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A Hybrid Framework of Facial Expression Recognition

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Abstract
Facial expression recognition (FER) has increased uncommon ground for various potential outcomes in human conduct acknowledgment, gesture based communication acknowledgment, human-PC collaboration, etc.The explore issue of Facial Expression Recognition is to choose the highlights which are required to speak to a Facial Expression. In this paper we proposed a hybrid technique for include extraction utilizing Principal Component Analysis(PCA) and Linear Discriminant Analysis (LDA).The all-around acknowledged five key feelings to be perceived are: Anxiety, Disgust, Fear, Happiness and Neutral.

Keywords: FER, PCA, LDA, Face detection, Hybrid, SVM.

I. INTRODUCTION

Human face is an extremely valuable and capable wellspring of open data about human behavior. Facial expression gives fundamental data about the mental, emotive and as a rule even physical conditions of the discussion. Face appearance acknowledgment has basically noteworthy significance; it offers tremendous application prospects, for example, easy to use interface amongst individuals and machine, humanistic plan of items, and a programmed robot for instance. Face recognition is an imperative part of human learning. Countenances contain much data around ones id and furthermore about inclination and perspective. Outward appearance associations normally significant in social life, instructor understudy communication, and believability in various settings, solution and so forth however individuals can without much of a stretch perceive outward appearance effectively, yet it is very difficult for a machine.

The traditional FER system has three basic steps: image acquisition, facial feature extraction, and classification. Recently, extensive works have been carried out towards the facial feature extraction with the objective of maximizing the between-class variability while minimizing the within-class variability. Employing deep learning techniques to learn effective feature representations has swept a variety of computer vision tasks. Thanks to its deep architecture and large learning capacity, some deep neural networks even get close to human performance on recognition tasks.

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Facial expression recognition consists of a few steps that need to be followed for a successful operation. They are as follows:

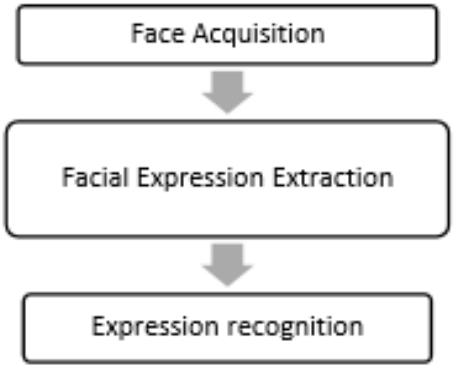

Figure: 1 Steps of facial expression recognition

Facial Expression Recognition System by combination of two or more techniques that can take human facial images having some expression as input, classify and recognize them into appropriate expression class that we are using. We proposed a hybrid method(PCA and LDA) in this research work.

II. PROPOSED METHOD

Every feature extraction technique for facial expression recognition has its own advantages. So each technique can extract only limited features with redundancy and a limited recognition rate is possible with its own extracted feature. For achieving higher recognition rate different feature extraction techniques are combined into a single combined technique to maximize the features. Using hybrid combinations advantage of different techniques also merged in proposed technique. Following Proposed algorithm extract the features of PCA and LDA. The steps of this framework are summarized below figure. The implementation and performance evolution of proposed algorithm is done in MATLAB R2014a software

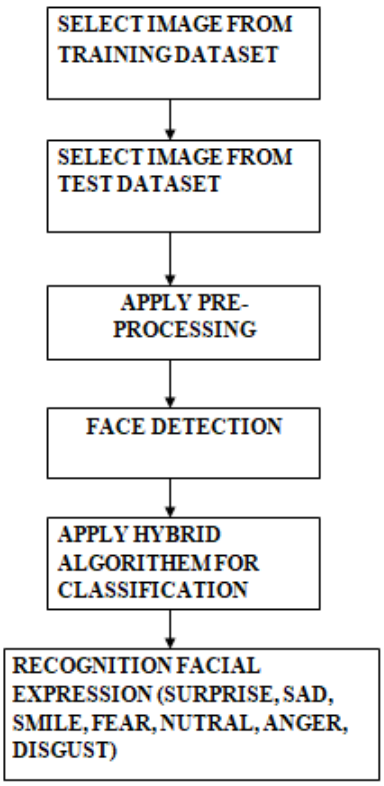

Figure: 2 Flow structure of proposed Methodology

Principal Component Analysis (PCA)

One of the simplest and most effective PCA approaches used in face recognition systems is the so-called eigenface approach. This approach transforms faces into a small set of essential characteristics, eigenfaces, which are the main components of the initial set of learning images (training set). Recognition is done by projecting a new image in the eigenface subspace, after which the person is classified by comparing its position in eigenface space with the position of known individuals. The advantage of this approach over other face recognition systems is in its

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simplicity, speed and insensitivity to small or gradual changes on the face. The problem is limited to files that can be used to recognize the face. Namely, the images must be vertical frontal views of human faces.

Linear Discriminant Analysis (LDA)

Linear Discriminant Analysis (LDA) is also a dimensionality reduction technique which is used for classification problems. Another name of LDA is fisher's discriminant analysis and it searches those vectors in the underlying space that are the best discriminant among classes. LDA combine the independent feature which leads the largest mean differences between the desired classes. LDA is a linear transformation after the transformation features are separate. It can be achieved through scatter matrix analysis. The goal of LDA is to maximize the between-class scatter matrix measure and minimizing the within-class scatter matrix measure. LDA is a derived form of Fisher linear classifier it maximizes the ratio of the between- and within-class scatters. It is widely used in face recognition community.

III. RESULT

The database obtained with 15 photographs of Japanese Female Facial Expression (JAFFE) in different expression. There are 15 images in database like Anxiety, Disgust, Fear, Happiness and Neutral. Database for testing phase is prepared by taking photographs of a person on different expression but in similar conditions. such as (lighting, background, distance from camera etc.). Accuracy, Average Recognition and matching time of all test samples are obtained.

Table 1: Distribution of samples in database

Expression class
Anxiety
Disgust
Fear
Happiness
Neutral

Table 2: Recognition rate of different images

Image	Emotions	Recognition rate (%)
1.TIFF	Anxiety	64.4496
2.TIFF	Anxiety	56.3407
3.TIFF	Anxiety	58.0002
4.TIFF	Disgust	56.929
5.TIFF	Disgust	70.7406
6.TIFF	Disgust	75.7943
7.TIFF	Fear	57.5331
8.TIFF	Fear	81.7006
9.TIFF	Fear	75.5585
10.TIFF	Happines	61.4091
11.TIFF	Happines	65.2963
12.TIFF	Happines	66.3143
13.TIFF	Neutal	56.1291
14.TIFF	Neutal	56.4746
15.TIFF	Neutal	55.52

Here is the formula for Recognition rate in percentage.

$$\text{Recognition Rate}(\%) = \frac{\text{No of Correct Matches}}{\text{Total No. of Test Images}} \times 100$$

Table 5.3: Recognition rate of different Feature extraction Method

Method	PCA	LDA	Hybrid
Avg.Recognition rate(%)	70[21]	56.25[21]	85.25

IV. CONCLUSION

Experimental results show that proposed techniques have 85.25% recognition rate. While PCA method has 70% recognition rate and LDA has 56.25% recognition rate. The percentages of the correct classification vary across different expressions from 50% to 82% for PCA and from 54% to 90% for LDA and from 67% to 90% for proposed technique. In this Thesis we conclude that when we combine the best features of different technique then we get the best features vectors which improve some recognition rate of facial expression. So Proposed technique can extract more distinguished information about the expression because each technique can extract only a limited features with redundant information so that a limited recognition rate is obtained but hybrid technique of different feature extraction techniques extract different features which increase the distinguished information for different expression.

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