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RESULT ANALYSIS OF FACIAL EXPRESSION RECOGNITION TECHNIQUES

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ABSTRACT

Expression recognition possesses practically significant importance; it offers vast application prospects, such as user-friendly interface between people and machine, humanistic design of products, and an automatic robot for example. Face perception is an important component of human knowledge. Faces contain much information about ones' id and also about mood and state of mind. Facial expression interactions usually relevant in social life, teacher-student interaction, credibility in numerous contexts, medicine etc. however people can easily recognize facial expression easily, but it is quite hard for a machine to do this. The comparative study of Facial Expression Recognition techniques namely Principal Component analysis (PCA), PCA with neural networks(NN) is done .The objective of this research is to show that PCA with NN is superior to former technique in terms of recognition rate.To test and evaluate their performance, experiments are performed using JAFEE and real database using both techniques. The universally accepted seven principal emotions to be recognized are: Angry, Happy, Sad, Disgust, fear, Surprise and neutral.

KEYWORDS: Facial Expression Recognition, Principle component Analysis (PCA), Recognition Rate, Neural Networks(NN), etc.

INTRODUCTION

Face recognition is the automated assignment of a digital image to a particular person by analyzing the features of the face in that image. The method of face recognition consists of three components: face detection, image processing and face identification. Face detection uses computer learning to detect the location of any faces within an image. Image processing consists of scaling and image rendering to prepare the face for identification. Face identification uses mathematical techniques on the pixel values or features in the facial area of an image to determine who the face belongs to. The most useful applications contain crowd surveillance, video content indexing, personal identification, mug shots matching, entrance security, etc. We believe recognition of human facial expression by computer is a key to develop such technology. In recent years, much research has been done on machine recognition of human facial expressions Face recognition has been studied extensively for more than 40 years. Now it is one of the most imperative subtopics in the domain of face research [1]-[4]. Face recognition is a technology which recognizes the human by his/her faces image. Recent advances in image analysis and pattern recognition open up the possibility of automatic detection and classification of emotional and conversational facial signals. The goal of this paper is to survey the work done in automating facial expression analysis in facial images and image sequences. The basic problems related to facial expression analysis is: face detection in a facial image or image sequence, facial expression data extraction, and facial expression classification. Our aim is to explore the issues in design and implementation of a system that could perform automated facial expression analysis. In general, three main steps can be distinguished in tackling the problem. First, before a facial expression can be analyzed, the face must be detected in a scene. Next is to devise mechanisms for extracting the facial expression information from the observed facial image or image sequence. In the case of static images, the process of extracting the facial expression information is referred to as localizing the face and its features in the scene. In the case of facial image sequences, this process is referred to as tracking the face and its features in the scene. At this point, a clear distinction should be made between two terms, namely, facial features and face model features. The facial features are the prominent features of the face eyebrows, eyes, nose, mouth, and chin. The face model features are the features used to represent (model) the face. The face can be represented in various ways, e.g., as a whole unit (holistic representation), as a set of features (analytic representation) or as a combination of these (hybrid approach).

The applied face representation and the kind of input images determine the choice of mechanisms for automatic extraction of facial expression information.

RELATED WORKS

Recent approaches include measurement of facial motion through optic flow [2], [4] and analysis of surface textures based on principal component analysis (PCA). In addition, a number of methods that have been developed for representing faces for identity recognition may also be powerful for expression analysis. These approaches are also included in the present comparison. These include independent component analysis [5] linear discriminant analysis, local feature analysis and Gabor wavelets. Bartlett explores and compares techniques for automatically recognizing facial actions in sequences of images. These techniques include analysis of facial motion through estimation of optical flow; holistic spatial analysis, such as independent component analysis, local feature analysis, and linear discriminant analysis; and methods based on the outputs of local filters, such as Gabor wavelet representations and local principal components[5]. Donato compared several techniques, which included optical flow, principal component analysis, independent component analysis, local feature analysis and Gabor wavelet representation, to recognize eight single action units and four action unit combinations using image sequences that were manually aligned and free of head motions[6]. Lien describes a system that recognizes various action units based on dense flow, feature point tracking and edge extraction. The system includes three modules to extract feature information: dense-flow extraction using a wavelet motion model, facial feature tracking, and edge and line extraction [7]. Fasel fulfills the recognition of facial action units, i.e., the subtle change of facial expressions, and emotion-specified expressions. The optimum facial feature extraction algorithm, Canny Edge Detector, is applied to localize face images, and a hierarchical clustering-based scheme reinforces the search region of extracted highly textured facial clusters[8].This paper provides a new fully automatic framework to analyze facial action units, the fundamental building blocks of facial expression enumerated in

Paul Ekman's Facial Action Coding System (FACS). The action units examined in this paper include upper facial muscle movements such as inner eyebrow raise, eye widening, and so forth, which combine to form facial expressions[9]. Geetha et al. [10] a method was described for real time face/head tracking and facial expression recognition. A face is located by extracting the head contour points using the motion information. In this paper, **a** new technique coined two-dimensional principal component analysis (2DPCA) is developed for image representation. Lee and Kim [11] approached a method of expression-invariant face recognition that transforms input face image with an arbitrary expression into its corresponding neutral facial expression image. To achieve expression-invariance, first extract the facial feature vector from the input image. As opposed to PCA, 2DPCA is based on 2D image matrices rather than 1D vector[12]. But after 2DPCA, PCA must be applied which is unrealistic in such situation [13]. Next, transform the input facial feature vector into its corresponding neutral facial expression vector using direct or indirect facial expression transformation. Finally, perform the expression-invariant face recognition by distance-based matching techniques nearest neighbor classifier, linear discriminant analysis (LDA) and generalized discriminant analysis (GDA). Among the facial features, eyes are the most prominent features used for determining the size of a face[14]. The visual features are modeled using support vector machine (SVM) for facial expression recognition.

FACIAL EXPRESSION DATABASE

PCA

Principal component analysis or karhunen-loeve transformation is a standard technique used in the statistical pattern recognition and signal processing for data reduction. As the pattern often contains redundant information, mapping it to a feature vector can get rid of this redundancy and yet preserve most of the intrinsic information content of the pattern. These extracted features have great role in distinguishing input patterns. A face image in 2-dimension with size N × N can also be considered as one dimensional vector of dimension N^2 [15].

PCA with Neural Networks

A large neural network for all people in the database was implemented. After calculating the eigenfaces, the feature projection vectors are calculated for the facial expressions in the database. These feature projection vectors are used as inputs to train the neural network. When a new image is considered for recognition, its feature projection vector is calculated from the eigenfaces, and this image gets its new descriptors. These descriptors are fed to the neural network and the network is simulated with these descriptors, where the network outputs are compared. By looking at the maximum output the new facial expression is decided to belong to the class of person with this maximum output.

PRINCIPAL COMPONENT ANALYSIS (PCA) AND NEURAL NETWORKS

Principal Component Analysis (PCA) is a statistical technique used for dimension reduction and recognition, & widely used for facial feature extraction and recognition. PCA is known as Eigen space Projection which is based on linearly Projection the image space to a low dimension feature space that is known as Eigen space. Many PCA-based face-recognition systems have also been developed in the last decade. However, existing PCA-based face recognition systems are hard to scale up because of the computational cost and memory-requirement burden. A 2-D facial image can be represented as 1-D vector by concatenating each row (or column) into a long thin vector.

The neural network is an outcome of various neurons as inputs. It plays an interesting, fundamental role in many different applications. On such application is in digital image processing. NN in digital applications provides a robust method of storing large images as smaller, more manageable square ones. This is accomplished by reproducing the original image with each succeeding nonzero singular value. Furthermore, to reduce storage size even further, images may approximate using fewer singular values. The singular value decomposition of a matrix A of m x n matrix is given in the form,

RESULTS COMPARISON OF PCA & PCA WITH NEURAL NETWORK

The comparison on the basis of various characteristics is given in the table below of PCA and PCA with NN. This shows that PCA with NN is superior to former technique in terms of its recognition rate and various other properties

Table 5 :Comparison of facial expression recognition techniques[15]

Facial Expression	Recognition Rate with PCA (%)	Recognition Rate with PCA and NN (%)
Happy	42.85	83
Disgust	68.42	86
Neutral	70	90
Sad	71.43	90
Anger	75	90
Surprise	50	85
Fear	63.63	88

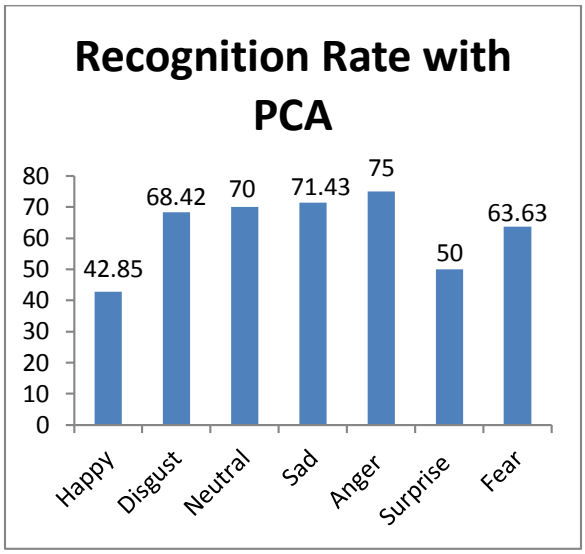

Fig1.1 Bar Graph shows Recognition rate with PCA[15]

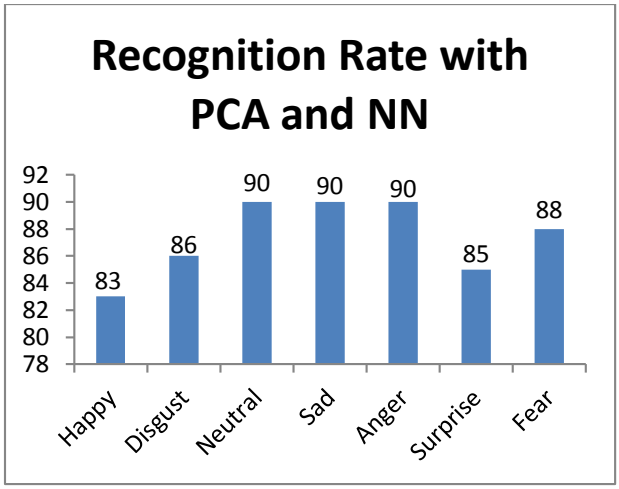

Fig1.2 Bar Graph shows Recognition rate with PCA and NN

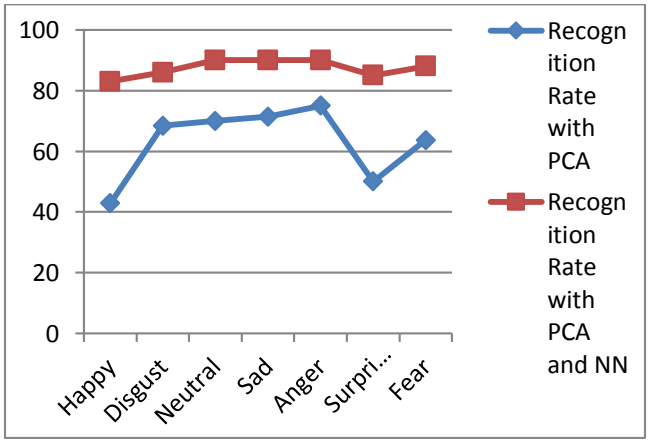

Fig1.2 CURVE shows Recognition rate with PCA and PCA with NN

CONCLUSION

In this research paper comparative study of PCA for classification of emotion using Neural Network and PCA is done. We achieved 88% result for all principal emotions along with Neutral on training dataset using PCA with NN. The implementation is done on both real database as well as JAFFE database. Experimental results show that algorithm can effectively distinguish different Expressions by identifying features. The results show that PCA with NN is superior to PCA in terms of recognition rate .Each image is enhanced, localized and its features are extracted using PCA with NN.

Future work consists three aspects, one is to work on more complex image such as vary large size 2D image or 3D images with NN technique for image compression and recognition; second, deeply to study and investigate the roles of singular values and Singular vectors in image processing. Third, this application is completed on the MATLAB, in the future; the application can be performed with programming of Java or C++.

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