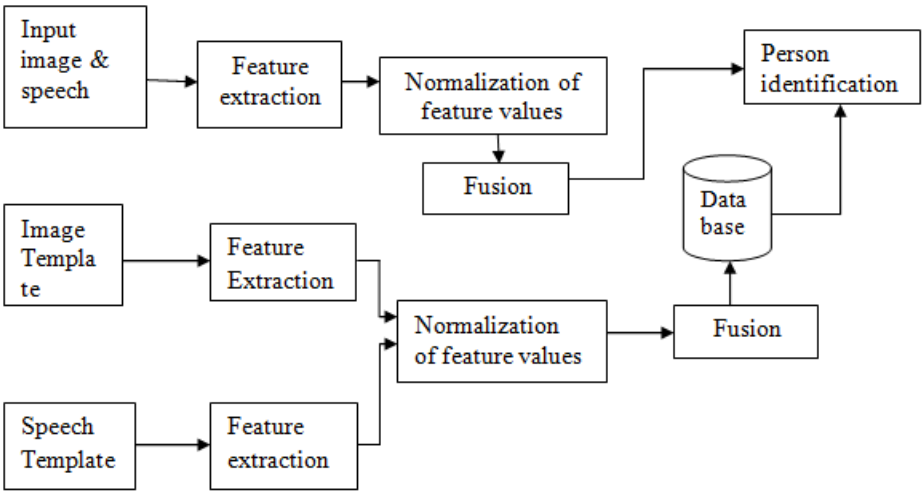

Figure 6 Proposed multimodal system

a) Fusion technique Simple sum rule

In multimodal biometric system The fusion technique is needed to combine the information effectively. In this paper, we propose a new fusion technique called simple sum rule. The Simple sum rule fusion technique is more popular technique in multimodal biometrics). For the fusion rules presented in this paper, g is the fused score, y_r is the score of the r th matcher, r=1,2,…, R.

In SSR rule, the fused score is computed by adding the scores for all modalities involved. The computation here is defined as [4].

$$g = \sum_{i=1}^{R} y_r \qquad (10)$$

V. RESULTS AND DISCUSION

The figure 7 shows Eigen faces of the all original faces. It can be generated by using highest Eigen value of each face image. Eigen faces will help to find person identification.

Fig 7 Eigen faces of original images

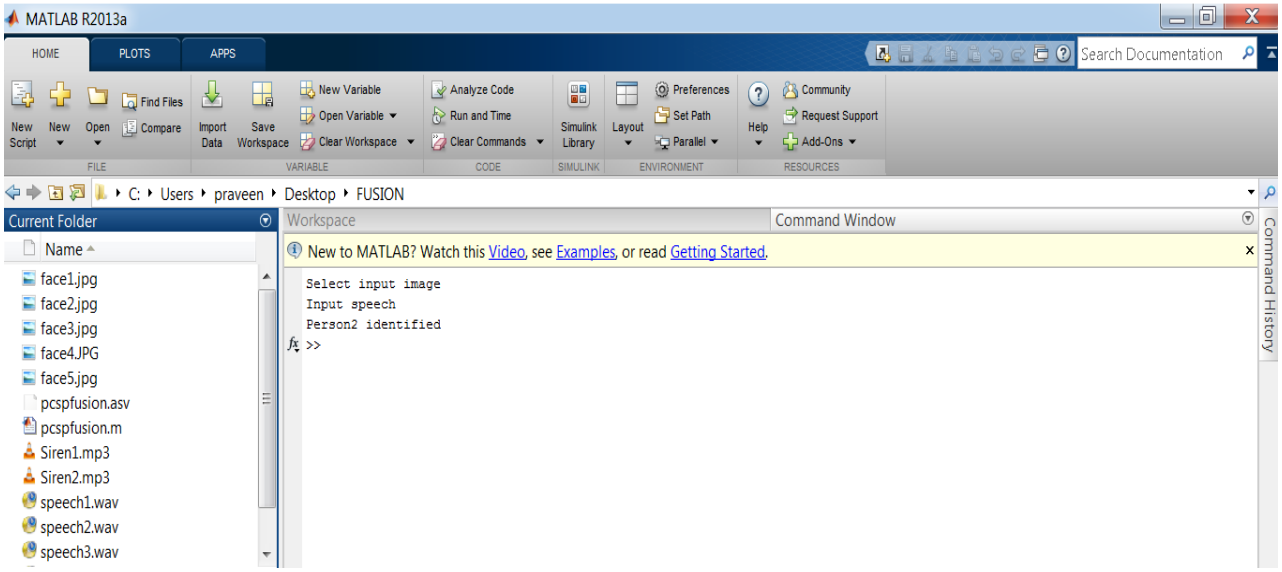

Fig 8 output of person identified

In the Fig 8 person is identified after matching the fusion results due to results have less variation. In the second case Fig 9 person not identified when fusion results are not matched that has more variations in the results.

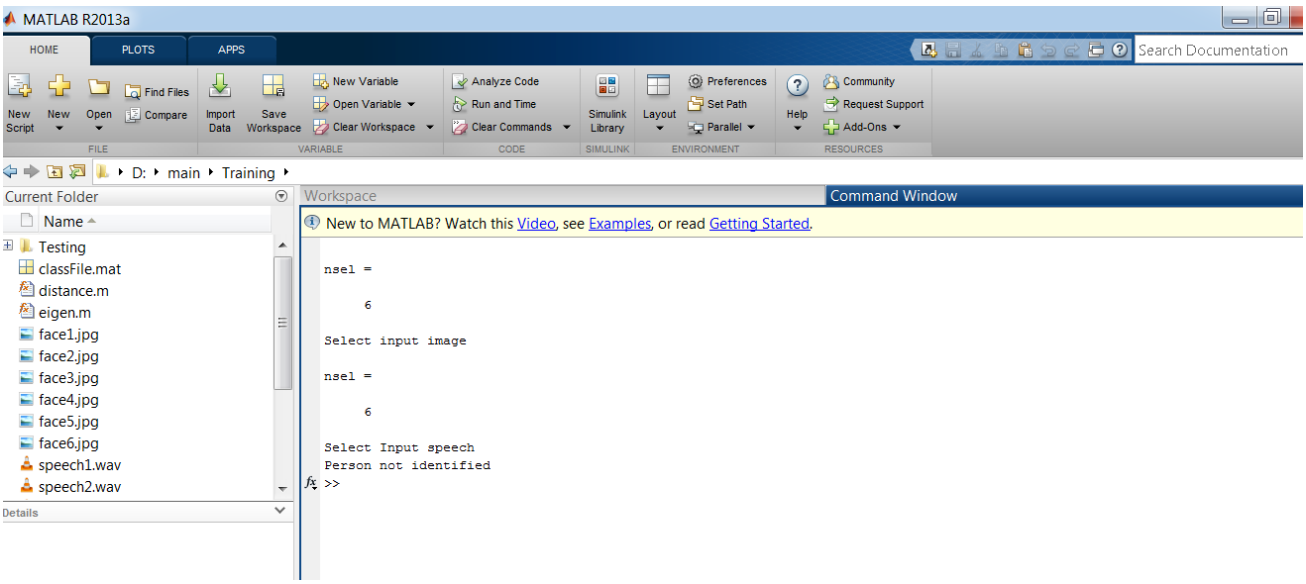

Fig 9 Output of person not identified

V. CONCLUSION

From this paper we have overcome the limitation of low recognition rate of singular biological characteristic by considering the multimodal characteristics system. An extraction of speech feature is done by using technique called singular spectrum analysis. Face feature extraction is done by using the PCA technique. The fusion results of speeches and faces are stored in the storage. We use these fused results to compare with the fusion results of real time inputs (Testing inputs) to identify the person. In this paper simple sum rule is used as a fusion technique. In this paper the Feature extraction techniques are easy to analysis, more storage database and less variation.

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