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A Comprehensive Study on Identification of Human Age Face Features

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Abstract*—*Research on age estimation draws more attention, face recognition is challenging and interesting. Facial images provide a lot of information such as age gender etc., Appearances of facial images are different from person to person, eyes are used for extracting gender and facial expression. Age estimation methods are tested on predefined or existing facial image. Age estimation is divided into two categories; classification based and regression based. Applying of the existing methods on facial images the results differ to equipment used such as phone, camera, laptop and the quality of the camera used to capture the facial image. Facial age feature helps in finding the missing persons. Human age estimation also helps in employments to find the person's age for retirement. This paper gives the identification of human age estimation through facial features.

Keywords*—*age estimation, facial images, facial expressions, identification, facial features.

I. INTRODUCTION

Facial images provide a lot information such as gender, age, facial expression and personal identity. Expressions and eyes are also used for extracting age, but in many cases it is hard to estimate person age based on facial image. The accurate estimation of age is hard because of shape and texture. Facial images differ from person to person and on individual bones that are affected by changes in expression, speaking and age progression, as well as lighting variations (El Dib., et al., 2011). Some of the existing work on the facial aging progress, originating from psychological and biological studies. Despite that some existing works provide accurate method for estimating people age, age estimation methods is categorized into two groups; classification based (Ylioinas, J., et al. 2012) and regression-based (Rusek, K. and P. Guzik 2016).. More generally, humans quickly estimate each other's gender, age, and identity through the appearance of the other person's face in order to select different social styles. Age estimation methods are tested on facial images that are captured with high performance camera and the well-known predefined dataset such as FG-NET database or MORPH. The facial image that captured by low quality camera such as laptop camera or smart phone camera gives different results when applying existing methods. Some of existing techniques can be used for authenticating persons based on their facial image. The most known

biometric modalities, focused on fingerprints, face features (Prakash and R. Dhanalakshmi., 2015) iris and handwritten signature. Compared with other approaches, such as fingerprint recognition, handwriting verification and retinal and iris scanning, face recognition is more straightforward, user friendly and extensively used. The features such as flow-type learning, feature-based dimensionality are used to construct face age features. The most effective methods for face feature extraction is Bioinspired features(BIF). The Gabor filter with different scales and directions is used to convolute face features.

II. AGE ESTIMATION FROM FACES

Classification of age estimation is categorized into classification or regression.

Classification:

Evaluated the performance for each category of age estimation, such as Artificial Neural Network (ANN), nearest neighbor classifier (Lanitis, A., et al. (2004). The AAM method is used for the representation for the face images. This function is used to relate the face representations to age labels and is also called as quadratic function classifier. The proposed author suggested that first do the clustering process and then refining process for the age estimation in a hierarchical fashion.

Regression:

By considering age estimation is a regression problem, (Lanitis, A., et al. (2004) investigated three formulations for the aging function i.e. linear, quadratic and cubic. Inspired from the Lantis's work, multiple linear regression function is used to fit the CEA aging manifold, this function results in the improvement over of the existing techniques.

Facial images using histogram of oriented gradients (HOG) (Y. Fu and T. S. Huang). ROC build a region of certainty (ROC) to link uncertain shape features with surface features (K-H Liu., et al. 2014).

III. FACIAL FEATURE EXTRACTION TECHNIQUES

Face feature extraction, extracts features of human face with different models. The combination of Active appearance model(AAM) and principal component model(PCA) replaces the face geometry characteristics for age estimation.

A. Active Appearance Models (AAM)

According to (Chao, W.-L., et al. 2013) active appearance models (AAM) is the most popular feature extraction technique which takes into account both facial shape and textures. AAM mainly uses age estimation as global features as they offer a huge amount of information relating to the appearance and shape of a face than local features. AAM is mainly based on grey scale so that the average global feature is extracted without effecting the textures information for faces. The AAM

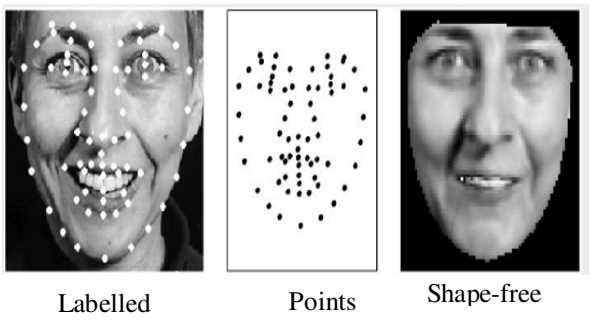

Figure 1 graphical representation of the AAM and the require a training set of annotated images combines shape variation and appearance variation of facial image in a shape normalized frame. This feature requires accurate key point and location technology.

B. Aging pattern subspace

An aging pattern is defined as the sequence of face images coming from the same person. The aging pattern of the face images of all ages are available for all individuals is called as complete age patterns, otherwise it is called as incomplete age pattern.

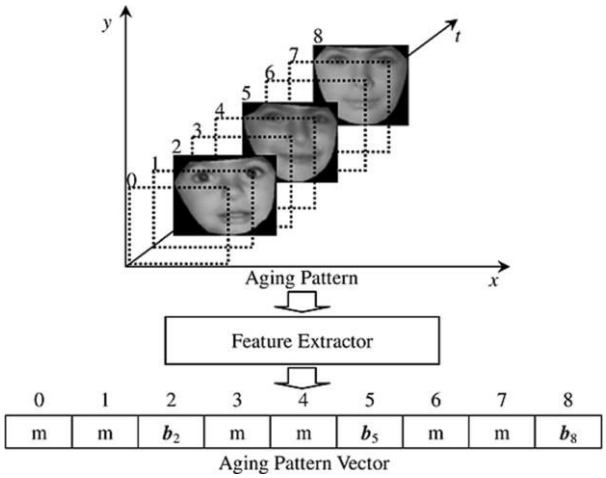

Figure 2 Aging pattern vectorization. Age is marked at the top-left corner of the corresponding feature

This aging method is works in two stages: the learning stage and the age estimation stage. In the first learning stage, PCA technique is used to obtain subspace representation.

C. Local binary patterns (LBP)

Local Binary Pattern (LBP) introduced for texture analysis. According to (T. Ojala., et al. 1996), LBP has a powerful approach to describe local structures of an image. LBP's tolerance to monotonic illumination variations and its computational simplicity have made it a popular technique for facial

images' feature analysis in recent years as stated, especially in facial expression recognition. attempted to use different approach by extract micro textures using the multiscale local binary patterns (LBP) (D Huang., et al. 2011)

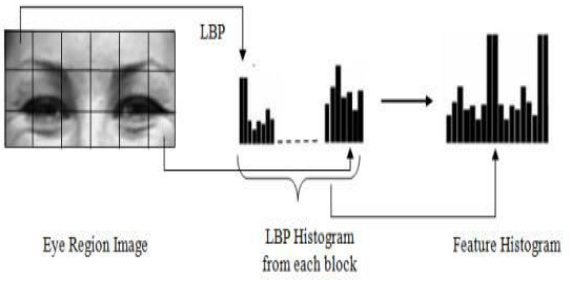

Figure 3 An example shows the eye regions after dividing the eye area into 3X6 small regions, the LBP histogram

The idea is based on quality of the image and assessed, the characterization of printing artifacts and varies in light reflection. Maatta and Hadid tried to detect spoofed face from the texture. They presented a novel approach based on analyzing facial image textures for detecting whether there is a live person in front of the camera or a face print. The proposed approach analyzes the texture of the facial images using multi-scale local binary patterns (LBP).

D. Appearance Models

The facial feature extraction is focused by appearance model. There are two types of features in age estimation systems (i) global feature and (ii) local feature. Semantic level was for facial features and gender estimation was to improve age estimation. Aging patterns are different for male and female. To extract feature spectrum from facial appearance by using FFT and Genetic algorithm is used for feature selection (H Takimoto., et al., 2007).

E. Hybrid Models.

Models that combine together to form a hybrid modeling technique is to share and apply the strengths of these technique. By combining different techniques, the accuracy for age estimation not only improves but will be robust. The combination can be in either hierarchical or parallel manner and results for final age estimation.

IV. CLASSIFICATION OF FACIAL IMAGES

A. *Extended Curvature Gabour(ECG)*

Age estimation uses Extended Curvature Gabor (ECG) (Jiwhan Kim., et al. 2015) decreased the complexity of computational by using feature selection and demonstrated the effectiveness of ECG features simultaneously.

B. *Support Vector Machine(SVM)*

Support Vector Machine (SVM) was experimented and shown efficient for age classification (Aparna Asthana., et al. 2015). A Support Vector Machine (SVM) is a supervised machine learning algorithm that can be employed for both classification and regression purposes. SVMs are more commonly used in classification problems and as such, this is what we will focus on in this post. This method is to classify human facial images based on the age features. Pattern recognition can be used to extract facial features.

C. *Pesudo Zernike Moment (PZM)*

Recently, a novel method was proposed a novel method for estimating facial age that is Pesudo Zernike Moment (PZM) (Nasim Borzue and Karim Faez., 2015). Pseudo-Zernike Moment (PZM) and artificial neural network (ANN) was combined within the hybrid architecture for face recognition. Improved PZM was used to extract face feature, and encoded to form the input vector sending to ANN. Experimental results demonstrate the present approach taking advantage of ANN, basically eliminates the effects of the change of face scale and rotation, and has better robust to variation of illumination, pose and facial expression.

D. *Deep Convolutional Neural Networks*

Another recent work proposed an unconstrained age estimation system by using Deep Convolutional Neural Networks (DCNN) (Rajeev Ranjan., et al 2015). Convolutional neural networks are deep artificial neural networks that are used primarily to classify images (e.g. name what they see), cluster them by similarity (photo search), and perform object recognition within scenes. They are algorithms that can identify faces, individuals, street signs, tumors, platypuses and many other aspects of visual data. FG-NET. This is an ageing database was used for carrying out research in various disciplines including age estimation, age-invariant face recognition and age progression.

E. *Principal Component Analysis (PCA)*

The PCA is a tool which effectively reduces the dimensions by compressing the image without losing the data.

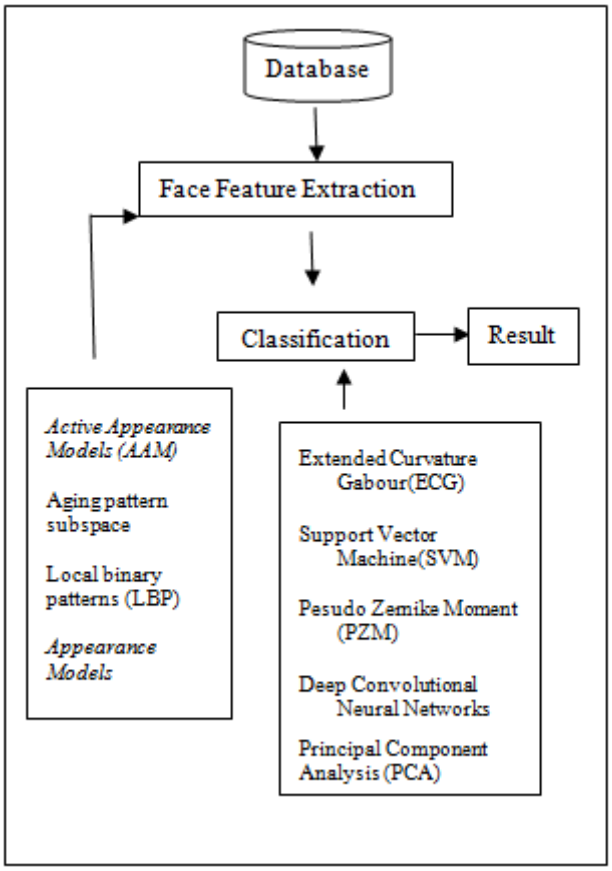

Figure 4 Face Feature Extraction techniques combined with classification methods.

Figure 4 shows the combination of face feature techniques to produce the results.

V. MATERIALS AND METHODS

A. *Materials*

The materials that can be used to capture facial images are smartphone, dataset, laptop, webcam, camera.

B. *Methods*

- Low Level methods: It includes corner detection, ridge detection, Blob detection, Edge detection.
- Image Motion approach: It includes area base, motion flow, optical flow etc.,
- Shape Based approach: It includes Template matching, Blob extraction, Circles, arbitrary shapes, cluster detection, class variables etc.,
- Flexible methods: Parametrized shapes and active contour models.

- Knowledge-Based approach: It relies on human face. It concerns on parts of the face, color edge direction.
- 3D Vision-Based approach: The 3D models give more information and possibilities than 2D image. It more popular.

VI. CONCLUSION

This paper gives a survey on facial age features, age estimation methods. The different facial extraction methods are explained. These methods can be applied to various applications.

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