Comparative Analysis of Face Recognition Methodologies and Techniques

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Abstract — In the field of computer sciences such as graphics and also analyzing the image and its processing, face recognition is the most prominent problem due to the comprehensive variation of faces and the complexity of noises and image backgrounds. The purpose and working of this system is that it identifies the face of a person from the real time video and verifies the person from the images store in the database. This paper provides a review of the methodologies and techniques used for face detection and recognition. Firstly a brief introduction of Facial Recognition is given then the review of the face recognition's working which has been done until now, is briefly introduced. Then the next sections covered the approaches, methodologies, techniques and their comparison. Holistic, Feature based and Hybrid approaches are basically used for face recognition methodologies. Eigen Faces, Fisher Faces and LBP methodologies were introduced for recognition purpose. Eigen Faces is most frequently used because of its efficiencies. To observe the efficient techniques of facial recognition, there are many scenarios to measure its performance which are based on real time.

Index Terms—Face Recognition, Automated Teller Machine, Principal Component Analysis, Fisher’s Discriminant Analysis, Linear Discriminant Analysis, extended Local Binary Pattern Histograms, 3 Dimension , 2 Dimension.

I. INTRODUCTION

Human beings can easily recognize the faces of person from eyes without any fluctuation but computers can’t do so easily. This was the interesting problem in computer domain. To make the computers efficient in recognizing the faces, face recognition system introduced. There are many areas in which we can use this system for various purposes. For example to check the record of those who are illegal criminals. Moreover, this system also uses for security purpose. Like by fixing the cameras in social or public areas. The benefit of using the camera is that we can easily find the misplaced children’s from the images captured by the camera. Is the same way there are many examples in which the face recognition system used. So our computers work more efficiently than humans as they are more than intelligent.

Human can let the computers to do intelligent work like recognizing the images, videos and pattern recognition. Face recognition involves the pattern recognition technique which means it gives the ability to people to make the integrated power into the system to make it intelligent enough that they can do non-trivial work easily. The task of face recognition is to “identifying or verifying one or more person in the scene from still images or video sequences using a stored database of facial images”. Already stored images are unknown to the system. When the system will recognize the face it will match with the stored input images. The system will further accepts or rejects the claimed identity of query face [1]. This will works automatically.

In general, manual attendance is the tradition in institutes. They marks the attendance on the paper by hand. This takes a lot of time to keep the records of every person manually and also complicated to manage and confirm everyone [2]. To end up the manual system it was necessary to mark the attendance automatically by recognizing the faces of person. For this purpose automatic attendance management system introduced. This system works in various areas like in institutes for attendance, also as a security as well as in social uses.

The technology of face recognition based on computer system is playing a great role in the field of research. The working of automatic attendance by recognition of face is efficient and quick task without any time consuming. Attendance marks automatically after recognizing the face. It detects the face, recognize it and match it from predefined database. It saves a lot of time and also note the time of attendance. The working is easily understandable [3].

II. LITERATURE REVIEW

Because of the increasing security threats in daily life, the demand of something easier to work with, for the identification or suspects and for security purposes, is also increasing day by day. Hence Face Detection and Recognition is becoming more important aspect of Computer Vision in the application of security. Therefore OpenCV was introduced as a solution to Computer Vision’s problem of better recognition and increased security. OpenCV is a multi-platform framework used for image processing and face detection & Recognition purposes. Its functionality for face recognition is in its several modules like Machine-learning interface, CVCam contains information about video access on 32-bit windows platform though DirectX, CXCore namespace containing the persistence functions, basic data type definitions, linear algebra and statistics methods, and the error handlers, CVaux, HighGUI. Its implementation contains
multiple techniques of Haar Cascade Classifier, PCA, LDA and LBPH for face Detection and Recognition, that can be used separately in any algorithm from Eigen Faces, Fisher Faces and LBP [4].

In the discipline of computer sciences, recognition of face is the essential research problematic. There are many reasons, one of them is that the system has large number of uses and applications. This involves the identification of bank cards, for observation of security, criminal records, searching of mug shots and investigation system. These applications are important because they help in communicating and interacting with others [5].

The performance of recognition of face based on matching the patterns of faces individually. The patterns involves the mouth, eyes and also nose [6]. There were various proposed methods for solving the problems of face recognition but it was not solvable easily and faced many problems and obstacles related to face matching. This obstacle was the reason of not matching the face accurately and in comparison of finger printing, the face recognition’s performance is much bad.

The existing face recognition system is working best as compared to previous ones, because of the images of faces which is to be test and then recognized is taken in the same environment in which the training images is taken. But if the variation occurs in between both i.e. test images and training images, then they are not good enough to be recognized [7].

The pattern of person’s face images is difficult to recognize. Especially in that background where there is a complexities. This is the foremost prominent problem in this system of automatic recognition of face. After some passage of time a new methodologies were introduced that is based on identification and detection of faces in complicated background [8].

The application of mug shots is used to identify the criminal and illegal person. It shows the clear sketch of a person. The sketch is the image that is captured when the person/criminal arrested. The purpose of having the images makes it easy for the law enforcement to collect the record of criminals who are arrested [9]. Mug shot consists of two segments i.e. one side views image taken and other is front view. The image background should be simple so that it will not create any noise in the images.

The demand and approach of video surveillance is growing day by day. It needs to observe the people at different places by fixing the camera so that it will be able to gain information about the people and their activities. The camera take the images from real time videos for security purposes. The moving analysis help out us to solve the problems of surveillance applications. They mentioned the different techniques related to background modelling like 2D and 3D methods of tracking human body. This modelling is used to detect the position of body and its activities in video classification [10].

Face recognition system is used in different areas for security purposes because security is becoming essential in public areas. The areas include airports for checking the passengers at boarding time and airline staff. The checking is done by recognition of faces. This technology is greatly applied at airports [11].

For the recognition of faces the algorithm which is mostly used is PCA (Principal component Analysis). As PCA has many restrictions that involves a load of large calculations. For this the method that is proposed is sub-band. PCA applied on this specific method of wavelet sub-band. Usually PCA is useful on the full facial images for the representation of human faces but in the proposed methodology the transformation of wavelet is used for the decomposition of facial images into sub-bands of frequency. The frequency that lies in the midrange is typically used for the representation of PCA. By comparing this approach with Principal Component Analysis that was used before, the proposed approach has better results of recognition rate. Moreover it decreases the load of calculation if the database size of images will be greater with the training images [12].

Local Binary Pattern Histogram (LBPH) is the dominant for the description of texture images. The mechanism of LBPH is that it marks the image pixel by entering in the area of 3*3 of every pixel along with the middle value since the result will be in binary number so that the histogram of marked images can be used as a description of texture images. The histogram has the information related to the dissemination of designs like edges and areas on the full facial image [13].

The reason of doing this comparison is that we’ve tried to implement the mentioned methodologies and techniques in the development of the Auto-Attendance System. This system works on detection and recognition of person’s face. But after the implementation we faced some problems in recognition based on the light variation, dataset size variation, pose variation and distance variation and also detection problems in some methodologies. All the techniques and methodologies are introduced and compared in the following sections.

III. FACE RECOGNITION METHODOLOGIES

Face Recognition methodologies consists of Eigen Faces and Fisher Faces. These methodologies are based on some approaches that are used for facial recognition and detection also. These approaches are further classify into three kinds i.e. holistic, feature based and hybrid approaches [14]. These are

*Holistic Approach –* this approach uses whole face region and extract features and do recognition

*Feature Based Approach –* this approach do not take whole face. It just extract the main features of face that is eyes, lips, nose [15]

*Hybrid Approach –* This approach deals with the combination of two approaches one is Holistic and other is Feature based. In this method image is caught from a 3D environment like a real time system. Then the detection of
facial features, their location or position and numerical representation is calculated. After that, calculated data is then compared with the pre-stored data and then detection and recognition operations are performed [11].

1) Eigen Faces

Eigen Faces is an algorithm that is used to for recognition purpose. It uses PCA technique for recognition. To deal with the problem of recognition of faces, a set is generated as Eigen vectors and the name of Eigen faces is given. In this methodology total sample images should not be 1 they should be more than 5 in order to get more accuracy. Greater the sample space more will be the accuracy. It generates Eigen Faces or low dimensional images of the total number of M training data set shown in Figure 2.

![A Training Set Consisting of total M images](image1)

Fig. 1. Multivariable dataset

Eigen Faces are actually images of lower dimensions that are made by transforming original images to Eigen Faces shown in Figure 3.

![Transformation (Eigen Faces)](image2)

Fig. 2. Transformation to Low Dimensional Images

The Eigen faces are generated in such a way that starting ones are dominant and useful but later ones are just noise as shown in Figure 3.

2) Fisher Faces

In fisher faces the training set of images gives the information to build the method for decreasing the dimensionality of space between the facial features. The method of fisher faces usually use the linear method of specific classes [16] and also (FLD) for the decrease in dimensionality and decrease in the feature space of simple classifiers [17].

Fisher Faces algorithm reflects the ratio between the difference of one person and that of another person. The strong key point of Fisher Faces in recognition of face problem is that it uses the method which is linear for decreases in the dimensionality of facial feature space.

3) LBP

In the LBP-based facial representation, the images of faces are divided to abstract the histograms of LBP. They are divided into the sub-regions equally which cannot overlap to each other. After the extraction of histograms the sub-regions are concatenated into the single eLBP feature of histogram. The main criticism of this methodology is that it divides the face into a grid. That is in sub-regions which are not associated with features of face. It predicts that the resulting image of face of sub-regions suffers from the original size and position and they are not placed accurately back on to the calculated face in comparison to the original one.

These mentioned methodologies use some techniques for face detection and recognition. For Face Detection, Haar Cascade Classifier is used in all the methodologies so it will not be compared with any face detection mechanism. For Face
Recognition Eigen Faces uses PCA, Fisher Faces uses LDA and LBP uses LBPH technique. The introduction of Face detection technique is given in the next section.

IV. FACE DETECTION TECHNIQUE

1) Haar Cascade Classifier

Haar Cascade is also known as Viola Jones algorithm. It works on four categories that includes Haar features, Integral images, Adaboost and Cascading [18]. Detection of objects that used Haar features based is actual method of object detection which is proposed [19]. The method of machine learning is described for graphically detection of object that is able to process images quickly so that it gets high rates of object detection. There are three contributions in which this working is described. The 1st contribution is the integral image which tells us about the new image. It calculates the features quickly which is being used by the detector. The 2nd contribution is the algorithm of learning that is based on AdaBoost. This is used to collect features in small number from the large one. The classification result is very efficient. The 3rd one is to combine the classifier which is increasing, in a cascade classifier.

Its flow chart in Figure 4 explains the working stages of Haar Cascade algorithm. It first take an input of an image and extract its haar features by calculating the pixel values and then generating the Integral values of those calculated pixel values. After this step it eliminate redundancy using Adaboost techniques that is it eliminate those pixel values that are not recognized as features and select best features only. Mathematically

\[ F(x) = \alpha_1 f_1(x) + \alpha_2 f_2(x) + \alpha_3 f_3(x) + ... \]

Then it classify all the pixels values/ integral values in different cascades or groups on the basis of similarity in them. After that it compares all these values with the predefined feature’s values and then if it is detected as face it shows faces is detected otherwise not [20].

Haar Cascade is the only technique used for face detection improved and approved by many scholars and researchers. It is 90 – 95% accurate.

V. FACE RECOGNITION TECHNIQUES

For comparison of Face Recognition techniques we’ve selected OpenCV’s techniques for Face Recognition that are PCA, LDA and LBP, introduced below.

1) Principal Component Analysis (PCA):

Principal Component Analysis (PCA) is used for Face Recognition. This technique is based on statistical method which transforms a set of observing the connected variables in a set of values of not connected variables linearly. This is known as Principal Components. Their sum is equal and less than the original values sum. The technique of PCA is most widely used in all the computer analysis forms. Its example is from neuroscience to graphics of computer. The reason is that it is a simple method which is used to extract only the related information from the data set [21]. PCA do the analysis on the basis of multivariable dataset that is a set of images or a training set consisting of total of M images show in Figure 2 and each image consist of N x N dimensions that is the total of N^2 dimensions.

PCA uses the data set that is transformed into the low dimensional images of given data set shown in Figure 3 known as the Eigen Faces. These low dimensional images are selected as K Eigen faces shown in Figure 4 and are generated by extracting the mean or average matching face from the selected K Eigen faces and K is ever equal and less than that of original value images that is M. mathematically

\[ K \leq M \]

Because of the noise in Eigen Faces, PCA selects only those that are dominant that is K useful Eigen Faces and discarded the noisy ones. Then it calculates the weights of the input face and calculates the average matching face and do the recognition using Eigen Faces algorithm. Mathematically weights are like
And weights are actually the weightage value of average matching features extracted by calculating the means shown in Figure 6.

2) Linear Discriminant Analysis (LDA):

LDA is a technique that is mostly used for the classification of data and also decrease the dimensionality of faces. LDA is also called as FLDA (Fisher’s Linear Discriminant Analysis). It observes the original space vectors that is good in separation of classes. Its working is almost similar to PCA except that it has reduced set of calculations that is it doesn’t need to do the calculation of features within the classes but among the classes [22].

The technique of LDA is that it analyze the set of data linearly form classes of them. It calculates the discriminant of features from each face and form classes of them that is features having greater discriminancy are placed in a separate class which means unlike PCA, LDA has an ability to separate data into various classes on the basis of their differences. To identify that which data belongs to which class a discriminant function is used that takes the values of x and y axis. Mathematically that discriminant function is represented as

\[ f(y) = w^T x + \alpha \]

In this mathematical expression \( x \) contains the value of x and y axis. Alpha is something called as Bias and \( w \) is the weightage of the data extracted from that facial image calculated by LDA. If its result is greater than 0, class will be 1 other will be 2, greater than 2 class will be 3, less than 2 class will be 4 and so on. Mathematically

\[ f(y) \geq 0 \text{ for Class 1} \]
\[ \text{And } f(y) < 0 \text{ for Class 2} \]

The value of X and Y axis is calculated by finding the variance and mean of data along x-axis and y-axis separately. LDA, after creating classes separates their results linearly. Graphically their separation can be shown as

In this graphical representation each color represents a class separated linearly by a straight line.

LDA uses a dimensionality reduction method that is during extraction of features it keeps those features that are unique and best extracted and discarded the others that are not best selected as a feature. Because of this Dimensionality reduction technique of LDA, less memory is consumed and calculation cost is reduced. It also classifies the data in different classes according to the discriminancy in them.

3) Local Binary Patterns Histograms (LBPH):

Local Binary Pattern Histogram (LBPH) is the one that involves the removal of the most valuable features from facial images that are preprocessed to implement face recognition. LBPH can do it by dividing an image into many small areas from which the features are removed. Principal Component Analysis (PCA) is the one that process dimensional reduction procedure and process the face as a whole. Face recognition is an important application whose results are very interesting as well as complicated because the evaluation effects at the recognition phase.

The LBPH is introduced to image texture for the analysis of image quality. With its operator the image amount of the LBP program is composed into the histogram that is used as histogram intersection [24]. The LBP has recently been used for description of face by adopting the histogram approach. The spatially eLBPH which was the first LBP-based face recognition methodology that divides the complete image of face in the small sub images. It sort out the local LBPH from every region for face recognition and finally gathered the histograms of local small sub- images with the histogram of global face images.

In LBPH a textured image of the face shown in Figure 8 is saved and then a histogram is generated against it. For recognition the histogram values of that textured face is compared and recognition occurred accordingly.
The comparison and introduction of these techniques is discussed in next section.

VI. COMPARATIVE ANALYSIS OF FACE RECOGNITION TECHNIQUES

1) PCA VS LDA

The major variance in between LDA and PCA is that LDA classifies the training data into multiple classes on the basis of their discriminancy and then it calculates the minimum variance within the class scatter and maximum variance between the class scatter so that the recognition can be done efficiently.

But as PCA requires more training images’ samples for recognition as compared to the LDA (requires only one sample image of face as more sample images of one face effects the recognition rate and confliction occurs in recognition) then recognition is much accurate as compared to LDA but in greater or lesser light variance (variation of light on the face stored in training dataset and on the face being recognized) both PCA and LDA doesn’t work better, their accuracy rate effects negatively though PCA’s recognition rate in case of normal light is much better than LDA because of the increased sample space available for PCA as compared to LDA.

As PCA requires larger number of sample images as compared to LDA so the Eigen faces that were created first will be accurate, dominant and visible but later ones will be considered as noise by the PCA because the features of them will not be visible accurately. Hence in case of greater database/training set size LDA will perform better than PCA but in smaller DB/training set size both will work accurately or efficiently.

Because of the larger training images size of PCA, faces will be stored in variant poses so recognition rate will be better than LDA.

Both of the LDA and PCA will work good if the distance of the face to be recognized and the face already stored in training set from the camera is not greater otherwise recognition rate will effect negatively.

2) PCA VS LBPH

The comparison of PCA and LBPH is that for face recognition LBPH removes the valuable features from images and separate the images into small parts while PCA is used to extract only the related information from the data set.

The best algorithm for recognition of face images with factors of varying illumination, variance of poses, distance and dataset size variance is PCA (Principal Component Analysis) because this technique is higher towards many of the numerical techniques. Using numerical techniques recognized face is calculated. Whereas LBP features is simpler because in face recognition system it is enough to differentiate known and unknown faces quickly but LBP are constant and affected by light changes greatly.

PCA doesn’t works well in case of greater or lesser light variation but it works well than LBPH if the light variation is normal so that the recognition rate will be accurate. LBPH is not best in this particular scenario because if light luminance is greater, then the features in the textured image will be mixed up and juggled because of which facial feature extraction will not be accurate but if the light luminance is normal, LBPH works good so that the features will not be mixed up with each other and recognize the face accurately, recognition rate will be better.

In case of lesser distance both PCA and LBPH will work good for recognizing the face but if the distance is greater than the LBP based facial texture can’t be visible accurately because if distance is farther then the features will not be prominent and it will not recognize face accurately so recognition rate will be greatly effect negatively. Whereas PCA performance is better than LBPH in case of greater distance.

3) LDA VS LBPH

The technique of LDA is that it analyze the set of data linearly. It calculates the discriminant of features from each face and form classes of them that is features having greater discriminancy are placed in a separate class which means LDA has an ability to separate data into various classes on the basis of their differences.

In LBPH a textured image of the face shown in Figure 8 is saved and then a histogram is generated against it. For recognition the histogram values of that textured face is compared and recognition occurred accordingly.

Hence LDA is better than LBPH because if light luminance is greater, then the features in the textured image will be mixed up and juggled because of which facial feature extraction will not be accurate. In case of greater distance LBP based facial texture can’t be visible accurately so recognition rate will be greatly effect negatively. While LDA works much better than LBPH in this scenario because it doesn’t work on textured faces whilst it consider the whole facial pattern.

The next section demonstrates the comparative analysis of all the techniques in tabular form and also demonstrates the reasons of their Excellent, good, ok or poor performances.
VII. COMPARISON OF FACE RECOGNITION TECHNIQUES IN TABULAR FORM

The reasons for 100% or less than 100% performance of the compared techniques depend upon the following basic criteria.

1. Light Variation – Recognition rate in brighter or dim light
2. Pose Variation – Recognition rate in multiple poses i.e. faces being recognized from different angles (left side, right side, front side)
3. Distance Variation – Recognition rate from farther or closer distance
4. Dataset size Variation – Recognition rate in case of varying database size/training database size i.e. if training database is of larger size then what will be the recognition rate/accuracy rate in recognition.

Table 1 shows the performance analysis of all three recognition techniques. Excellent performance means recognition rate is always accurate. Good performance means recognition rate varies very slightly that is there are least chances that recognition is not done accurately. Ok performance means sometimes it shows correct recognition and sometimes it recognized a person’s face with someone else’s face and poor performance means that recognition is not done anyway.

Table 1: Comparative Table/Performance Analysis

<table>
<thead>
<tr>
<th>recognition Rate</th>
<th>Factors</th>
<th>PCA</th>
<th>LDA</th>
<th>LBPH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light Variation</td>
<td>Greater</td>
<td>Ok</td>
<td>Ok</td>
<td>Poor</td>
</tr>
<tr>
<td></td>
<td>Normal</td>
<td>Excellent</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td></td>
<td>Lesser</td>
<td>Ok</td>
<td>Ok</td>
<td>Ok</td>
</tr>
<tr>
<td>Pose Variation</td>
<td>Greater</td>
<td>Excellent</td>
<td>Ok</td>
<td>Poor</td>
</tr>
<tr>
<td></td>
<td>Lesser</td>
<td>Good</td>
<td>Good</td>
<td>Ok</td>
</tr>
<tr>
<td>Distance Variation</td>
<td>Farther</td>
<td>Ok</td>
<td>Poor</td>
<td>Poor</td>
</tr>
<tr>
<td></td>
<td>Closer</td>
<td>Excellent</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Dataset Size Variation</td>
<td>Greater</td>
<td>Ok</td>
<td>Good</td>
<td>Poor</td>
</tr>
<tr>
<td></td>
<td>Lesser</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
</tr>
</tbody>
</table>

Considering the comparison done in the previous section if all the above mentioned criteria are satisfied in any technique then its performance will be 100% while other’s is calculated on the basis of the criteria satisfied in those techniques.

Table 2: Overall Performance Analysis on the basis of Percentage Scale

<table>
<thead>
<tr>
<th>recognition Rate</th>
<th>Features</th>
<th>PCA</th>
<th>LDA</th>
<th>LBPH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light Variation</td>
<td>85 – 90 %</td>
<td>83 – 88 %</td>
<td>70 – 75 %</td>
<td></td>
</tr>
<tr>
<td>Pose Variation</td>
<td>88 – 93 %</td>
<td>83 – 88 %</td>
<td>68 – 73 %</td>
<td></td>
</tr>
<tr>
<td>Distance Variation</td>
<td>88 – 93 %</td>
<td>78 – 83 %</td>
<td>70 – 75 %</td>
<td></td>
</tr>
<tr>
<td>Dataset size variation</td>
<td>85 – 90 %</td>
<td>87 – 92 %</td>
<td>80 – 85 %</td>
<td></td>
</tr>
</tbody>
</table>

The next section demonstrate our overall findings in the comparative analysis of PCA, LDA and LBPH.

VIII. DISCUSSION

After comparing different techniques of Face Recognition provided by OpenCV we find out that all three techniques works efficiently in normal light variation but PCA’s performance is much better than others in overall fashion because LBPH needs to calculate the textured image of face due to which the white spots in face varies in light variation and LDA works with one sample image or training image that effects the recognition rate in variant light factor.

PCA is very good in pose variation and distance variation as compared to others because it takes more than 1 sample images for training data set while others not.

In case of data size variation LDA works better than PCA and LBPH because LDA further classify the data into classes on the basis of variance among them and only single face image is required for recognition which lessens the size of dataset, though LBPH also requires one face image for recognition but at greater distance LBPH’s generated histogram from textured image of face to be recognize, creates greater variation as compared to one already stored.

From the comparison we’ve found out that by using more input images i.e by taking more photos of each person, particularly from different angles and lighting conditions like PCA does, performance of Recognition is effected positively and accuracy increases but in the same context it also effects the dataset size that creates negative impact on the accuracy/recognition rate but if LDA’s classification technique, PCA’s technique of using more input images and LBP’s technique of generating histograms of the faces – as it can
clearly shows the differences among the faces stored already and to be recognized, is used in a combined way then the accuracy can be increased.

We’ve also found that if the photos or images of a person’s face are taken in variation of poses, lights and distances then it will be easy for the used classifier/recognition object to recognize one’s face more accurately but it should be kept in mind that the poses or angles of faces doesn’t vary much means if the angle of first captured face is 30 degree then the next one shouldn’t vary to the angle of 90 degree because it will create a lot of variation among the images of the same person and it will affect the accuracy and recognition rate negatively. It’ll add positive affect to the recognition rate if the person and it will affect the accuracy and will create a lot of variation among the images of the same face's component for one person also varies like a male face with glasses and no glasses, mustaches and no mustaches, beard and no beard, smiley face and laughing face etc.

IX. CONCLUSION

In the field of computer sciences such as graphics and image processing, face recognition is the most prominent problem due to the comprehensive difference of faces and the complexity of noises and image backgrounds. Holistic, Feature based and Hybrid approaches are basically used for face recognition methodologies. Eigen Faces, Fisher Faces and LBP methodologies were discussed for recognition purpose. Eigen Faces is most frequently used because of its efficiencies. There are many scenarios to measure the real time performance to observe the efficient techniques. From the comparison we concluded that as a whole PCA works better than LDA and LBPH.

REFERENCE