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Aging Groups Classification based on Facial Feature

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Abstract- Humans can easily categorize a person's age group and are often precise in this estimation. Many researchers haven't been successful in finding a global aging function mainly due to lack of good training databases. As a result, training images are collected from the Internet and some images are taken from my friends under controlled lighting conditions. This work is based on using Eigen face to derive a function that can classify the age of a given frontal face image. Eigen face has recently gained a great deal of popularity in the computer vision community, proving to be very successful on several classical pattern recognition problems. Age classification is concerned with the use of a training set to train a model that can predict the age of the facial images. The efficiency of the system can also be tested by using the large number of images for each age group.

Keywords- Eigen face, age group, age classification, feature extraction, face recognition.

I. INTRODUCTION

Age classification is concerned with the use of a training set to train a model that can estimate the age of the facial images. Among the first to research age prediction were, Kwon and Vitoria Lobo who proposed a method to classify input face images into one of the following three age groups: babies, young adults and senior adults [1]. Their study was based on geometric ratios and skin wrinkle analysis. Their method was tested on a database of only 47 high resolution face images containing babies, young and middle aged adults. They reported 100% classification accuracy on these data. Hayashi focused their study on facial wrinkles for the estimation of age and gender [2]. Skin regions were first extracted from the face images, followed histogram equalization to enhance wrinkles. Then, a special Hough transform, DTHT (Digital Template Hough Transform) was used to extract both the shorter and longer wrinkles on the face. Their experiments were not very successful on the age classification task though, achieving only 27% accuracy of age estimation and 83% on gender classification. It is important to note that they did not mention the size or source of their test to generate their accuracy values. Hayashi also noted the difficulty of extracting wrinkles from females' ages between 20 and 30 due to presence of makeup [2].

Lanitis empirically studied the significance of different facial parts for automatic age estimation [3]. The algorithm is based on statistical face models. Lanitis claims that introduction of the hairline has a negative effect on the results [3].His study was limited to subject ranging from 0 to 35 years old, and contained 330 images, of which only 80 were used for testing purposes. Evidently, faces with more wrinkles weren't used, leaving in doubt his ability to estimate the age of subjects older than 35 years. Some researchers have focused on particular age groups only, while others use an extremely wide classification range. Primarily, due to the lack of a good database, a global age prediction function, covering an extensive range of ages has yet to be developed.

J . R . Scolar and P . Navarreto [4] proposed an face recognition algorithm based on Eigen space. J . Yang and et al.[5] introduced the a new approach to appearance-based face representation and recognition. Most of the research in this area is very limited by the size and quality of the database used.

In this research, age dependent face recognition system based on the diagonal PCA (Principal Component Analysis) method is developed. First, the age of the input individual is predicted and then face recognition is performed with corresponding age group in face database. Finally, the record of the matched person is appeared as output.

Age changes cause major variations in the appearance of human faces. Due to many lifestyle factors, it is difficult to precisely predict how individuals may look with advancing years or how they looked with "retreating years". The desire aged face is simulated from the input face image base on the PCA (Principal Component Analysis) method.

This system provides the personal identification and recognition for security system. It will be provided the searching of the missing children and wanted persons. By considering the individual age groups, the processing time and complexities will reduce in the face recognition and identification. The proposed system can be applied to classify the current facial appearance of children missing for several years and suspected terrorists. It will become a valuable and routine forensic tool used by criminal investigators.

II. PRE-PROCESSING

Image enhancing stage is performed to obtain the specific result for acquired image as shown in figure 1. Face region extraction, noise filtering, resizing image, histogram equalization and image adjusting processes are included in enchaining step. Rectangle tool is applied for face region extraction. Neighboring pixel approximation method and median filtering method are used for resizing of the required size of face image and noise filtering, respectively.

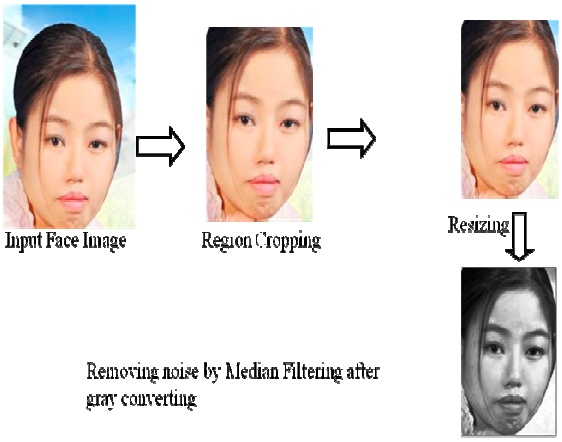

Figure. 1 Image Enhancing

III. FEATURE EXTRACTION

The fast and accurate facial features extraction algorithm is developed. Features extraction- deals with extracting features that are basic for differentiating one class of object from another. The extracted features of each face in database can be expressed in column matrix shown in Figure 2.

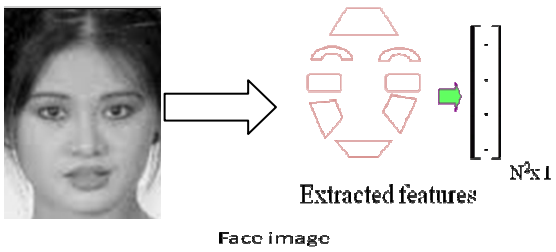

Figure. 2 Feature Extraction

$$\text{M face images} \quad \left\{ \begin{bmatrix} \cdot \\ F_1 \\ \cdot \\ \cdot \end{bmatrix} \begin{bmatrix} \cdot \\ F_2 \\ \cdot \\ \cdot \end{bmatrix} \cdots \begin{bmatrix} \cdot \\ \cdot \\ \cdot \\ \cdot \end{bmatrix} \right\}_{N^2 \times M} \qquad [1]$$

$$\text{Mean Face} = \Psi = \sum_{i=1}^{M} F_i \qquad [2]$$

$$A = \left\{ \begin{bmatrix} \cdot \\ \Psi\text{-}F_1 \\ \cdot \\ \cdot \\ \cdot \end{bmatrix} \begin{bmatrix} \cdot \\ \Psi\text{-}F_2 \\ \cdot \\ \cdot \\ \cdot \end{bmatrix} \cdots \begin{bmatrix} \cdot \\ \Psi\text{-}F_M \\ \cdot \\ \cdot \\ \cdot \end{bmatrix} \right\}_{N^2 \times M} \qquad [3]$$

The fundamental matrix A and it mean feature are computed for each age group. The matrix Ω can be described as

$$\Omega = \left\{ \begin{bmatrix} \cdot \\ A_1 \\ \cdot \\ \cdot \\ \cdot \end{bmatrix} \begin{bmatrix} \cdot \\ A_2 \\ \cdot \\ \cdot \\ \cdot \end{bmatrix} \cdots \begin{bmatrix} \cdot \\ A_M \\ \cdot \\ \cdot \\ \cdot \end{bmatrix} \right\}_{N^2 \times M} \qquad [4]$$

And then the age group that gives the minimum Euclidean distance will be assumed as the age of the input image.

IV. PROPOSED SYSTEM

In this research, automatic classification of the face aging system is developed. Three different research activities around human aging: age invariant face feature, age estimation and simulating aging process. The steps of the proposed system overview are shown in Figure 3. Face region extraction, noise filtering, resizing image and histogram equalization process are included in enchaining step. Eigen faces for each age group are stored in Database. The minimum different is computed among the input face and mean faces of all age groups for classification age. Finally, in age classification stage, the simulated face is produced by the mean structure of the desire age groups.

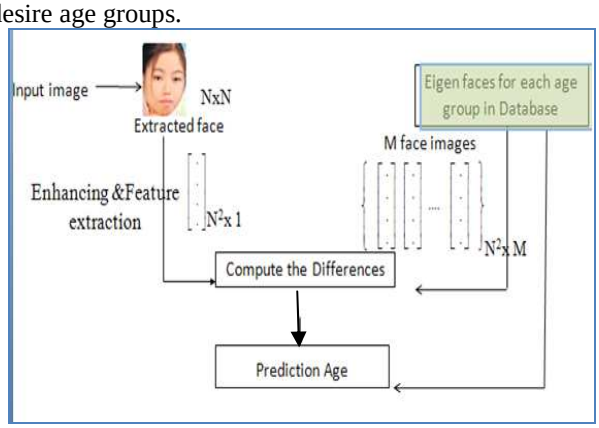

Figure. 3 System Flow Diagrams

V. APPROACH TO AGE CLASSIFICATION SYSTEM

Eigen faces for each age groups are stored in Database. The minimum different is computed among the input face and mean faces of all age groups for classification age. High-Level Functioning Principle of the Eigen face-Based Age Classification Algorithm is shown in Figure 4. The processing steps for creating the face database are as following:

1. Acquire an initial set of face images (the training set).
2. Calculate the Eigen faces from the training set, keeping only the M Eigen faces that correspond to the highest Eigen values. These M images define the face space.
3. Calculate the corresponding location or distribution in M-dimensional weight space for each known individual, by projecting the face images (from the training set) onto the "face space".

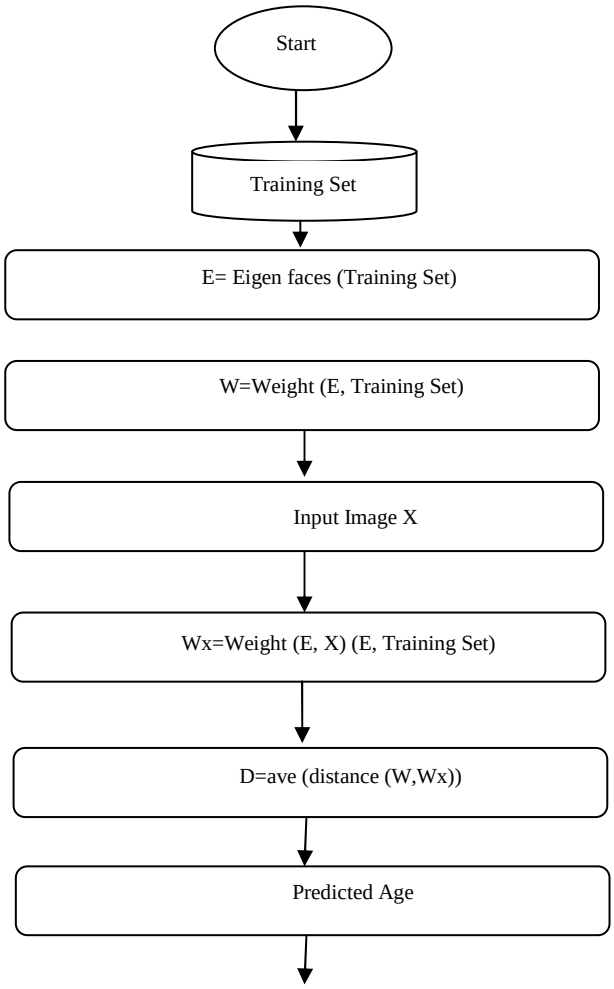

Figure. 4 High-Level Functioning Principle of the Eigen face-Based Age Classification Algorithm

These operations can also be performed occasionally to update or recalculate the Eigen faces as new faces are encountered. Having initialized the system, the following steps are then used to classify new face images:

1. Calculate a set of weights based on the input image and the M Eigen faces by projecting the input image onto each of the Eigen faces.
2. Classify the weight pattern to classify the age.
3. (Optional) Update the Eigen faces and/or weight patterns.

In the age classification task, the age of the subject is predicted based on the minimum Euclidean distance between the face space and each face class.

VI. EXPERIMENTS AND RESULTS

A range of an age classification result is 15 to 70 years old, and divided into 10 classes with 5 years old range. If the class of the estimation result contains the real age of the subject, the result is considered as correct. The accuracy rate is about 95 percent. Since one of our research targets is to test our system and compare it with human being, we took opinions of thirty people for 150 images selected from all ranges randomly. It is interesting to see how much far or close our system to human being is. The classification result is shown in figure 5.

Predicted Age: Age between 35-40
Actual Age : 38

Predicted Age: Age between 25-30
Actual Age : 27

Predicted Age: Age Over 60
Actual Age : 68

Figure. 5 Classification Results

VII. CONCLUSIONS

The age classification system for a very wide range is introduced. The age classification errors were due to the poor quality images, the lighting condition, and the large variation of pose and so on. So, the age of the persons can only be classified within a range of five years. This system limits the prototypes from 15 years to 60 years in age because the face undergoes major changes in shape before the age of 15 years. The accuracy of the system can be analyzed by the variation on the range of the age groups. This research highlights some of the problems and challenges in the field of forensic face recognition. This approach is a simple and powerful means for performing automatic age classification for facial images.

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