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AGE ESTIMATION IN FACIAL IMAGES USING HISTOGRAM EQUALIZATION

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ABSTRACT: The digital world draws sensitive attention in the field of face recognition and facial age estimation. Despite of various transpiring researches in this domain, invigoration is indeed required. With respect to various challenges, the estimation of age requires consideration of several aspects. The estimation of age can be refined by considering both geometrical measures and texture analysis. The steps to be followed are normalization, face cropping, filtering, feature extraction and finally classification to provide the refined age of the face image. The normalization of face is done using histogram equalization to study the intensity component. From the image the face is cropped. The median filter is applied on the image to detach noise in the image and to maintain the edge details. The requisite features are extracted from the image such as geometric measures, texture details. The structure of texture features and the intensity transitions are analyzed. With these descriptors, the age of the image is classified.

1.INTRODUCTION

As an important biological information carrier, the human face reflects lots of properties such as identity, age, gender, expression, and emotion. With the passage of time, the facial appearance changes as human aging, which indicates human behaviour and preference. Although different people are aging differently and aging shows various forms in different ages, there are still some general changes and resemblances we can always describe [1]. Human age can be directly inferred by distinct patterns from the facial appearance. For the same person, the photos taken at different years reveal the aging process on their faces. Age information plays an important role in human computer interaction and Artificial Intelligence systems and shares many in other face-related tasks such as face detection and recognition. Image based human age estimation has wide potential practical applications, e.g., demographic data collection for supermarkets or other public areas, age-specific human computer interfaces, age-oriented commercial advertisement, and human identification based on old ID-photos. Estimating age from images has been historically one of the most challenging problems within the field of facial analysis. With the rapid advances in computer vision and pattern recognition, computer-based age estimation on faces becomes a particularly interesting topic. However, human estimation of facial age is usually not as accurate as other kinds of facial information such as identity and gender. It is very challenging to accurately predict the age of a given facial image because human facial aging is generally a slow and complicated process influenced by many internal and external factors.

In recent years, the interest in human facial age estimation has significantly increased [2]–[6]. A typical pipeline of the existing methods for age estimation usually consists of two modules [7]: (1) extracting image features/representations for age, and (2) learning an age estimator with these image features. Various facial age features have been developed for facial age estimation.

Among them, biologically inspired features (BIF) proposed by Guo et al. [8] shows the best performance on age estimation and has been wildly used. With the obtained image features for age, various methods have been proposed to learn an age estimator. In most of these methods, age estimation is regarded as either a classification problem [9] or a regression problem [10]. Recently, deep learning schemes, especially Convolutional Neural Networks (CNNs), have been successfully employed for many tasks related to facial analysis, including face detection, face alignment [11], face verification [12], and demographic estimation [13]. Wang et al. [14] extracted feature maps obtained in different layers as age features based on the deep learning model. Huerta et al. [4] provided a thorough evaluation on deep learning for age estimation and compared it with the hand-crafted fusion features.

2. LITURE SURVEY

Human age estimation using biometric features has wide range of real -world application in law enforcement, security control, and human computer interaction. However, despite advances in automatic age estimation, itremains a challenging problem. Age estimation is challenging due to age progression, extracting these features accurately are very important for better performance. One of the most successful works is based on biologically inspired features (BIF). In this work we extend BIF by automatic initialization and extracting fine details of facial features using active appearance model (AAM) and analyzing a more complete facial area by including the forehead details.

Estimating the age of a human from the captured images of his/her face is a challenging problem. In general, the existing approaches to this problem use appearance features only. In this paper, we show that in addition to appearance information, facial dynamics can be leveraged in age estimation. We propose a method to extract and use dynamic features for age estimation, using a person's smile. Our approach is tested on a large, gender-balanced database with 400 subjects, with an age range between 8 and 76. In addition, we introduce a new database on posed disgust expressions with 324 subjects in the same age range, and evaluate the reliability of the proposed approach when used with another expression. State-of-the-art appearance-based age estimation methods from the literature are implemented as baseline. We demonstrate that for each of these methods, the addition of the proposed dynamic features results in statistically significant improvement. We further propose a novel hierarchical age estimation architecture based on adaptive age grouping. We test our approach extensively, including an exploration of spontaneous versus posed smile dynamics, and gender-specific age estimation

The main challenges of age estimation from facial expression videos lie not only in the modeling of the static facial appearance, but also in the capturing of the temporal facial dynamics. Traditional techniques to this problem focus on constructing handcrafted features to explore the discriminative information contained in facial appearance and dynamics separately. This relies on sophisticated feature-refinement and framework-design. In this paper, we present an end-to-end architecture for age estimation which is able to simultaneously learn both the appearance and dynamics of age from raw videos of facial expressions. Specifically, we employ convolutional neural networks to extract effective latent appearance representations and feed them into recurrent networks to model the

temporal dynamics. More importantly, we propose to leverage attention models for salience detection in both the spatial domain for each single image and the temporal domain for the whole video as well. We design a specific spatially-indexed attention mechanism among the convolutional layers to extract the salient facial regions in each individual image, and a temporal attention layer to assign attention weights to each frame. This two-pronged approach not only improves the performance by allowing the model to focus on informative frames and facial areas, but it also offers an interpretable correspondence between the spatial facial regions as well as temporal frames, and the task of age estimation

3. EXISTING SYSTEM

In existing Different types of method are implemented. Face recognition (principal component analysis (PCA), LDA, ICA) to assess the feasibility of real world face recognition.

One of the important technique of recognition is template matching in which a template to recognize is available and is compared with already stored template. In our approach PCA method for feature extraction and matching is used. Principal Component Analysis: PCA is used to reduce the dimensionality of the image while preserving much of the information. It is the powerful tool for analyzing the data by identifying patterns in the dataset and reduces the dimensions of the dataset such that maximum variance in the original data is visible in reduced data.

PCA was invented by Karl Pearson in 1901. It works by converting set of correlated variables to linearly uncorrelated variable called principal components. Principal components are calculated by computing Eigen vectors of covariance matrix obtained from the group of hand images. The highest M eigenvectors contains the maximum variance in the original data. These principal components are orthogonal to each other and the first component is in the direction of greatest variance.

We can use PCA to compute and study the Eigenvectors of the different pictures and then to express each image with its principal components [9] (Eigenvectors). It is a way of identifying patterns in data, and expressing the data in such a way as to highlight their similarities and differences. First of all, we had to create the data set. The aim is to choose a good number of pictures and a good resolution of these in order to have the best recognition with the smallest database. Then, the next step is to subtract the mean from each of the data dimensions. The mean subtracted is simply the average across each dimension. The step three is to calculate the covariance matrix of the database. We could not calculate the covariance matrix of the first matrix, because it was too huge. So we had to find a way to find out the principal eigenvectors without calculating the big covariance matrix. The method consists in choosing a new covariance matrix.

4. PROPOSED SYSTEM

Feature extraction based face recognition, gender, and age classification is proposed in proposed that the frontal face view form an isosceles triangle combining the two eyes and mouth. This isosceles triangle is quite useful for face recognition and age range estimation. The face triangle is unique for every person and this face triangle can be used for face recognition with age.

The face images of 50 persons are captured by means of a digital camera (NIKON Coolpix L10). This paper proposed a novel and effective age group estimation using face features from human face images. This process involves three stages: Pre-

processing, Feature Extraction, and Classification

The proposed steps in estimating the age from the facial image is as illustrated by The input image is first normalized. Only when the image is normalized, the processing of the image yields satisfied results. This is achieved using histogram equalization. The face is then cropped from the image using Viola jonescascade object detector. After cropping the face, median filtering is applied to the face to avail smoothened image with fine edge details. From the filtered image, the required features are extracted using SFTA & LDN. The age group is then classified using DNN method.

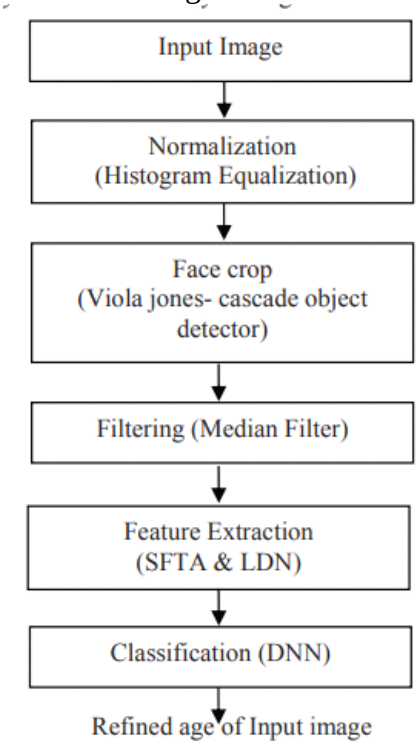

Fig 1: Steps for estimating the age from the given facial image.

Normalization

The input image is first normalized. Normalization is an indispensable process in image processing because only by normalizing the image the range of pixel intensity values are changed according to the requirement of the algorithm. The illumination flaws in the images are rectified for example poor contrast due to glare, are enhanced to bring the contrast of the image to the required range. Normalization is just contrast stretching or histogram stretching or dynamic range expansion. In this paper we use histogram equalization method to increase the contrast of the image. So the distribution of intensity is surpassed. The global contrast of the image is enhanced to higher contrast. The higher contrast eases feature extraction. The most frequent intensity values are effectively spread out. Histogram equalization works well in grey scale images .Normally histogram equalization when applied on color(RGB) images, the contrast stretching is performed on all the three bands R,G and B .Performing equalization on all three components independently may not enhance the image. The effects of histogram equalization may thrust undesired upshots in case of color images. This deleterious effects can be circumvented by using color histogram equalization in our paper.

Fig 2: Histogram equalization of a given input image

The input image is converted from RGB to HSI image. The intensity value of the image alone is enhanced while preserving the hue and saturation values. The enhanced image is then converted to color image. This is a fair straightforward technique and an invertible operator

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Face detection is done by the Haar algorithm proposed by Viola and Jones in 2001. This is based on machine learning. A special function is conditioned using negative and positive images. Open CV holds several pre-trained classifiers for face, eyes, smiles, etc. For our system we have created an eye and mouth detector. When the face is detected, the facial landmark identification

The face image of a person is captured by a digital camera as shown in Fig. Crop the detected rectangular face area as shown in Fig. using Matlab in-built object function

Fig 3: cropping of the image

Filtering

The next step is filtering which is used to smoothen the image. This is also an inevitable pre-processing step to facilitate further processing. Weiner Filters involves noise smoothening and is inverse filtering. Adaptive filter requires high computation time. Anisotropic filter preserving the edges of the object but lacks in reducing the noise. While smoothening the image, it is very much important to preserve the edge details. Only using the edge detection the features can be extracted from the image. Feature extraction plays a vital role in age detection from the facial images. Only when the appropriate features are detected from the image, the estimation of age is accurate. We have used median filter in our paper. In median filtering, the neighboring pixels are ordered according to the intensity value and the median value becomes the intensity value of the centre pixel. The intensity value of the neighbor window are also ordered as per the intensity order and again the median value is assigned as the next centre value. Without blurring the image, the edge details are preserved and noise is removed even for images which are distorted by defective pixels. The actual value of noise does not affect the median value as in. The Fig elucidates the significance of median filter.

Fig 4: Median filter applied on the image

Features extraction

The most important stage of any image processing is feature extraction. In case of facial age estimation , it is the feature extraction that magnifies the accuracy[15][18] in estimating the age. The features that are required for the processing are extracted using [8] Segmentation based Fractal texture analysis and Local directional number. The input image is fragmented into a group of binary images. From binary image the fractal dimensions of each group is calculated to arrive the texture pattern. The fragmentation of the input image is achieved by Two-Threshold Binary Decomposition(TBD) algorithm.

SFTA extracts texture

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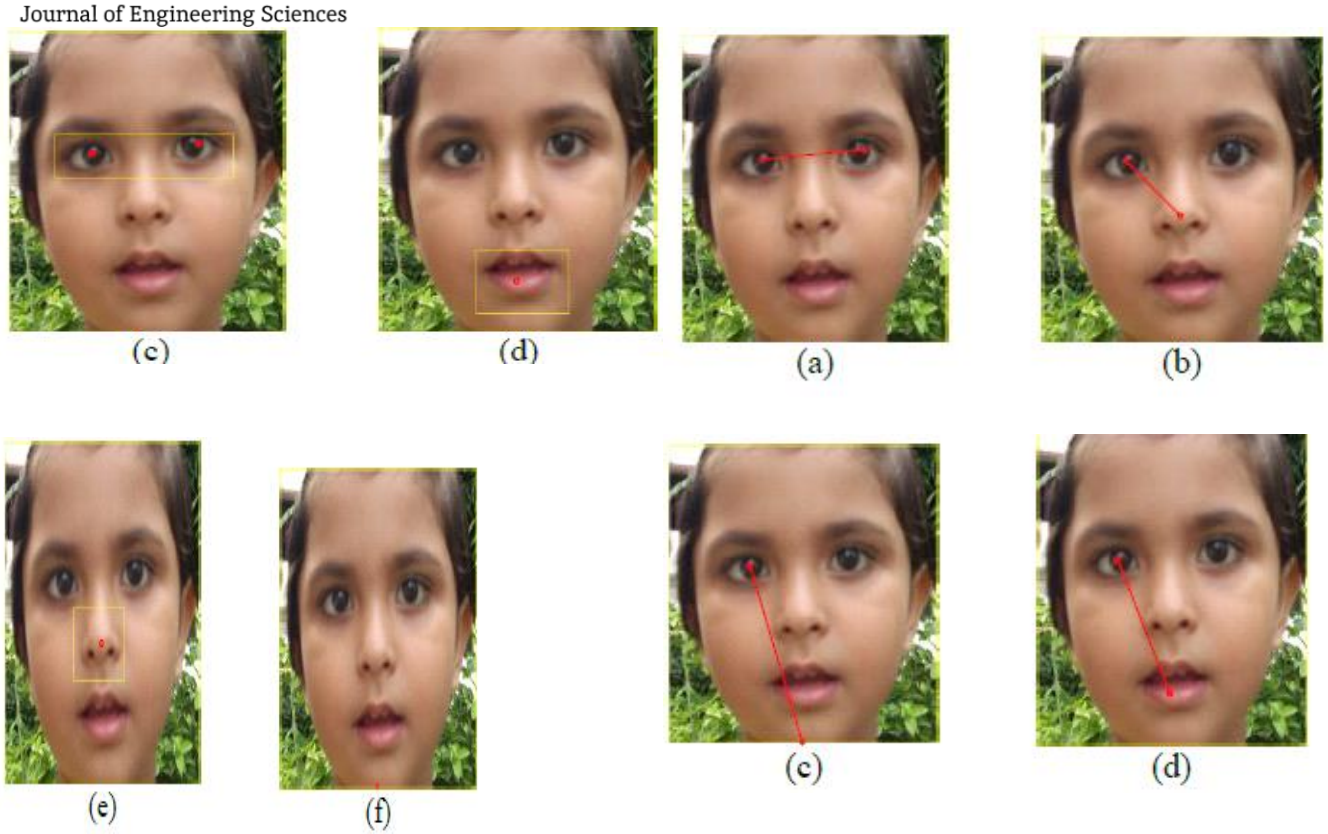

Fig 5: (a) Face image (b) Cropped face image (c) Eye pair detected image (d) Mouth detected image (e) Nose detected image (f) Chin detected image

A combination of global and grid features are extracted from face images. The global features such as distance between two eye balls, eye to nose tip, eye to chin, and eye to lip is calculated in Fig. 2. Using four distance values, four features F1, F2, F3, and F4 is calculated as follows:

F1 = (distance from left to right eye ball) / (distance from eye to nose)
F2 = (distance from left to right eye ball) / (distance from eye to lip)
F3 = (distance from eye to nose) / (distance from eye to chin)
F4 = (distance from eye to nose) / (distance from eye to lip)

Fig 6: Distance between (a) two eyeballs (b) eye to the nose tip (c) eye to chin (d) eye to lip

Using the Grid features of face image, feature F5 is calculated. It is entirely based on wrinkle geography in face image. The grid feature includes forehead portion, eyelid regions, upper portion of cheeks and eye corner regions as shown in Fig. 3(a). To calculate feature F5, the following steps have to be followed: The color face image is converted into gray scale image. Then canny edge detection technique is applied on gray scale face image. It gives a binary face image with wrinkle edges as shown in Fig. 3(b). The white pixels of the wrinkle regions in Fig. 3(b) give wrinkle information in the face image. (a)

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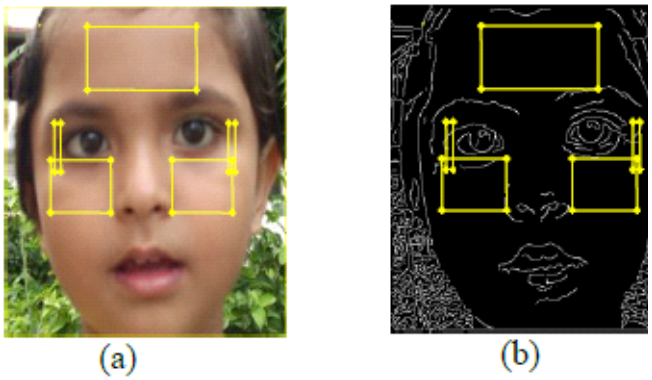
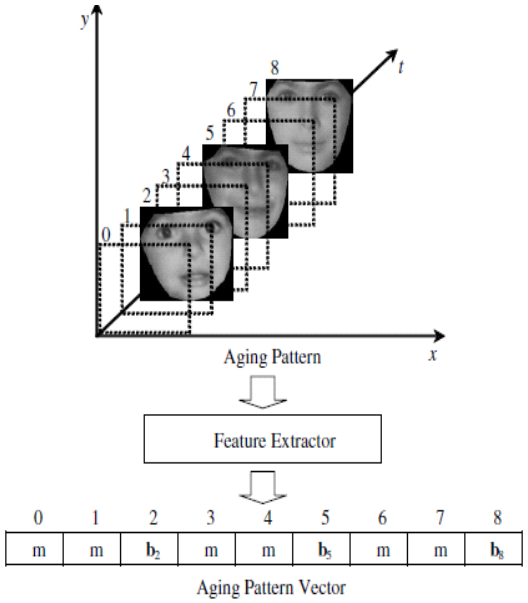


Fig 7: (a) Grid features region of face image (b) Canny edges of face image

Facial Aging Patterns for Automatic Age Estimation Aging Pattern Vector

An aging pattern is a sequence of personal face images sorted in time order. If age estimation is regarded as a conventional classification problem, then one straightforward way is to model face images at each age. The problem is that different persons age in different ways. 'Age' is a relative concept specified toeach person. Thus a face at a particular age is more related Two keywords in this definition are 'personal' and 'time'. All face images in an aging pattern must come from the same person, and they must be arranged by time



Learning the Aging Pattern Subspace

A representative model for the aging patterns can be built up by the information theory approach of coding and decoding. One widely adopted technology is using PCA

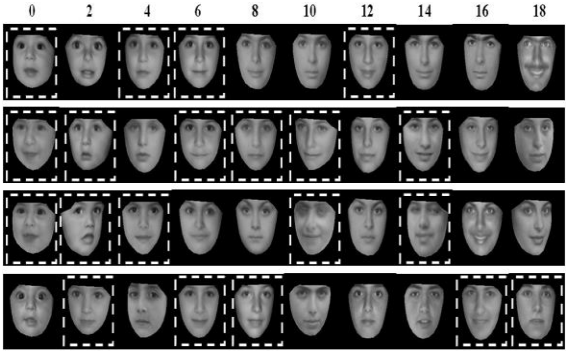


Figure 8: 'Full-filled' aging patterns. Flowchart of age estimation in AGES

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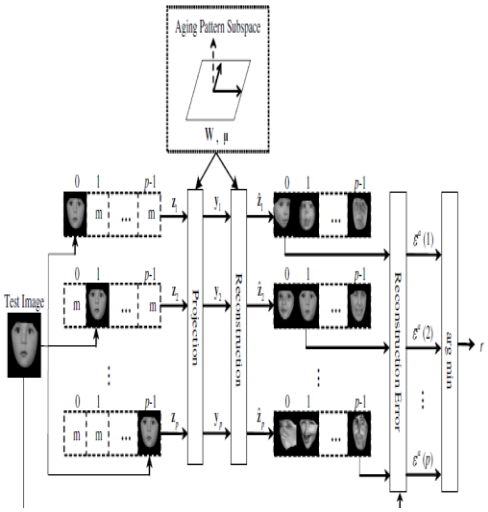
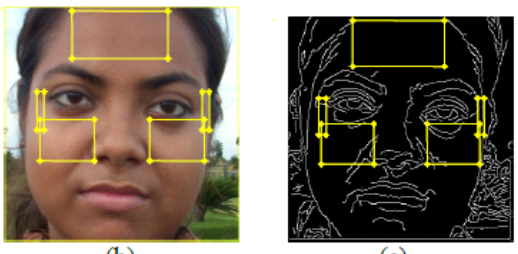


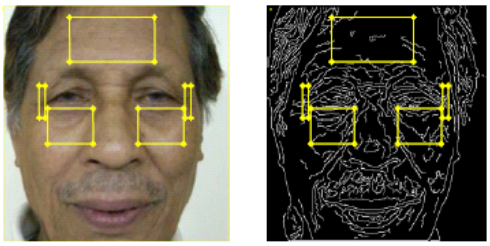
Flowchart of age estimation in AGES

In binary image white pixel is represented by 1, and black pixel is represented by 0 as shown in Fig. 3(b). So, sum of wrinkle region in binary face image is more when more wrinkle present in the face as shown in Fig. 4. Wrinkle feature signifies age of a person. Feature F5 is calculated as follows:

F5= (sum of pixels in forehead region / number of pixels in forehead region) + (sum of pixels in left eyelid region / number of pixels in left eyelid region) + (sum of pixels in right eyelid region / number of pixels in right eyelid region) +(sum of pixels in left eye corner region / number of pixels in left eye corner region) + (sum of pixels in right eye corner region / number of pixels in right eye corner region)



(b) (e)



(c) (f)

Fig 9 : (a), (b), (c) Wrinkle region features of face (d), (e), (f) canny edges of respective face

The feature vector giving the texture details are computed. To achieve better accuracy, the input image is converted to a grayscale image. The structure of the texture and its intensity transitions is obtained by Local Directional Number Pattern (LDN) which is a six bit binary code assigned to each pixel of an input image. LDN encodes the directional information of the face in the image. The face is divided into regions and LDN features are extracted from them. These features are concatenated into a feature vector and is used as face descriptor

***Classification*:**

Classification is the final step which provides the refined age of the person from the facial image. Neural networks are great technique to handle many difficulties in the field of image recognition, speech recognition and natural language processing. The biologically inspired features are fed in the database and the software is tuned to learn features from the observed data. In this project we used Deep Neural Network (DNN) for classification. DNN depicts large set of functions than shallow networks and aids easy decompositions. In deep neural network the first layer groups the pixels in the image facilitating detection of edges and the second layer groups together the edges. The efficiency of deep neural networks is enhanced by using four layered DNN and increasing the size of data by collecting over 1000 images and the ages are also labeled.

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5. RESULT

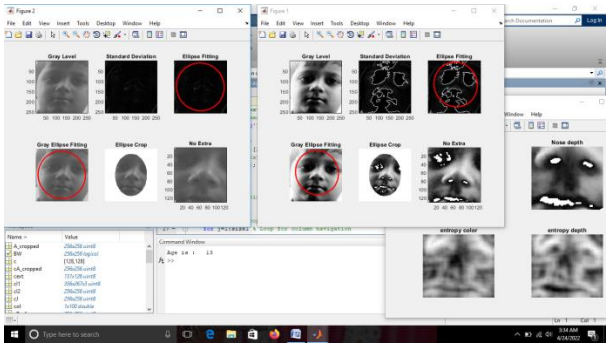

Fig 10. Output Image

6. CONCLUSION

In this paper we have analyzed the various challenges in facial age estimation and the steps to estimate facial age. The algorithm works very well for all the images irrespective of illumination and quality of the image. This amelioration is achieved by extracting the features after normalization. The algorithm has been tested for over 500 images and the age has been accurately estimated for all the tested image. The age groups used were about 6 groups and accuracy is achieved in these groups. Further enhancement of this algorithm is to achieve better accuracy by increasing the number of age groups and measure the efficiency of the algorithm by directly accessing various open CDN for input images instead of restricting to training set inputs.

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