# Improving the Recognition Accuracy of Natural Facial Expressions

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***Abstract*—The importance of recognizing expression variant faces in image processing, video processing its ability used for criminal investigation. Sometimes face recognition is also important where human and machine interaction takes place. It depend upon the information extracted by faces such as expressions, occlusion. If the system able to detect the face then it is successful otherwise failure. For this input images are collected only in constrained conditions. Such that an extreme sparse learning scheme works on the basis of spatio-temporal descriptor and optical flow correction algorithm to deal with real world situations of face expressions. But there is a drawback of using these scheme is fail to recognize the faces if the same emotion is appeared frequently. So that by using Eigen faces is to develop a Facial Recognition System which gathers human facial images containing some expression as input and recognition of person may have too many different expressions or emotions at different times. In this method dimensionality reduction is used so that expressions of face represented with in limited dimension , so which is useful to solve the face recognition with expression variants.**

***Keywords---- Limit, dimensionality reduction recognition, expressions etc***

## I. INTRODUCTION

Biometric-based techniques have emerged as the most important for recognizing individual persons in recent years, instead of authenticating people and granting access to physical and virtual domains based on passwords, PINs, smart cards, plastic cards, tokens, keys. In these biometric techniques face recognition play key role for individual identification. Face recognition is the process of locating the face in any set of training images. It has two important keys I) Extraction of facial features from training images II) Then classify the different classes of images. In recent years for the applications of image analysis and effective understanding with computer interaction need to recognize the expression variants of faces. It is also essential for the extraction meaning of concepts from human to computer. The more changes in expressions of face more complexity arises to recognize the expression variant faces.

The objective of present work is to recognize the faces in variants of expressions like happy, smile, sad etc. Eigen face approach [7] is one of the techniques used in face recognition. This approach represents original training images with smaller set of data using dimensionality reduction. So first the dimensionality of an image should be reduced to face space. Then the Eigen values are computed by using Eigen decomposite function, by calculating distance between images used for recognition. If the difference is less than threshold considered as known face otherwise unknown. The remaining of this paper is structured as follows. In Section II presents review of related work. Section III presents the proposed system in detail. Section IV presents experimental results while SectionV paper conclusion.

## II. RELATEDWORK

Face recognition is important in research areas such as machine learning, computer vision, neural networks, psychology, pattern recognition, etc. It is the process of identifying the individual within the set of image faces. It uses different approaches geometric or template based approach, appearance or model based approach and statistical or neural network approaches.

A geometric representation [4] is obtained by transforming the image into geometric primitives as points and curves. For example here the recognition by locating distinct features such as eyes, nose, chin and measuring their width, relative position, width and other parameters. As appearance based representation is based on various statistics of the pixels values with in the face image. In the past decades ago for recognition of expression variant faces weighted subspaces are used. But these resulted in failures to recognize the faces in real world environments. So there were some research carried out face recognition by using some other techniques such as Hidden markov models [3], geometric displacement [5].

Hidden Markova models are primarily applicable only for human speech recognition and optical character recognition, then it was adapted by [Samaria 1994] for face recognition. Samaria implemented Embedded HMM model algorithm in the C++ library and Intel digital image processing for face recognition. Human face contain different types of expressions it was sometimes fails to detect the face with expressions. So then for effective understanding of human behaviour focused on using rule based, Gabor wavelet and neural network approaches. But all these models are not able to applicable for dynamic appearance of face images. In Y. Zhang and Q. Ji [10] using dynamic Bayesian networks (DBN) for facial expressions from dynamic appearances'. Zhao and M. Pietikainen [6] in his work using the local binary patterns for dynamic texture face recognition.

Sirovich and Kirby (1988) developed Eigen faces for face recognition. Then Turk and Pentland [7] successfully implemented an Eigen based face recognitio.

It is motivated by information theory. Aitao Zhao, Pong Chi Yuen and James T. Kwok, [8] proposed a novel incremental principal component analysis on the basis of Eigen faces for face recognition. Eigen faces uses mathematical methods of Eigenvector and Eigen values to represent the information of an image. Some of the Eigen value problems in engineering applications are Google search, a cantilever beam and in structural engineering for vibration analysis Eigen values and Eigen vectors are used. A comprehensive literature survey various face recognition techniques are found in [2].

## III. PROPOSED SCHEME

Eigen faces is one of the face recognition mehod based on dimensionality reduction. In dynamic situations such as video processing, biometric based systems face recognition is difficult because of many changes in face like pose variation, illumination conditions. Inorder to solve these problems Eigen faces method is used. This works on the basis of computing Eigen values and Eigenvectors. Eigen values determine facial features, and the Eigen vectors determine changes in features of faces.

Eigen face approach consists of 3 modules are training database, feature extraction and last recognition phase based on threshold decision. The important characteristic of these method is dimensionality reduction, means that it can represent larger image information with a relatively smaller set of data...

### *A. Train the database:*

To create database of training set of images are taken by using webcam with different expressions of individuals and all these images are under same lighting conditions .Here in these experiment nearly 20 samples of images are used.

### *B. Feature extraction:*

The feature extraction is performed for the purpose of face recognition, because to vary the one face from set of faces it is needed. The features of face are eyes, nose, and mouth extracted using Eigen faces. The Eigen faces are representation of face image with smaller set of data. It should be stored in the form of Eigen vectors; each image has different Eigen values. So by using these Eigen values can classify the unknown image within the set of training data images.

*The Eigen values and Eigen vectors are computed as follows*

Let take an image of size NxN pixels, then by using Eigen decomposition function represent it in the form of Eigenvector matrix 'A'.

Then to perform dimensionality reduction, covariance matrix of 'A' is calculated as

$C=AA^T$ *//it must gives the result of I (identity matrix) to compute Eigen values*

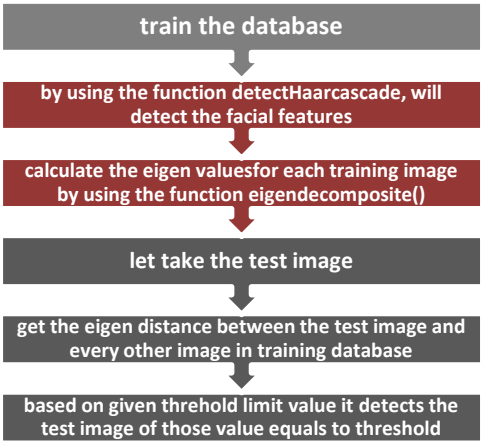
The Eigen values are computed as follows

$$A-\lambda I=0$$

Here A is the Eigen vector matrix of an image, λ is the Eigen coefficient, I is the identity matrix

By solving the above equation can calculate the Eigen values.

*It uses the following algorithm as follows.*




### *C. Recognition phase:*

In these phase an unknown image is compared with training image, by using Euclidian distance method. Here, threshold value is chosen arbitrarily. There is no formula for calculating the threshold value. Its value is chosen arbitrarily or taken as some factor of maximum value of minimum Euclidian distances of each image from other images.

## IV. RESULTS

The Eigen based algorithm is applied on different images taken under lighting conditions and with various backgrounds. The recognition depends on pose variation ,facial expressions, hair and illumination conditions .In this approach with 20 samples of tiring samples are taken overall 95% recognition rate and total time taken for recognition is 15 milliseconds

### *A. Recognition Rate:*

These results are performed for only 20 features are taken ,such that calculation of recognition performance is by dividing the number of test images to be recognized to overall training images. Here 95% performance is achieved for smaller features, but the results may be varied by taken larger number of training images.

The formula to calculate recognition rate is

Recognition rate in %= no. of images recognized/total no of images

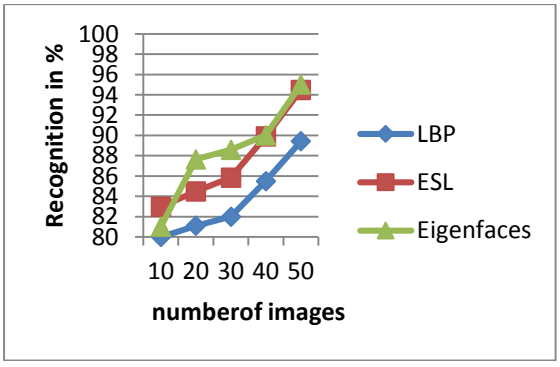



Figure 2: Recognition vs Number of images

*B. Time complexity:*

The time taken to recognize a test image is calculated by varying different observations of images .Here the time complexity is measured as 15 milliseconds

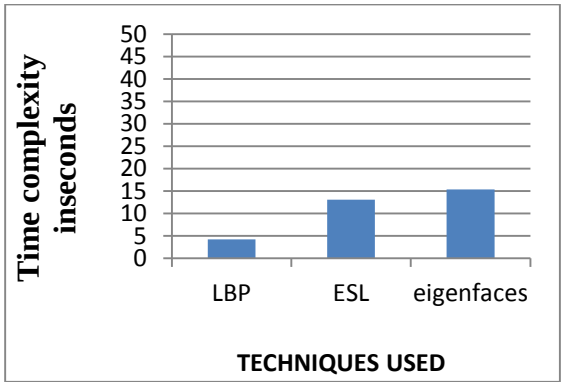



Figure 2: Time complexity vs. Techniques used

## V. CONCLUSIONS

Face recognition is real world situation using Eigen faces is the easy with smaller number of training images. But for larger set of data increases it is more complex to calculate the Eigen values and to perform the classification of faces. So there is scope to apply the Eigen face concept to larger databases for real world analysis.

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