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Face Recognition Techniques with Nearest Neighbor Using PCA Based System

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ABSTRACT: A facial recognition system is a computer application for automatically identifying or verifying a person from a digital image or a video frame from a video source. One of the ways to do this is by comparing selected facial features from the image and a facial database. It is typically used in security systems and can be compared to other biometrics such as fingerprint or eye iris recognition systems. Face recognition is not perfect and struggles to perform under certain conditions. There are two key problems for any face recognition problem: the illumination problem and pose problem. The performance for face recognition system drops significantly when pose variations are present in input images. The task of face recognition becomes even more difficult when illumination variations are present. Face recognition applications commonly suffer from three main drawbacks: a reduced training set, information lying in high-dimensional subspaces, and the need to incorporate new people to recognize. We propose an accurate 3D facial feature localization approach based on 3D shape descriptions using Nearest Neighbor technique. An accurate face alignment using a combination of face alignment method PCA is implemented. The proposed method is shown in the experiment with more accuracy.

KEYWORDS: Face recognition, image resizing, nearest neighbor, PCA.

I. INTRODUCTION

Face recognition is an important chapter in Information Technology field that helps in many field ie, security, entertainment shows,public laws etc.Many of the researcher finding a different and efficient way to acheive the good results from the past.Many researcher being done in the area of 3D recognition which hopes to improve upon the inherent limitations of 2D recognition.2D recognition has many disadvantages the 3D recognitoion will over come with many new techniques.Pose variations is the one of the major and tought problem that we are faceing currently in the face recognition.Many researcher has handled different techniques and issues in order to attain excat results some of them were mentioned below in the Literature survey part.

II. RELATED WORK

In this survey various methods for face recognition has been briefly described below. Face recognition methods are categorized as Feature based methods, Hybrid methods, pose based methods.The most widely used methods are eigen faces which is based on principal component analysis and nearest neighbor.

Q. Chen [2007] has proposed the 3D model based face recognition by using the pose estimation method. Facial features points are extracted using LDA method on the wavelet faces of the face image in the gallery and it shows the high accuracy.

M.A. Rabbani [2007] has proposed [1] the appearance based statistical method for face recognition. His Eigen face approach has provided better practical solution for face recognition problem. His experimental result shows high accuracy for face recognition using median with various distance measures.

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Stan Z. Li [1998] has proposed Nearest feature line with least feature points. It is based on nearest distance from the feature point. Thus it achieves very low error rate and better results for the ORL database.

Unsang Park [2010] has proposed 3D aging model technique to compensate the age variation for better results in face recognition. He performed on different aging database by validating the 3D shape and texture for good result.

The most recent work on 3D face recognition by Zhan-Li Sun [2013] uses Non Linear Square model for estimating different facial feature points by similarity transform. The time taken for training the image became less thus it improves the recognition efficiency[2][3].

III. PROPOSED METHOD

The proposed method 3D facial feature localization approach based on 3D shape descriptions were obtained using the nearest neighbor technique.PCA is also implemented for the face alignment. The technique which improves the quality of the object. The experiment obtains the better results and brief explanation shows below[4][5].

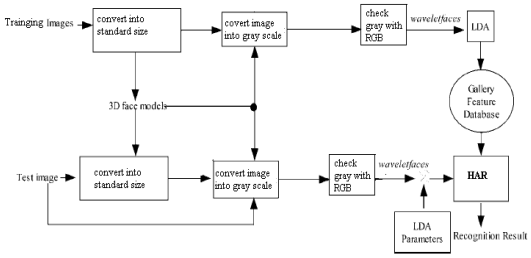

Figure 1 : Over all architecture of this system

3.1 Principal Component Anaylsis(PCA)

Principal Component Anaysis was invented in 1901 by Karl pearson.PCA is powerful tool for identifying patterns in data and highlight thier differences and similarities. The main Pros of PCA is that once you have identified the patterns in the data and you can reduce it or compress it based on the number of dimensions without much loss of data[6]. PCA can be done by eigen values or data matrix.PCA method is one of the best technique that produce most accurate results in the face recognitions system. The proposed nonlinear mapping not only considers the statistical property of the input features, but also adopts an Eigen mask to emphasize those important facial feature points. The new nonlinear mapping is combined with the conventional kernel PCA to be called “doubly” nonlinear mapping kernel PCA.

Figure 2 : Original left PCA right

3.2 Nearest Neighbor Technique

Nearest neighbor(NN) technique is simple, more efficient and effective in face recognition system. It identifies the unkown data points on the basis of its nearest neighbor[7]. This principle is mostly used in pattern recognition, categorization of text, ranking models etc. There are many techniques that are used in face recognition system they are k Nearest Neighbor(kNN), Weighted k Nearest Neighbor(WkNN), Condensed nearest neighbor (CNN), Reduced Nearest neighbor(RNN), Model based k nearest neighbor (MkNN) Rank nearest neighbor(kRNN) etc.. Each technique has it own key ideas, advantages, disadvantages and targeted data.

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Figure 3 : Image samples obtained from ORL database

3.3 Wavelet Transform

Wavelet transform is Haar wavelet.It was proposed by the mathematician Alfrd Haar in 1909.After him there were many researchers who gave many shape and reconstructed into an efficient and it has been used in the numerous applications. There are many types of wavelet transform they are Discrete wavelet transform, Fast wavelet transform, subband coding, 2D wavelet transform, continuous wavelet transform etc.Application of wavelet transform are image compression, Edge and corner detection, pattern recognition, Filter design, Electrocardiogram etc[8][9].

3.3.1. PCA on Wavelet Subband Approach:

The new approach in using PCA – apply PCA on wavelet sub band. Traditionally, to represent the human face, PCA is performed on the whole facial image. In the proposed method, wavelet transform is used to decompose an image into different frequency subbands[10][11], and a mid-range frequency Subband is used for PCA representation. In comparison with the traditional use of PCA, the proposed method gives better recognition accuracy and discriminatory power: further, the proposed method reduces the computational load significantly when the image database is large, with more than 400 training images.

3.4. Linear Discriminant Based Method:

The main objective of LDA is to perform dimensionality reduction while preserving as much of the class discriminatory information as possible.It seeks to find directions along which the classes are separated.It has capablity of distinguishing image difference by varying with other source such as illumination and expression.The linear tranformation is described in matrix which is also called as Fisherfaces. The process is PCA is first applied to the data set to reduce its dimensionality and then LDA is applied to further reduce the dimensionality[12].

A new algorithm has been developed to deal with the problem of face image retrieval from huge databases such as those found in internet environments. Such retrieval requires a compact face representation which has robust recognition performance under lighting and pose variations. The partitioning of a face image into components offers a number of benefits that facilitate the development of an efficient and robust face retrieval algorithm. Variation in image statistics due to pose and illumination changes within each component region can be simplified and more easily captured by a linear encoding than that of the whole image. So an LDA encoding at the component level facilitates better classification. Furthermore, a facial component can be weighted according weighted less in the matching stage to yield a more reliable decision.[13]

IV. RESULT AND ANALYSIS

In this experiment, we only consider pose variation in a face regardless of illumination change. Therefore, only pose differences in the face database are used. Lighting conditions remain constant. To verify the robustness against pose variation, we generated a database consisting of 100 subjects, each exhibiting five different poses (left, right, up, down and front) with respect to the ToF camera for a total of 500 images. Using those images, we can generate 3D multi-spectrum face and perform normalization.

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Fig 4: Example images from the database of five different facial poses: front, up, down, right and left.

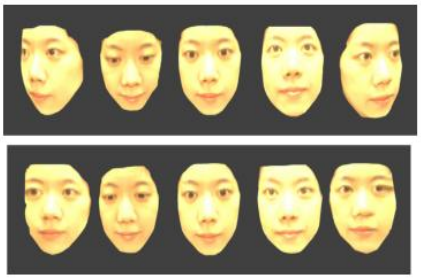

Fig 5: The first row shows 3D visible multi-spectrum face data before normalization and the second row shows normalized 3D visible multi-spectrum face data.

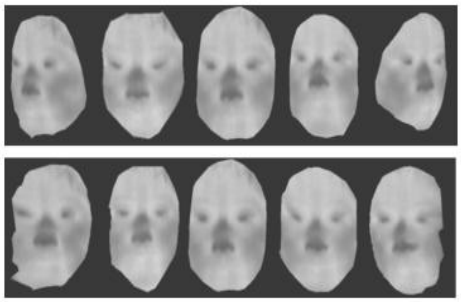

Fig 6: The first row shows 3D thermal-IR multi-spectrum face data before normalization, and the second row shows normalized 3D thermal-IR- multi-spectrum face data.

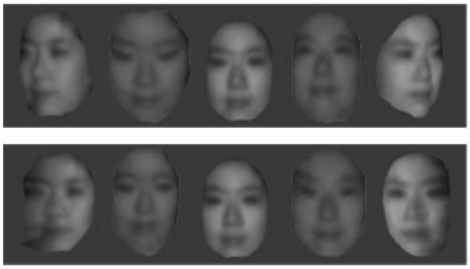

Fig 7 : The first row shows 3D near-IR multi-spectrum face data before normalization, and the second row shows normalized 3D near-IR multi spectrum face data.

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Experiments using five-fold cross validation are performed to verify the face images[14]. That is, four face images of a person are used for training, and then, one face image is used for testing. We first train each classifier using 400 faces data images, with four posed data images per subject, and perform the test using 100 other face data images in different poses. Recognition is performed using a nearest neighbor classifier with PCA, FDA, PCA + SVM and PCA + RM. To compare the proposed 2.5D face recognition using 3D multi-spectrum face data by PCA, FDA, PCA + SVM AND PCA + RM. In this experiment, we have used different polynomial orders 1(RM), 2(RM_2) and 3 (RM). Since order 3 shows saturated performance, the 3. In the SVM and RM experiments, we extracted features using PCA and adopt SVM and RM as classifiers. In the SVM experiments, we adopt the linear model, a polynomial, model and a radial basis function as kernals[15]. The parameters, such as the number of principal components in the Eigen face and the number of support vectors with SVM, are experimentally selected to achieve the lowest error rate with each method. Five types of experiments are performed to observe the performance and the robustness against pose variation using 3D multi-spectrum face data. The datas are shown in the following table.

	PCA	FLDA	PCA + SVM(linear)	PCA + SVM(poly)	PCA + SVM (rbf)	PCA + RM1	PCA + RM2	PCA + RM3
2D-vis	48.6	50.8	53.2	57.2	55.8	53.8	55.2	57.2
3D	44.2	48.6	50.6	52.6	54.6	52.6	49.8	54
3D + ICP	74.6	83.8	87.8	91.2	87	84.4	87.2	87.8
2D-vis+3D+ICP	87	93.2	94.4	96.4	90.6	92.4	94.4	94.4
2D-the+3D=ICP	88.4	91.2	93.2	94.4	98.4	93.2	96.4	93.2
2D-NIR+3D+ICP	83.8	88.6	91.2	93.2	92.4	89.8	91.8	91.2

Table.1: Recognition rate with respect to pose variation

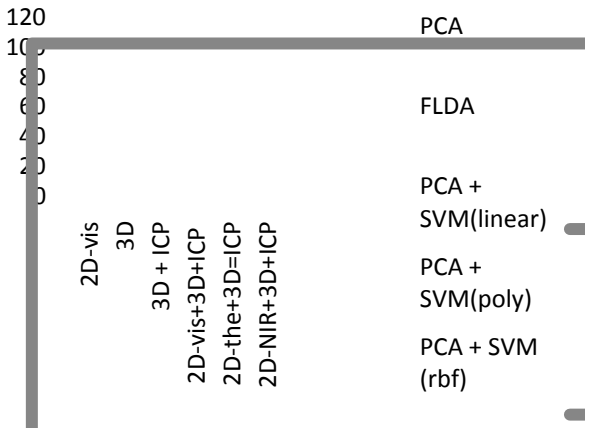

Fig 8: Recognition rate in terms of recognition approaches.

V. CONCLUSION

In this paper we proposed 3D facial feature localization approach based on 3D shape descriptors using Nearest Neighbor technique and PCA is implemented for a accurate face alignment. This results in sharper output. We showed the face recognition using various pose and illumination and the results are obtained. It is more effective. This proposed concept will in used in many security process and surveillance.

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