Assessment of PSO and PCA Algorithms for Face Recognition Using Different Performance Index Factors

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Abstract*: In this paper we provide a novel approach for analysis and comparison of advanced face detection method to find out the best algorithm in between PCA and PSO using different parameters that are used for face reorganization. To find out the best algorithm from the above two we used different parameters such as PSNR, MSE, Elapsed Time (Sec) and Accuracy (%).The conventional method for measuring quality of image is MSE & PSNR. In this paper we compared the different image enhancement techniques by using their quality parameters (MSE & PSNR) & proposed a new erosion enhancement technique. This technique gives better result than other techniques and their PSNR value is high & MSE is low. The experimental results show that the proposed enhancement method gives better results Face recognition is one of the most important biometrics which seems to be a good compromise between actuality and social reception and balances security and privacy well. It has a variety of potential applications in information security law enforcement and access controls. This paper discusses different face recognition techniques by considering different test samples. The experimentation involved the use of Eigen faces and PCA. Another method based on PSO in spectral domain has also been implemented and tested. The best method will be decided on the result of Accuracy, Elapsed time, PSNR value and MSE values of both methods.

Keywords: PCA (Principal Component Analysis), PSO (Particle Swarm Optimization), PSNR (Peak Signal-to-Noise Ratio), MSE (Mean Squared Error)

I. INTRODUCTION

Face recognition is one of the most important biometrics which seems to be a good compromise between actuality and social reception and balances security and privacy well. It has a variety of potential applications in information security law enforcement and access controls. Face recognition systems fall into two categories: verification and identification. Face verification is 1:1 match that compares a face images against a template face image. On the other hand face identification is 1: N problem that compares a probe face image against all image templates in a face database. Face recognition is a very difficult problem due to a substantial variations in light direction (illumination) , different face poses , diversified facial expressions , Aging (changing the face over time) and Occlusions (like glasses, hair, cosmetics). So the building of an automated system that accomplishes such objectives is very challenging. In last decades many systems with recognition rate greater than 90% has been done however a perfect system with 100% recognition rate remains a challenge Face recognition is biometric identification by scanning a person's face and matching it against a library of known faces. Face recognition is defined as the identification of a person from an image of their face. Face Recognition systems can be of two types [1]. Firstly, Face Identification: Given a face image that belongs to a person in a database and to tell whose image it is. Secondly, Face Verification: Given a face image that might not belong to the database, verify whether it is from the person it is claimed to be in the database.

The main aim of most commercial face recognition is to increase the capability of security and surveillance systems. In theory, security systems involving face recognition would be impossible to hack, as the identification process involves unique identification methods, and thus only authorized users will be accepted [2]. Face recognition has N classes, where each class represents one person from N individuals that mean multi class classification (one person vs. all the others). Face recognition must discriminate between the subtle differences of human faces. Face recognition is performed in order to determine the identity of each face. Applications of face recognition are access control, face databases, face identification, human computer interaction, law enforcement, smart cards and multimedia. management.

II. RELATED WORK

Currently there are many methods of biometric identification viz., fingerprint, eye iris, retina, voice, face etc. Each of these methods has certain advantages and disadvantages, which must be considered in biometrical system developing: system reliability, price, flexibility, necessity of physical contact with scanning device and many others. Selecting the certain biometrical identification method[14] or using the multi-biometrical system can help to support these, often discrepant, requirements. Face identification can be an important alternative for selecting and developing optimal biometrical system. Its advantage is that it does not require physical contact with image capture device (camera). Face identification system does not require any advanced hardware; it can be used with existing image capture devices like web cams, security cameras etc [3]. The PSNR block computes the peak signal-to-noise ratio, in decibels, between two images. This ratio is often used as a quality measurement between the original and a compressed image. The higher the PSNR, the better the quality of the compressed or reconstructed image. The Mean Square Error (MSE) and the Peak Signal to Noise *Ratio (PSNR)* are the two error metrics used to compare image compression quality. The MSE represents the cumulative squared error between the compressed and the original image, whereas PSNR [4] represents a measure of the peak error. The lower the value of MSE, the lower the error. To compute the PSNR, the block first calculates the mean-squared error using the following equation:

$$MSE=\sum_{M,N}([I(m,n)-I(m,n)])^2/M*N$$

In the previous equation, *M* and *N* are the number of rows and columns in the input images, respectively. Then the block computes the PSNR using the following equation:

$$PSNR=10\log_{10}(R^2/MSE)$$

III. PARTICLE SWARM OPTIMIZATION

Based on the idea of collaborative behaviour and swarming in biological populations inspired by the social behaviour of bird flocking or fish..Recently PSO has been applied as an effective optimizer in many domains such as training artificial neural networks, linear constrained function optimization, wireless network optimization, data clustering, and many other areas where GA can be applied [5].

For each particle i = 1.....,... S do:

Initialize the particle's position with a uniformly distributed random vector: $x_i \sim U(b_{lo}, b_{up})$, where b_{lo} and b_{up} are the lower and upper boundaries of the search-space.

- Initialize the particle's best known position to its initial position: $p_i \leftarrow x_i$
- If $(f(p_i) < f(g))$ update the swarm's best known position: $g \leftarrow p_i$
- Initialize the particle's velocity: $v_i \sim U(-|b_{up} b_{lo}|, |b_{up}-b_{lo}|)$
- Until a termination criterion is met (e. g. number of iterations performed, or adequate fitness reached), repeat:
- For each particle i = 1, ..., S do:
- For each dimension d = 1, ..., n do:
- Pick random numbers: $r_p, r_g \sim U(0,1)$
- Update the particle's velocity: $v_{i,d} \leftarrow \omega v_{i,d} + \varphi_p r_p (p_{i,d}-x_{i,d}) + \varphi_g r_g (g_d-x_{i,d})$
- Update the particle's position: $x_i \leftarrow x_i + v_i$
- If $(f(x_i) < f(p_i))$ do:
- Update the particle's best known position: $p_i \leftarrow x_i$
- If $(f(p_i) < f(g))$ update the swarm's best known position: $g \leftarrow p_i$
- Now g holds the best found solution.

The parameters ω, φ_p, and φ_g are selected by the practitioner and control the behaviour and efficacy of the PSO method [6].

IV. Principal Component Analysis

PCA also known as Karhunen Loeve projection. PCA calculates the Eigen vectors of the covariance matrix, and projects the original data onto a lower dimensional feature space, which is defined by Eigen vectors with large Eigen values. PCA has been used in face representation and recognition where the Eigen vectors calculated are referred to as Eigen faces. In gel images, even more than in human faces, the dimensionality of the original data is vast compared to the size of the dataset, suggesting PCA [7] as a useful first step in analysis. There are many approaches to face recognition ranging from the Principal Component Analysis (PCA) approach (also known as Eigen faces),Prediction through feature matching[10]. The idea of feature selection and point matching has been used to track human motion. Eigen faces have been used to track human faces.

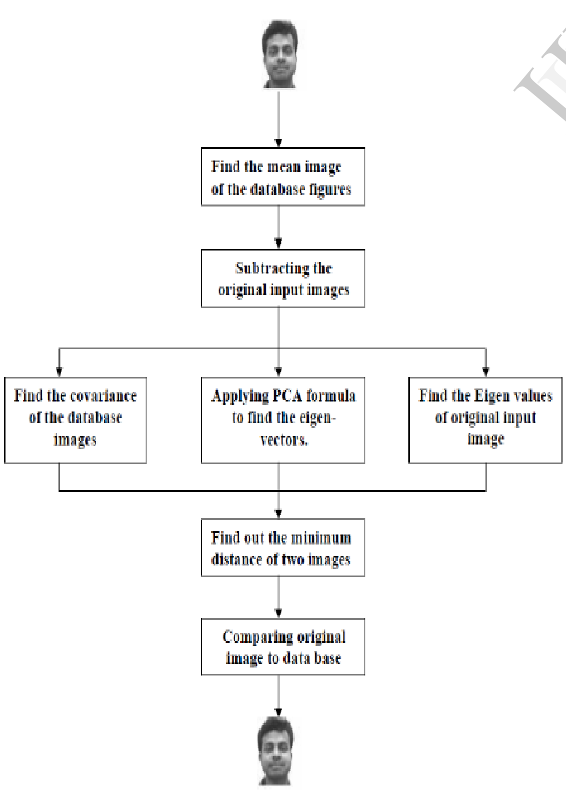

Figure 1. Face reorganization system for PCA

V. Methodology

Data Acquisition

A database of different image sets of faces was constructed. So that we can match a face of a person whose photos are taken in different angles. Because it is not possible in every time that the image of a person present in data base is always from the front view. It may be from side angle, upper angle, lower angle[11] and any form of angle. So in this data base set we are used all the possible angle so that we can calculate the accuracy of the image using PCA and PSO.

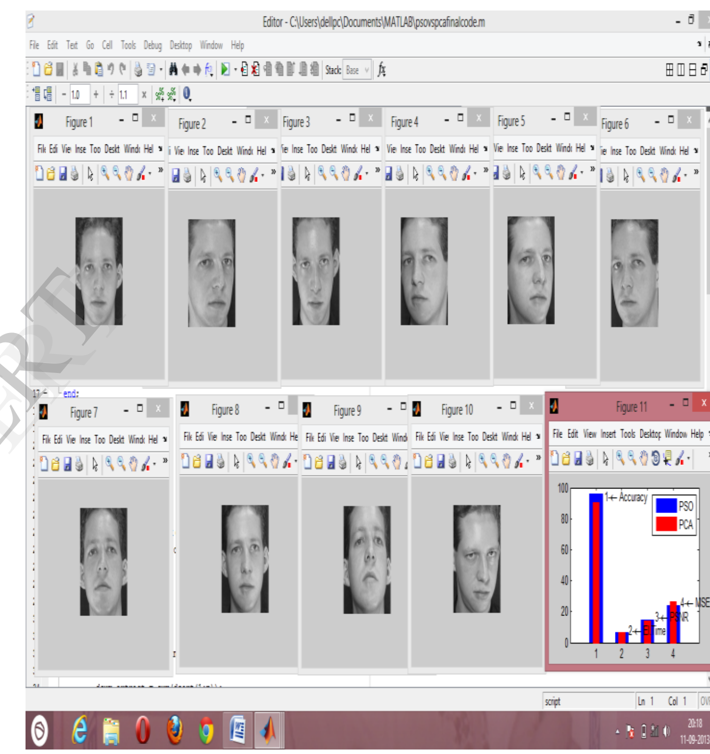

Figure 2. Images for different angles for PSO & PCA algorithm

VI. Calculation of PSNR and MSE value of the images for PSO & PCA

PSNR is most commonly used to measure the quality of reconstruction of lossy compression codes (e.g., for image compression) [12]. The signal in this case is the original data, and the noise is the error introduced by compression. When comparing compression codes, PSNR is an approximation to human perception of reconstruction quality. Although a higher PSNR generally indicates that the reconstruction is of higher quality, in some cases it may not. One has to be extremely careful with the range of validity of this metric; it is only conclusively valid when it is used to compare results from the same codec (or codec type) and same content. PSNR is most easily defined via the mean squared error [8] (MSE). Given a noise-free m×n monochrome image I and its noisy approximation K, MSE is defined as:

$$MSE=1/mn\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}[(i,j)-k(i,j)]^2$$

The PSNR is defined as:

$$PSNR=10.\log_{10}(MAX_I^2/MSE)$$

$$=20.\log_{10}(MAX_I/\sqrt{MSE})$$

$$=20.\log_{10}(MAX_I)-10.\log_{10}(MSE)$$

VII. Calculation of Accuracy and Elapsed Time of PSO & PCA Algorithm

The accuracy of a classification is usually assessed by comparing the classification with some reference data that is believed to accurately reflect the true land-cover [15]. Sources of reference data include among other things ground truth, higher resolution satellite images, and maps derived from aerial photo interpretation [09]. Note that virtually all reference data (even ground truth data) are inaccurate to some degree as well. The accuracy assessment reflects really the difference between our classification and the reference data. Consequently, if your reference data is highly inaccurate, your assessment might indicate that your classification is poor, while it really is a good classification [13]. It is better to get fewer, but more accurate, reference data. Also be aware of temporal changes: If you satellite image was taken at a different time than when you collected your reference data, apparent errors might be due to the fact that your landscape has changed.

Flow Chart:

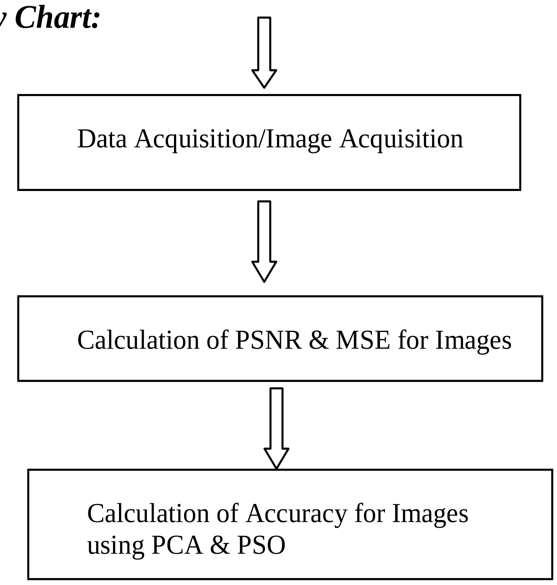

Figure 3.Flowchart for calculation of accuracy

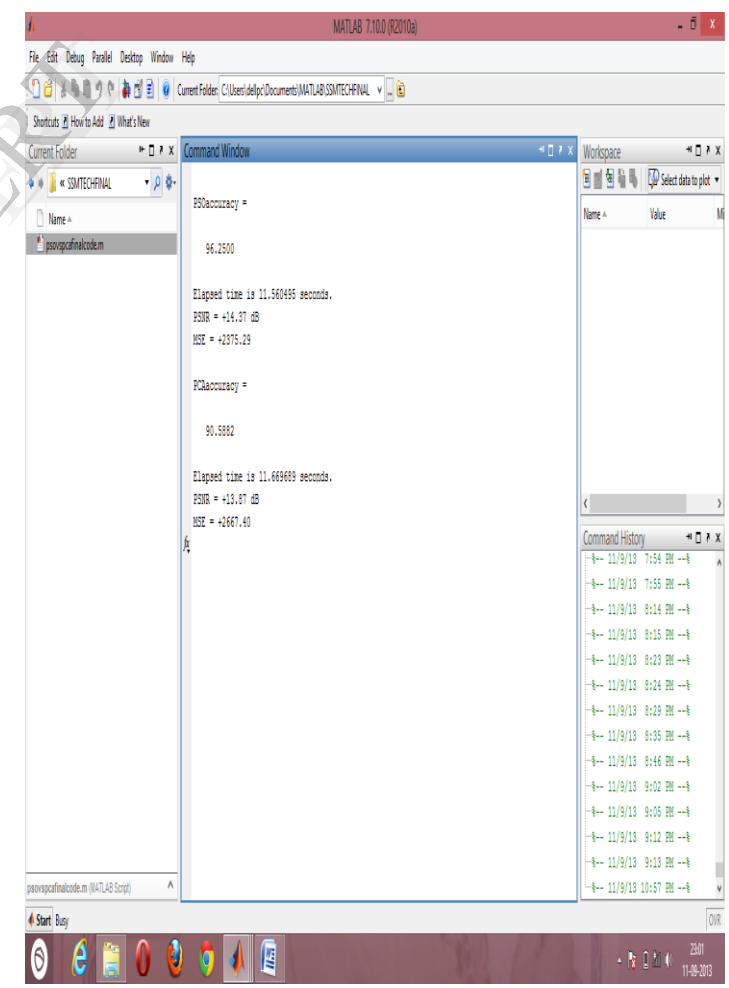

Figure 4.Final Output or Result

Algorithms	PSNR	MSE	Elapsed Time(Sec)	Accuracy(%)
PSO	+14.37 dB	+2375.29	11.560495	96.2500
PCA	+13.87 dB	+2667.40	11.669689	90.5882

Table 1-Comparison Table for PSO & PCA Algorithm

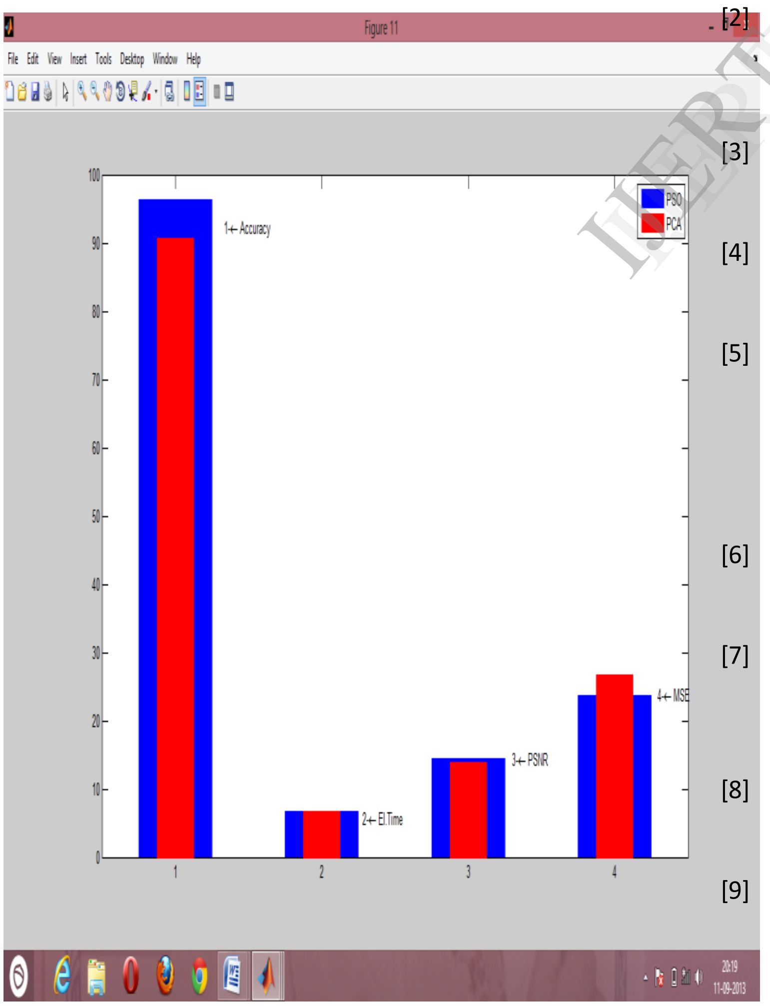

Figure 5.Comparison chart of PSO & PCA algorithm

VIII. Conclusion

After implementing the different performance indexes such as PSNR, MSE, Elapsed Time and Accuracy on PSO and PCA Algorithm we found that the PSNR value of PSO is maximum over PCA and the value of MSE is minimum for PSO algorithm, the required for PSO algorithm is minimum and the accuracy factor of PSO algorithm is higher than that of PCA algorithm. For a better Face detection algorithm we required maximum value for PSNR, less value for MSE and better accuracy. From PSO and PCA algorithm PSO fulfills all the criteria which is given in the Table-1 and a comparison chart is given in Figure-5. So, from the above analysis we conclude that PSO is better than PCA algorithm.

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