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

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ABSTRACT
The classification of human age group using facial images have a vital role in image processing and computer vision. The task of facial processing is widely used in security and multimedia application. The human beings are capable to categorize a person's age group from the facial images. It is proved that computer can classify the human age group according to facial features using Active Appearance Model (AAM) and Sammon's mapping method. So the challenge is to develop an age group classification system by using the different methodologies. The existing system is based on facial images uses in Cost-Sensitive Ordinal Hyper Planes Ranking Algorithm (CSOHP) with an effective descriptor Scattering Transform.Age group classification method uses that describe Ageing pattern Subspace (AGES), Warped Gaussian Process (WGP), AdaBoost algorithm and also Local Binary Pattern algorithm. Accuracy of classification is based on the algorithm used for Extracting the feature points and Mis-classification is possible if the image quality is poor. The framework is composed of four main modules (i) Pre-Processing, (ii) Feature Extraction using Active Appearance model (AAM), (iii) Reducing the dimensions using Sammon's mapping method, (iv) Classification of facial images using K-Nearest Neighbor (K-NN).The proposed approaches uses four pre-processing techniques such as cropping face image, Gamma Correction, DoG filtering & Contrast Equalization, then Extract the features are extracted from the facial images using an Active Appearance Model(AAM) and the dimensions are reduced further using Sammon's Mapping method. The facial images are classified into the three different age group Adolescence, Adult, and Senior Adult using K-Nearest Neighbour (k-NN) classifier algorithm, using color Feret database. A maximum classification rate of 90% is achieved in using KNN classifier algorithm.
Keywords: *Gamma correction, DoG filtering, Contrast Equalization, Facial Aging, Age group classification, AAM, Sammon's mapping.*

INTRODUCTION

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 classification of human age has wider applications in identifying criminals and missing individuals etc. Human faces are subjected to change with in some short durations. 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. The human facial images convey a set of information which allows another person to identify their characteristics such as age group, it includes fourstage 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), the dimensions of images are not totally reduced. Consequently, the sammon's Map is used to reduce the dimensionality of the images further, and K-Nearest Neighbour (KNN) algorithm is used to classify the facial images into three different groups such as Adolescence, Adult, and Senior Adult. Theage group classification experimented using Color Feret database. The

purpose of this study is to be able to determine a person's age by analysing a set of facial feature points extract from facial images.The feature extraction stage produces lot of salient features, which represents the information needed for age group classification training phase. In the training phase, those salient features belongs to the same facial image are grouped together and used as a reference for further classification. Then the classification phase, the same kind of features are extracted and compared with the reference abstained in the training stage, Therefore, the performance of the age group classification system basically depends on the extracted facial features.

PREVIOUS WORK

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.(Sithu Ubaid, Dr. Shyama Das, 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 classificationalgorithm is trained and tested using MORPH database which consists of images of various age groups. (J.Nithyashri & G. Kulanthaivel-2014), this paper concerns with providing a methodology to classify the age group using face features.it involves three stages: Pre-processing, Feature Extraction and Classification. The geometric features of facial images like wrinkle geography, face angle, left eye to right eye distance, eye to nose distance, eye to chin distance and eye to lip distance are calculated. Based on the texture and shape information age classification is done using K-Means clustering algorithm. (Ranjan Jana, Debaleena Datta, Rituparna Saha-2013), to extract age relevant texture and shape features from a set of imagesand 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 classier 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. (Matthias Steiner-2010), The primary facial features are the center of the two eyes, nose peak, mouth peak, fore head, sides of the face and the chin point, 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. Othman1, Dina A. Adnan-2014), The proposed approaches used to improve the accuracy of the estimation of age group. Apart from geometric shape features, wrinkle analysis is also incorporated in classifying the age group. Multiple algorithms are applied for different phases like feature extraction, illumination correction, image fitting and edge detection to using find the age group classifier. (C. Arun Kumar, Praveen Kumar R V, Sai Arvind R -2014).

PROPOSED SYSTEM

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 croppingthe image, Gamma correction, Dog filtering and Contrast Equalization.

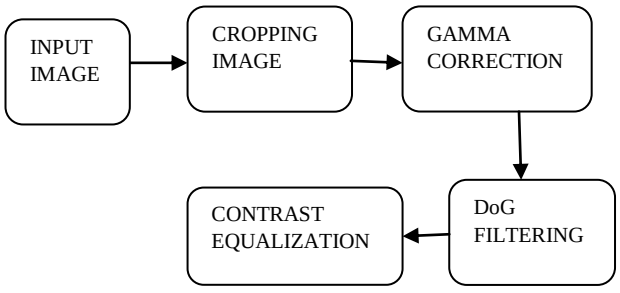


Fig 1. A FRAMEWORK FOR PRE-

PROCESSING

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.

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.

$$S = Cr^{\gamma} \text{.....(1)}$$

Where

S-represents the image after gamma correction,

*C*and γ 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 $\gamma > 1$.

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. Difference of Gaussian is an image segmentation technique in which the edges are sharpened. Therefore, the classification phase has become easier, thus increasing the 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.

$$g(m,n) = g_1(m,n) - g_2(m,n) \text{.....(2)}$$

Where $g_1(m,n)$ and $g_2(m,n)$ are two Gaussian functions which are given by,

$$g_1(m,n) = e^{s^2/2\sigma^2_0} \text{.....(3)}$$

$$\text{And } g(m,n) = e^{s^2/2\sigma^2_0} - e^{s^2/2\sigma^2_1} \text{.....(4)}$$

Where $s^2 = m^2 + n^2$, σ -Difference of two Gaussians. The value of σ, assumed in this work are σ=1 and σ=2.

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, with an intention to maintain a new enhanced facial image and uniform histogram.

$$c(h) = round\left(\frac{cdf(h) - cdf_{\min}}{(M*N) - cdf_{\min}}\right)*(L-1) \text{.....(5)}$$

Where $cdf_{\min}$ 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.

FEATURE 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. It is robust against head poses, which extracts craniofacial growth, skin and generalise to almost any face.

Statistical Appearance Model: c-parameters, p-controlling the shape, r-texture

$$p = \overline{p} + Q_s c \text{.....(6)}$$

$$r = \overline{r} = Q_g c \text{.....(7)}$$

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 and texture is represented as g is normalized the face images.

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 $d_{ij}^{*} \equiv dist[_i, _j]$ and the distance between the corresponding vectors Y_i and Y_j in the d - space to be defined by $d_{ij} \equiv dist[Y_i, Y_j]$. Sammon's mapping aims to minimize the following error function, which is often referred to as Sammon's stress (or) Sammon's error.

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

Where, the distance between i and j objects in the original space by $d_{ij}^{*} \equiv dist[_i, _j]$, and the distance between their projectionsby $d_{ij} \equiv dist[Y_i, Y_j]$.

CLASSIFICATION USING KNN

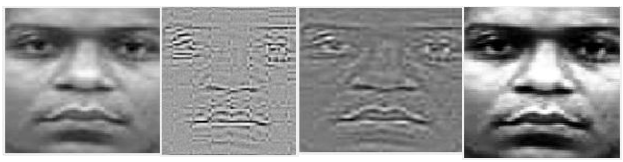
K-Nearest Neighbor is the simplest and most powerful algorithm in which classification is done by finding the nearest or closest neighbors and finally identifies the class to which it belong. The main disadvantage of K- Nearest Neighbor technique is requires large number of samples for accuracy.

Steps of KNN classifier algorithms

i. The distance of all training samples to test samples are calculated,
ii. Choose K-closest neighbor to the sample
iii. Determine the majority of the sample.

EXPERIMENTAL WORK

The intact experimental study was carried out using Color Feret database. The Age group classification is considering 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. It is widely used pre-processing techniques in which the image intensities are adjusted. Facial features extraction is done by the enhanced facial images using Active Appearance Model. but the dimensions of the images are not totally reduced, Sammon's mapping methods is to used reduce the dimensions of the facial images of age group classification. Finally the facial images are classified into three age groups using K-Nearest Neighbor classify technique.



(a) (b) (c) (d)

Figure 3. (a) Cropped image (b) Image after Gamma Correction (c)Image after Dog Filtering (d) Image after Contrast equalization

Figure 4. Feature Extraction using AAM

	Mean Value	Entropy	Max value
ADOLESCENCE	26.9477	16.0153	16.2604
	0.9258	0.7733	0.7334
	248	232	240

	Mean Value	Entropy Value	Max value
ADULT	17.8941	20.2619	17.4960
	0.7879	0.8262	0.7741
	240	240	248

	Mean Value	Entropy Value	Max value
SENIOR ADULT	18.3570	18.8186	21.5598
	0.7998	0.8095	0.8931
	248	240	248

Data BaseFeatures	91.9579	86.2273	89.0522
	82.9295	87.0294	86.5427
	85.6646	88.7567	90.1510

Figure 5. Mean, Entropy and Max-Intensities values of Images

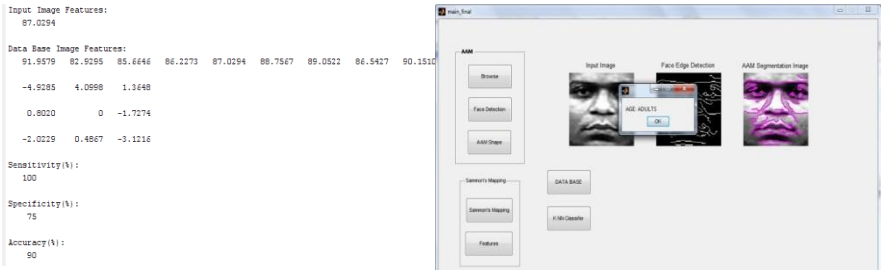


Figure 6. KNN Classifier Analysis

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'sMap. 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, noise, 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.

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