

WWJMRD 2017; 3(7): 104-107  
www.wwjmr.com  
Impact Factor MJIF: 4.25  
e-ISSN: 2454-6615

**Sukhjinder Singh**

M.Tech. (Final Year) Guru  
Kashi University, Talwandi  
Sabo, Punjab, India

**Harpal Singh**

Assistant Professor Guru Kashi  
University, Talwandi Sabo  
Punjab, India

## Biometrics: A Comparative Analysis of Face Recognition Techniques

**Sukhjinder Singh, Harpal Singh**

**Abstract**

Biometrics system means measuring the physical characteristics of a human being that have come into existence from the birth in different forms. It differs from person to person and it provides a measurement of physical characteristics. Face recognition is the most popular physiological characteristic used to identify a person in biometric systems, because of feasibility, permanence, distinctiveness, reliability, accuracy, and acceptability. This paper presents various face recognition techniques in the field of security and identification purposes. Each method covers a number of advantages in comparison to others. Although, there are various biometric methods available, but face recognition is most challenging aspect which provides a best and efficient security and identification criteria. Comparison study reveals that face recognition using genetic system provides best and efficient results.

**Keywords:** Biometrics System, Face Recognition

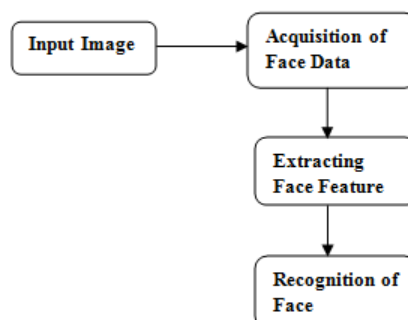
**Introduction**

Biometric is derived from the Greek words bio, means life and metrics, means to measure. Biometric is the technology that measures physical characteristics and behavior of a human being by providing a sample of the physical characteristics. Biometric system inputs a sample of some physical characteristics of a human being applies corresponding method and identifies the right entity. Face recognition means measurement of facial features. It is a computer system application for automatically determining or verifying an individual from a digital image or a video framework from a video source. The face of a human being has various distinguish characteristics that can be measured by a software i.e. [13].

- Distance between eyes
- Width of the nose
- Depth of the eye sockets
- Shape of the cheekbones
- Length of the jaw line

By measuring these points a special numeric code is created. This code is called a face print, and it is this code that represents the face in the database [15].

Face recognition is a non-intrusive method, and facial images are probably the most common biometric characteristic used by humans to make a personal recognition. Face recognition system works as given below.



**Fig. 1:** Components of Face Recognition system

**Correspondence:**

**Sukhjinder Singh**  
M.Tech. (Final Year) Guru  
Kashi University, Talwandi  
Sabo, Punjab, India

### A. Acquisition of Face Data

Acquisition and Processing of Face Data is first step in the face recognition system. In this step face images are collected on real time from webcam or may be at static time i.e. from website and stored in the database.

### B. Extracting Face Feature

This process can be defined as the process of extracting relevant information from a face image. In feature extraction, a mathematical representation of original image called a biometric template or biometric reference is generated, which is stored in the database and will form the basis (vector) of any recognition task. Later these extracted features are used in recognition.

### C. Recognition of Face

In this process, once the features are extracted and selected, the next step is to classify the image. For that appearance-based face recognition algorithms use a wide variety of classification methods. Such as PCA, LDA, Fisher face etc. In classification, the faces are compared for the similarity between faces from the same individual and different individuals after all the face images in database are represented with relevant features.

### Face Recognition Techniques

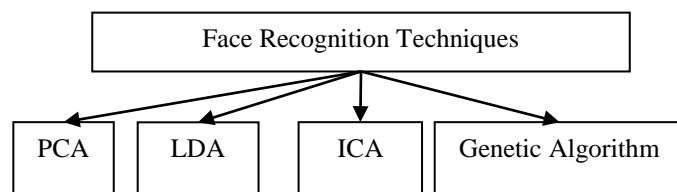


Fig. 2: Overview of Face Recognition Techniques

### Principal Component Analysis (PCA)

PCA for face recognition is based on the information theory approach. It extracted the relevant information in a face image and encoded as efficiently.

- In this process, every image in the training set can be represented as a linear combination of weighted eigenvectors called as “Eigenfaces”.
- With the help of Eigen values and Eigen vectors, covariance matrix is computed.
- Feature vector for each image is then computed. This feature vector represents the signature of the image. Signature matrix for whole database is then computed.
- Euclidian distance of the image is computed with all the signatures in the database.
- Image is identified as the one which gives least distance with the signature of the image to recognize.

Advantage of this Algorithm is to minimize the MSE (mean square error) between the reconstructed and original data for any specified data compression. The main demerit of this algorithm is that there is considerable computational effort are needed for generation of Eigen values and Eigen values of the covariance matrix [9].

### Linear Discriminant Analysis (LDA)

Linear Discriminant Analysis (LDA) finds the vectors in the underlying space that best discriminate among classes. Linear discriminant group images of the same class and

separates images of different classes of the images. For all samples of all classes the between-class scatter matrix  $SB$  and the within-class scatter matrix  $SW$  are defined. This criterion tries to maximize the ratio of the determinant of the between-class scatter matrix of the projected samples to the determinant of the within class scatter matrix of the projected samples. LDA is a powerful face recognition technique that overcomes the limitation of Principal component analysis technique by applying the linear discriminant criterion. The major drawback of applying LDA is that it may encounter the small sample size problem [11].

### Independent Component Analysis (ICA)

Independent component analysis (ICA) is a method for finding underlying factors or components from multivariate (multidimensional) statistical data. It searches for a linear transformation to express a set of random variables as linear combination of statistically independent source variables. The search criterion involves the minimization of the mutual information expressed as a function of high order cumulants. ICA provided a more powerful data representation than PCA as its goal was that of providing independent rather than uncorrelated image decomposition and representation. The ICA is similar to blind source separation problem that boils down to finding a linear representation in which the components are statistically independent.

### Genetic Algorithm (GA)

The Genetic Algorithms (GA's) are characterized by a search technique inspired in the Evolutionist Theory by Darwin, uses some selection mechanism, which adapts selection mechanism where individuals that is the chromosomes, more adapted of a population are the ones that have more survival chances and can be used easily according to changes that occur in its environment. This makes the algorithm strong and fast in those situations where the search space is too big. In the genetic algorithm, the problem to be solved is represented by a list of parameters which drives an evaluation procedure, called chromosomes or genomes.

Genetic algorithm is the type of algorithm that is used to solve both constrained and non-constraint problems based on selection criteria. Genetic algorithm modifies the new population and generates new solutions until best solution has not been reached. From large set of population, genetic algorithm uses the random chromosomes to make it parent then make it to produce children. The repetition goes on until good solution has not been achieved on the basis on the fitness function.

Genetic algorithm has mainly three operators.

1. Selection, in which selection of chromosome is done.
2. Mutation, in which two chromosomes gets mutated to generate child.
3. Crossover, to apply new changes.

It is not possible always to generate optimal solution for complex problems.

Genetic Algorithm can be described as below:

F- Fitness function.

[Fitness] Evaluate the wellness  $f(x)$  of every chromosome  $x$  in the populace.

**[New population]** Create another populace by rehashing after ventures until the new populace is finished.

**[Replace]** Use new produced populace for a further run of calculation.

**[Test]** if the end condition is fulfilled, stops, and returns the best arrangement in current population [16].

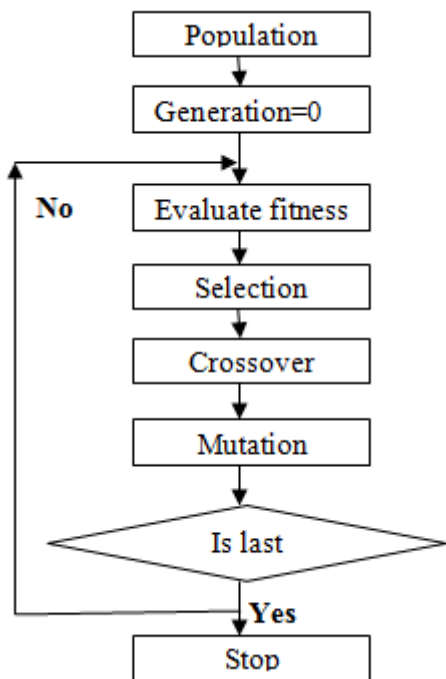


Fig. 2: GA Process

**Related Work**

In 2015, Shaveta, Naveen Kumari, [13] represent the brief survey on biometrics and its modalities. It consists of the comparison between the parameters that have been used on face, finger prints and speech. In this paper, the survey is followed as a consequence and specifies the strong technique using finger, face and speech. To overwhelm the weakness of the uni-modal biometric techniques, there is destitution of multimodal biometric techniques. This survey follows as a consequence and specifies the importance of a strong multimodal biometric technique using face, fingerprint recognition and enhanced speech features.

In2014 Mr.Vaibhav et al.[12] introduced a face detection and recognition system to detect (finds) faces in images

from galleries of known people. To detect the face before trying to recognize it, saves a lot of work, as only a restricted region of the image is analyzed, opposite to many algorithms which work considering the whole image.

This system is caped with three steps. The first step is to classify each pixel in the given image as a skin pixel or a non-skin pixel. The second step is to identify different skin regions in the skin detected image. The last step is to decide whether each of the skin regions identify is a face or not. Finally recognition is done by using Genetic Algorithm.

As the genetic algorithm is computationally intensive, the searching space is reduced and the required timing is greatly reduced.

In 2013, Hemant Makwana et al.[9] presented about the different algorithms which are used for face recognition. There are so many algorithms which are available for face recognition .There are two approaches by which the face can be recognize i.e. face Geometry based and face appearance based. The appearance based technique is also sub divided into two techniques i.e. local feature and global feature based.

The technique of local feature based is Discrete Cosine Transform (DCT). In this paper, the two global features (holistic) appearance based algorithms i.e. Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA) are discussed in which every face image is converted into 1D, using 1D for all the calculation and then these two algorithms are compared with the help of FAR (False Acceptance Rate), FRR (False Rejection Rate), time and memory and checks which algorithm gives the better result.

In 2016, Pratibha Sukhija et al.[15] presented a Genetic Algorithm (GA) based approach is used for face recognition. This algorithm recognizes an unknown image by comparing it with the known training images stored in the database and gives information regarding the person recognized. The Genetic algorithm is then compared with other known face recognition algorithms i.e. Principal Component Analysis (PCA) and Linear Discriminate Analysis (LDA) algorithms. It has been observed that the recognition rate of Genetic algorithm is better.

**Comparison Study of Various Face Recognition Techniques**

Comparison study considers some important parameters for the purpose of identifying that which is best technique as shown below.

Table 1: Comparison of Face Recognition Techniques

Technology used	Memory usage	Recognition Accuracy Rate	Data Representation
LDA	Low	Better than PCA	Strong
ICA	Moderate	Better than PCA	Powerful than PCA
PCA	High	Better than traditional methods	Powerful data representation
Genetic Method	Most Efficient	Highest recognition rate (almost 97%)	Powerful than ICA and PCA

**Conclusion**

Human face recognition plays a vital role in biometrics for human authentication as it is one of the biometric techniques used for security purposes in banks, and in various industries. A comparative study is made using Principle Component Analysis and Linear Discriminant Analysis and Independent component analysis along with face recognition using genetic algorithm. The genetic

system produces better result as compared to other techniques like PCA, LDA and ICA for same data set of images.

Still, more security and recognition accuracy rate can be achieved using genetic system in near future.

## References

1. Rupinder Saini, Narinder Rana, "Comparison of various Biometric Methods", IJAST, vol.2, issue1, March 2014.
2. A.M. Martinez, A. C. Kak(2001), "PCA versus LDA", IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol 23. No. 2.
3. Anil K. Jain et al., "Integrating Faces, Fingerprints, and Soft Biometric Traits for User Recognition", LNCS 3087, pp. 259-269, Prague, May 2004
4. Hsu, R.L., Mottaleb, M.A., Jain, A.K., "Face Detection in Color Images", IEEE Transactions on Pattern Analysis and Machine Intelligence **24** (2002) 696–706.
5. Arun Ross and Rohin Govindarajan, "Feature Level Fusion Using Hand and Face Biometrics", Vol.5779, pp.176-204(Orlando USA), March 2005.
6. Yukari Koga et al., "A Study on the Surveillance System Using Soft Biometric Information", IEEE 2nd Global Conference on Consumer Electronics (GCCE), 2011, pp 23-33.
7. Mahendra Pratap Panigrahy et al., "Face Recognition using Genetic Algorithm and Neural Networks", International Journal of Computer Applications (0975 – 8887) Volume 55– No.4, October 2012.
8. Aruni Singh, Sanjay Kumar Singh, Shrikant Tiwari, "Comparison of face Recognition Algorithms on Dummy Faces", The International Journal of Multimedia & Its Applications (IJMA) Vol.4, No.4, August 2012.
9. Liton Chandra Paul et al., "Face Recognition Using Principal Component Analysis Method", International Journal of Advanced Research in Computer Engineering & Technology (IJARCET) Volume 1, Issue 9, November 2012.
10. Hemant Makwana & Taranpreet Singh, "Comparison of Different Algorithm for Face Recognition", Global Journal of Computer Science and Technology Graphics & Vision Volume 13, Issue 9, Year 2013.
11. Divyarajsinh N. Parmar, "Face Recognition Methods & Applications", Divyarajsinh N Parmar et al, Int.J.Computer Technology & Applications, Vol 4 (1), 84-86, Jan-Feb 2013.
12. Rakesh Saini, Abhishek Saini, Deepak Agarwal, "Analysis of Different Face Recognition Algorithms", International Journal of Engineering Research & Technology (IJERT), Vol. 3, Issue 11, November-2014.
13. Mr. Vaibhav et al., "Human Face Detection and Recognition using Genetic Algorithm: A Review", International Journal of Science, Engineering and Technology Research (IJSETR), Volume 3, Issue 4, April 2014.
14. Shaveta, Naveen Kumari, "Multimodal Biometric Authentication Using Face, Speech and Fingerprint Feature", International Journal of Advanced Research in Computer Science and Software Engineering (IJARSSE), Volume 5, Issue 8, August 2015.
15. CHETAN KUMAR et al., "A Study of Multimodal Biometric System: Fusion of Iris and Fingerprint", International Journal of Emerging Technology in Computer Science & Electronics (IJETCSE), Volume 13 Issue 4 –MARCH 2015.
16. Pratibha Sukhija, Sunny Behal, Pritpal Singh, "Face Recognition System Using Genetic Algorithm", Procedia Computer Science 85 (2016) 410 – 417.