The Age Group Identifying For Human Using Active Appearance Model and K-NN Classifier

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Abstract- The Age Group classification for human has been widely studied since it can be used for various applications. However, most of FER techniques focus on discriminating typical facial expressions such as six basic facial expressions. Spontaneous facial expressions are not limited to such typical ones because the intensity of a facial expression varies depending on the intensity of an emotion. In order to utilize FER for real-world applications, therefore, it is necessary to discriminate slight difference of facial expressions. In this paper, we propose an effective FER method to recognize spontaneous facial expressions using ensemble learning which combines a number of naive Bayes classifiers. In addition, a method to estimate the intensity of facial expression is also proposed by using the classification results of the classifiers. The effectiveness of these methods are evaluated through an FER experiment and an experiment to estimate the intensity of facial expressions using a data set including spontaneous facial expressions.

Keywords: Facial expression recognition, Facial expression intensity estimation, Feature selection, Ensemble learning.

1. INTRODUCTION

The age group classification for human can be utilized for various applications such as retrieval of images and videos, robotics, and healthcare. It thus attracts attention and has been widely studied to improve the accuracy and efficiency of FER. FER is required, for example, to efficiently retrieve interesting scenes from large-scale video databases and to develop a robot which can communicate with human beings in real time. In FER, therefore, it is important to precisely and quickly recognize complex and subtle facial expressions and to handle personal difference of facial expressions. Most of FER methods construct FER models by utilizing some feature values computed from facial images. 1–10 Therefore, the feature values have great influence on the performance of FER. Variety of an age group classification is a one of the important task in facial image classification and it is a very challenging approaches for researchers. The wider applications in identifying criminals and
wider applications in identifying criminals and missing individuals etc. In this work, a novel method has been introduced in which the facial images were categorized into different age groups such as Adolescence, Adult and Senior Adult. It includes four stage of pre-processing techniques such as Cropping face image, Gamma correction, Dog filtering, Contrast Equalization to enhance the human facial images. Then the Enhanced facial images are using for extracting the facial feature points using Active Appearance Model (AAM).

2. RELATED WORKS

Human face is one of the most important sources of the information, which can be utilized for personal verification and identification, the human age is identified and classified using Hough Transform for feature extraction and Polynomial Regression for age classification.(SithuUbaid, Dr. ShyamaDas, Imthiyas M.P.- 2013), the facial features were extracted using Discrete Wavelet Transformation (DWT) and the classification of age group is done using K-Nearest Neighbor (KNN) classifier. They used three categories of age groups, namely Adolescence (13-18yrs), Adult (19-59yrs) and Senior Adult (60yrs and above). The classification algorithm is trained and tested using MORPH database which consists of images of various age groups. (G. Kulanthaivel-2014 It involves three stages: Pre-processing, Feature Extraction and Classification. Ranjan Jana, Debaleena Datta, Rituparna Saha-2013), to extract age relevant texture and shape features from a set of images and the classification is done in two steps. At first, a classification between Adolescence and adults are done. In the second step the exact age is estimated by a more specific classifier based on the result of the first step. Extensive experiments on the FG-NET aging database are conducted using the leave one person out evaluation scheme These primary features are used to compute the input facial images and to classify them into different age group (Baby, young, young adult and senior, and eight age categories: [1-6, 7-11, 12-19, 20-29, 30-39, 40-49, 50-65, 66+] (Zainab A. Othman, Dina A. Adnan-2014),

3. FACIAL FEATURE WORKS

3.1 PRE-PROCESSING

The input facial image is converted into grey scale image; the proposed approach uses four different types of pre-processing methods which includes cropping the image, Gamma correction, Dog filtering and Contrast Equalization.

![Fig 3.1. A Framework for Pre-Processing](image)

3.1.1. CROPPING THE IMAGE

The input images are cropped into a size of (128*128), the cropped images are converted into gray-scale images and the brightness of image is improved using Gamma Correction.

3.1.2 GAMMA CORRECTION
Gamma correction is a non-linear operation on an image defined by the power-law expression as below. Gamma correction is used to improve the brightness of the image and also ratio between the colors. \[ S = Cr^\gamma \] \hspace{1cm} (1)

Where, \( S \) represents the image after gamma correction, \( C \) and \( \gamma \) represent positive constants.

If \( r \) is the image before gamma correction. If \( \gamma < 1 \) it is known as encoding gamma and conversely, If \( \gamma > 1 \) it is known as decoding gamma. The image appears to be a dark image if \( \gamma < 1 \) and the image appears to be a bright image if \( \gamma > 1 \).

### 3.1.3. DoG FILTERING

The image after gamma correction consists of shading effects and is to be removed using DoG filtering. It is significant approach if finer details are to be detected, for example crow feet mar the eyes, wrinkles in the forehead etc. performance of the system. The DOG filtering is done by finding the difference between two Gaussian functions and it is given by the following equations.

\[ g(m,n) = g_1(m,n) - g_2(m,n) \] \hspace{1cm} (2)

where \( g_1(m,n) \) and \( g_2(m,n) \) are two Gaussian functions which are given by, \[ g_1(m,n) = e^{\frac{-s^2}{2\sigma^2_0}} \] \hspace{1cm} (3)

And \[ g(m,n) = e^{\frac{-s^2}{2\sigma^2_0}} - e^{\frac{-(s+\sigma_1)^2}{2\sigma^2_1}} \] \hspace{1cm} (4)

Here, \( s^2 = m^2 + n^2 \), \( \sigma = 1 \) and \( \sigma = 2 \).

### 3.1.4. CONTRAST EQUALIZATION

Contrast equalization is a widely used pre-processing techniques. It is used to adjust the intensity values of the images. This method is mainly useful in facial images with background and foregrounds that are both bright and dark images. It is used to increase the global contrast of the facial images. It is defined as a contrast enhancement technique,

\[ \alpha(h) = \text{rand} \left( \frac{\alpha_f(h) - \alpha_{f_{\min}}}{(M*N) - \alpha_{f_{\min}}} \right) *(L-1) \] \hspace{1cm} (5)

Where \( \alpha_{f_{\min}} \) is the minimum non-zero value of cumulative distribution functions.

\( M*N \)-Gives the image’s number of pixels, \( L \)-is the number of grey-level used.

### 3.2. EXTRACTION USING AAM

An Active Appearance Model (AAM) is a computer vision algorithm for matching a statistical model of object shape and appearance to a new image. AAM is commonly used algorithm for classifying the human age. Active Appearance Model is based on appearance that can deal with age, shape and texture. Statistical Appearance Model: \( c \)-parameters, \( p \)-controlling the shape, \( r \)-texture

\[ p = \bar{p} + Q_s c \] \hspace{1cm} (6)

\[ r = \bar{r} = Q_s c \] \hspace{1cm} (7)

Where, \( X \) is the mean shape, \( g \) is the texture mean shaped patch and matrices describing the modes of variation derived from the training set. The facial image shape is representing as a vector \( X \).
3.3. REDUCING THE DIMENSIONS USING SAMMON’S MAPPING

Sammon’s mapping is a nonlinear mapping of high dimensional data. The Dimensionality of the image are further reduced, using a sammon’s mapping method. Sammon’s mapping is an algorithm that maps a high-dimensional space to lower dimensionality by trying to preserve the structure of inter-point distances between high-dimensional spaces to lower-dimension space. Let the distance between the vectors $X_i$ and $X_j$ in the $L$-space to be defined by $d_{ij}^* = dist[i,j]$ and the distance between the corresponding vectors $Y_i$ and $Y_j$ in the $d$-space to be defined by $d_{ij} = dist[Y_i,Y_j]$. Sammon’s mapping aims to minimize the following error function, which is often referred to as Sammon’s stress (or) Sammon’s error.

$$E = \frac{1}{\sum_{i<j} d_{ij}^*} \sum_{i<j} (d_{ij}^* - d_{ij})^2 \quad \text{(8)}$$

Where, the distance between i and j objects in the original space by $d_{ij}^* = dist[i,j]$, and the distance between their projections by $d_{ij} = dist[Y_i,Y_j]$.

3.4. CLASSIFICATION USING KNN

K-Nearest Neighbor is the simplest and most powerful algorithm in which classification is done by finding the nearest or closest neighbors and finally identifies the class to which it belong. It is Very simple and good classification if the numbers of samples are large enough.

- **Steps of KNN classifier algorithms:**

  1. Read the training data from a file $<x,f(x)>$
  2. Read the testing data from a file $<x,f(x)>$
  3. Set K to some value
  4. Normalize the attribute value in the range 0 to 1.
  5. $\text{Value} = \text{Value} / (1+\text{value})$
  6. for each testing example value in the testing data set

     (i) Find the K-nearest neighbor in the training data set based on the Euclidean distance.

     (ii) Predict the class value by finding the maximum class represented in the K-Nearest Neighbors.

     (iii) Calculate the accuracy as $\text{Accuracy} = (\text{correctly classified example/testing example}) \times 100$.

3.4.1 EUCLIDEAN DISTANCE

The Euclidean distance between two points’ p and q in the length of line segment $(ab)$.

If $a = (a_1,a_2,....a_n)$ and $b = (b_1,b_2,....b_n)$ two points in Euclidean n-space, then the distance (d) from a to b.

$$d = \sqrt{\sum_{i=1}^{n} (a_i - b_i)^2} \quad \text{(9)}$$

The position of a point in Euclidean n-space is a Euclidean vector, so p and q, is Euclidean vector, starting from the origin of the space and their tips indicate two points.

4. SYSTEM ARCHITECTURE
5. EXPERIMENTAL WORK

The intact experimental study was carried out using Color Feret database, its includes the three different group of facial images (Adolescence, Adult and Senior Adult). The Age group classification is considering four stages of process in human facial images. In the first stages, four different types of Pre-Processing techniques are used the input images that are cropped into size of (128*128), and cropped images that are converted into gray-scale images. The Gamma correction is used to improve the brightness and ratio of image. The result of gamma correction images consists of shading effects to be removed using DoG filtering, The DoG filtering is done by finding the difference between two Gaussian functions. The result of DoG filtering images is considered as input of contrast equalization. In the second stage, Facial features extraction is done by the enhanced facial images using Active Appearance Model (AAM), but the dimensions of the images are not totally reduced, Sammon’s mapping methods is to used reduce the dimensions of the facial images in third stage of age group classification. Finally the facial images are classified into three age groups (Adolescence, Adult, and Senior Adult) using K-Nearest Neighbor (K-NN) classify technique.

Fig 5.1. Sample images of Color Ferret database using (K-NN) classify technique.

Fig 5.2 (a) Cropped image (b) Image after Gamma Correction (c) Image after Dog Filtering (d) Image after Contrast equalization.
Fig 5.3 Extraction using AAM

<table>
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<th>Mean Value</th>
<th>Entropy Value</th>
<th>Max-Intensities</th>
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Fig 5.4 Mean, Entropy and max-Intensities values of Images

**Figure 5.5 KNN Classifier Analysis**

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<td>88.7567</td>
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</tr>
</tbody>
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**Figure 5.6** Accuracy of the KNN classifier

- Sensitivity: 100
- Specificity: 76
- Accuracy: 90

**Table 5.1** AAM Segmentation Image

- Data Base Image Features:
  - 91.9579
  - 86.2273
  - 89.0522
  - 82.9295
  - 87.0294
  - 86.5427

- Data Base Image Features:
  - 90.1510

- Accuracy: 90

**Table 5.2** AAM Segmentation Image

- Data Base Image Features:
  - 92.0216
  - 91.9579
  - 86.2273
  - 89.0522
  - 82.9295
  - 87.0294
  - 86.5427
  - 90.1510

- Accuracy: 90

**Table 5.3** AAM Segmentation Image

- Data Base Image Features:
  - 92.0216
  - 91.9579
  - 86.2273
  - 89.0522
  - 82.9295
  - 87.0294
  - 86.5427
  - 90.1510

- Accuracy: 90

**Table 5.4** AAM Segmentation Image

- Data Base Image Features:
  - 92.0216
  - 91.9579
  - 86.2273
  - 89.0522
  - 82.9295
  - 87.0294
  - 86.5427
  - 90.1510

- Accuracy: 90

**Table 5.5** AAM Segmentation Image

- Data Base Image Features:
  - 92.0216
  - 91.9579
  - 86.2273
  - 89.0522
  - 82.9295
  - 87.0294
  - 86.5427
  - 90.1510

- Accuracy: 90
6. CONCLUSION

In this study, the facial images are enhanced by a sequence of four pre-processing techniques. To extract the facial features, the enhanced images are transformed using Active Appearance Model, then the dimensions of the facial image are further reduced using Sammon’s Map. Then K-Nearest Neighbor (KNN) is used for classifying the facial images into various age-groups and tested using Color Feret Database. Age group classification is provides a robust method that verifies the age group of individuals from a set of different aged face images. The crucial features such as distances between various parts of face such as eyes, nose, etc., these are best way compare to find the age group classification of the facial images in the database. Face images are uses in clustered into three groups (Adolescence, Adult, Senior Adult) using KNN classification algorithm. The accuracy of classification is decreased when the numbers of clusters groups are increased. So, it seems to be a definite possibility for further extension of the work.

7. REFERENCE


7. SithuUbaid, Dr. ShyamaDas,Imthiyas , “Human Age Prediction and Classification Using Facial Image” ISSN : 0975-3397 Vol. 5 No. 05 May 2013.


