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AGE ESTIMATION SCHEME USING PCA AND CLASSIFIER TECHNIQUE

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ABSTRACT

Age estimation is very important issue in the field of computer vision or HCI that is Human Computer Interaction from last several years. Thus study age estimation system is to be carried out which will take human facial image as input and system will classify that in specific age year or in a different age groups But here question arises that whether detecting age or age group is that much easy for machine as it is for human??? The answer is no it is not that much easy for machine, if need to do so then basic steps that machine has to follow for this analysis are Face Detection, feature extraction and classification of age or age group. According to training sequences age detection is basically performed on exact age or age group or age range. In this paper focus is given on four age groups like child, young, adult and aged. This paper also states method related to classification as well as approach used for preprocessing and feature extraction are discussed to solve problem of age detection for machine.

Keywords*: -age estimation, feature extraction, classification.*

INTRODUCTION

The Intelligence of Human Computer Interaction is one of the innovative researching areas. Recently in the world, the age estimation methods are widely researched. Automatic Age Estimation is an interesting and challenging problem as it is an important part of Human Computer Interaction. The primary goal of age estimation research is to create a system which can identify specific human age with the exact age (year) or the age group (year range) of the individual face given images and use them to convey information. Age estimation via faces have become very popular topic recently because of their explosively emerging real-world applications, such as forensic art, electronic customer relationship management, security control and surveillance monitoring, biometrics, entertainment, cosmetology etc. [9]. People have the ability, to determine age between 20 and 60 years and conceive appearance from the face with high accuracy, on average, with a group decision. Here question arises that whether machine or simply computer can perform same task of age detection? Answer is not that much easily as human can. The machine has to follow some procedure which is divided in basic three steps: I Face detection and Preprocessing for this one can use databases which is available on internet like MORPH, FG-NET, FERET etc. or one can create its own database to skip face detection step else there are various methods to perform face detection after this these images are preprocessed using different techniques as per requirement. Next step is Feature extraction in this we have to extract the facial features from the observed facial image. The facial

features are the prominent features of the various parts of the face- eyebrows, eyes, nose, mouth, and chin. The final step is to develop a classifier, which will classify age into exact age (year) or the age group (year range).

Age estimation from face images is still very challenging compared to other cognition problems. This is primarily because many external factors influence the aging progress. The aging process can be accelerated or slowed down by physical condition, living style. The most important parts for the process of automatic age estimation are the internal parts of the face and in particular the area around the eyes [7]. As a result, different people with the same age can have quite different appearances due to different rates of facial aging. Many methods have been proposed to detect faces such as neutral networks, skin locus, and color analysis [9]. Usually, the image sequence has the face in frontal view. Once the face is detected from the image sequence, the next step is to extract the information about age of given images. Because of high variability in the types of faces, it is very difficult for the machine to extract facial features. Variations in lighting conditions, head movements, non-frontal views, various distractions like glasses, facial hair makes the problem more difficult. Finally we have to classify the extracted facial information into a particular age or age group. The techniques used for classification are based, neural network, Shortest Distance, support vector machines(SVM) self-organization map (SOM) etc.

PROPOSED AGE ESTIMATION METHOD

This section describes age group estimation method. The proposed method consists of four parts: Data Acquisition, Pre-processing, Feature extraction using PCA (Principle Component Analysis) & Classification using Euclidian Distance Classifier. Each of them is describedbelow:

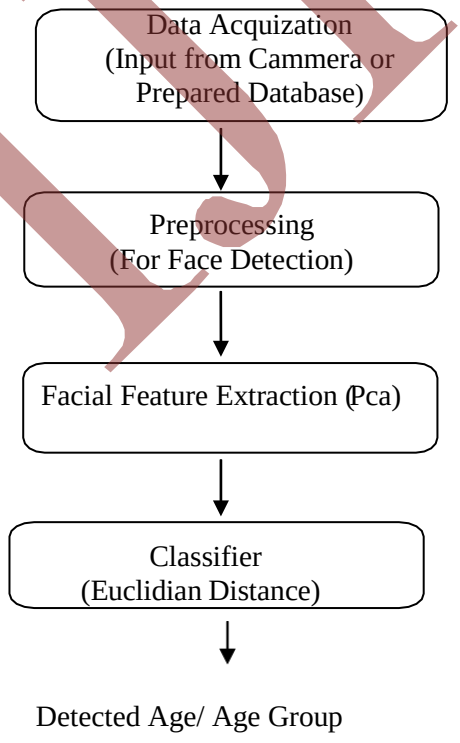

***Fig**. 1 Age Estimation System*

A. DATA ACQUISATION

As stated above data acquisition is nothing but to prepare a database which will be used for training & testing. One method to prepare it is, to take output of high definition camera. Else there are many databases easily available on internet to eliminate the step of acquisition & detection. For recognizing age group one has to detect face, there are number of techniques to detect the face in image.

P. Pirozmand, M. Fadavi Amiri, F. Kashanchi, Nichelle Yugeeta Layne used FG-NET [1] and MORPH [2] public face aging databases.[5] Ranjan Jana, Debaleena Datta, Rituparna Saha used face images of 50 persons which are captured by means of a digital camera (NIKON Coolpix L10).[10] V.Tamil Selvi V and K.Vani have used FGNET and INDIAN database with different age groups. [7]

For this paper, some photos from standard database available on internet and some photos taken by camera are used. Other sample pictures are taken by different cameras for various people with different conditions for four age groups child, young, adult, aged as stated above.

There are two sub databases prepared one for training and one for testing purpose. In training database there are total 37 photos all in JPEG format which are for thirty different people. Some of them are captured by using mobile camera and few of them are directly taken from internet and few of them are collected from photographers, named from Image001.jpg to Image037.jpg. For training database one text file is also prepared named as Label.txt which consist list of image name and age group related to that image. Testing database also consist photos of JPEG format named from Image001.jpg to Image043.jpg.

For both training and testing database following processes are carried out:

1. All images from training database are read, after image which is to be tested is also read by choosing test database.
2. Preprocessing step is performed on selected images from training and testing database.
3. PCA algorithm is applied on every image from training database so as to calculate eigenvalues and eigenvectors.
4. Euclidian distances are calculated.
5. For testing image PCA is applied to extract feature s, and then Euclidian distance is calculated, and the minimum value is chosen in order to find out the train image which is most similar to the test image.

B. PREPROCESSING

Images in database are may be affected because of camera type, background, light effects. Hence preprocessing is required and also some advanced preprocessing steps are carried out so as to detect face from original image. The steps followed in preprocessing are:

1. Cropping & Normalization: Input image is cropped to specific size to detect face only which consist eyes, Nose, mouth. After that cropped image is then resized to 280*180 pixels using following instruction.

I = imresize (image name,[280,180]);
Here image named as aa is resized to 280*180 pixels from its original dimensions. If want to resize more number of images then one can use for loop.

2. Light compensation: effect of light like brightness, darkness is adjusted using command imadjust as follows

J= imadjust (I, [low_in;high_in],[low_out; high_out])

This instruction maps the values in I to new values in J such values between low_in and high_in map to values between low_out and high_out. Values below low_in and above

high_in are clipped; that is, values below low_in map to low_out, and those above high_in map to high_out.

3. As database consist color photographs there is need to convert RGB color values to YCbCr color space using MATLAB command rgb2ycbcr.

C. FACIAL FEATURE EXTRACTION

The feature is defined as a function of one or more measurements, each of which specifies some quantifiable property of an object, and is computed such that it quantifies some significant characteristics of the object. We classify the various features currently employed as follows:

1. General features: Application independent features such as color, texture, and shape.According to the abstraction level, they can be further divided into:
2. Pixel-level features: Features calculated at each pixel, e.g. color, location.
3. Local features: Features calculated over the results of subdivision of the image band onimage segmentation or edge detection.
4. Global features: Features calculated over the entire image or just regular sub-area of animage.
5. Domain-specific features: Application dependent features such as human faces, fingerprints, and conceptual features.

Of these three activities, preprocessing, Feature extraction and classification; feature extraction is most critical because the particular features made available for discrimination directly influence the efficacy of the classification task. The end result of the extraction task is a set of features, commonly called a feature vector, which constitutes a representation of the image. [6]
Feature extraction converts pixel data into a higher-level representation of shape, motion, color, texture, and spatial configuration of the face or its components. The extracted representation is used for subsequent age group categorization. Feature extraction generally reduces the dimensionality of the input space.

Principal Components Analysis (PCA) is a way of identifying patterns in data, and expressing the data in such a way as to highlight their similarities and differences. Since patterns in data can be hard to find in data of high dimension, where the luxury of graphical representation is not available, PCA is a powerful tool for analyzing data. The steps involved in performing PCA on a set of data are:-

1. Get some data
2. Subtract the mean
3. Calculating the covariance matrix
4. Calculate the eigenvectors and Eigen values of the covariance matrix
5. Choosing components and formatting a feature vector
6. Deriving the new data set
7. Getting the old data back [3]

[C,S,L]=princomp (img name);

This command returns the principal component coefficients. Rows of image name correspond to observations, columns to variables. C is a p-by-p matrix, each column containing coefficients for one principal component. The columns are in order of decreasing component variance.
S is the representation of image name in the principal component space. Rows of SCORE correspond to observations, columns to components.

L is a vector containing the eigenvalues of the covariance matrix of X.
Principal Component Analysis is standard technique used in statistical pattern recognition and signal processing for data reduction and Feature extraction. Principal Component Analysis (PCA) is a dimensionality reduction technique based on extracting the desired number of principal components of the multi-dimensional data. The purpose of PCA is to reduce the large dimensionality of the data space (observed variables) to the smaller intrinsic dimensionality of feature space (independent variables).

D. AGE GROUP CLASSFICATION

As the features are extracted, a suitable classifier must be chosen. Facial classification is performed by using classifier. There is wide range of classifiers available to solve age estimation problem. For this purpose, one investigated the use of the following methods for designing an age estimator.
Quadratic Functions: Optimization methods have been used for defining the optimum coefficients of quadratic functions.
Shortest Distance Classifier: Based on the training data, the distributions of face parameters corresponding to a certain expressions are defined.
Supervised Neural Networks: Supervised neural networks have been trained with a set of face parameters and their corresponding expressions so that given an unknown set of parameters they produce at the output an estimate of the expression of the person in the corresponding face image.
Unsupervised Neural Networks: The Kohonen Self-Organizing Map (SOM), which is a

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clustering algorithm, has been utilized to train networks to classify a set of input vectors of face parameters in a number ofclusters corresponding to different expression. [4]
The classifier based on the Euclidean distance has been used which is obtained by calculating the distance between the images which are to be tested and the already available images used for training. Then the minimum distance is observed from the set of values and based on these values decision making is performed.

The formula for the Euclidean distance is given by,

$$D = \sqrt{\sum (X_2 - X_1)^2}$$

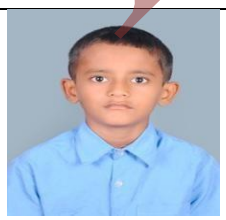
I. RESULTS

Here training for different age group like child, young, adult, aged is carried out this is helpful in age estimation. The pictures in the age training database are classified in the following age groups.

1. Image001 to Image012 = Child (below 15 years)
2. Image013 to Image017= Young (15-25 years)
3. Image018 to Image028 = Adult (25-45 years)
4. Image029 to Image037 = Aged (above 45 years)

After training the images, we are giving the inputs as the test database then the following results were obtained for age groups. According to table no. 2 system is predicting three falseresults for age detection from total 42 testing samples so as to provide good accuracy.

Table 1- Some Result's for age group estimation:

5			**Young**	√
6			**Child**	√
7			**Adult**	√

8			**Child**	×

Table 2- Summary of Age detection results

Representation	**Child**	**Young**	**Adult**	**Aged**
Correct detection of age group	05	06	23	6
Incorrect detection of age group	00	01	02	00
% Accuracy	**100**	**83.33**	**92**	**100**
Average accuracy=93.02%				

CONCLUSION & FUTURE SCOPE

In this paper age estimation technique with PCA and Euclidian distance classifier is discussed. As earlier stated detection of age or age group is divided into three sub problems face detection, feature extraction and classification. This technique is not best for all the problems, because there are some problems like head rotation, factor of aging, variation in illumination due light effects, etc. Thus if neural network is used then better results may be obtained. And also if camera of good quality is used to capture image to create database then also results may be improved. The proposed system can be further developed by increasing database size and using different classifier. The average Accuracy of the system obtained is about 80-90 %. We got 93.02 % average recognition rate for four principal age groups child, young, adult, aged. Due to the difficulties in collecting a large dataset with precise labeled human age, all experiments related toage estimation are performed on relatively small datasets.

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