Review of Human Age Prediction using Facial Images

Prof. D. R. Thakare[1], Prof. C. R. Ghuge[2]

1,2 Lecturer, Computer Department, Guru Gobind Singh Polytechnic, Nashik .

Abstract

Human face is one of the most key sources of the information, which can be utilized for personal proof and identification. This paper discusses the method of finding the human age using the facial image of a person. It has many actual world applications like human computer interaction, internet security, multimedia communication, vending machines etc. During growth, aging is affected in two main forms, one is the size and shape variation and the other is the textural variation. In this paper, we use the textural variation of the face during the growth, which appear more in the adulthood in the form of wrinkles. Areas of the face where these textural differences occur more are identified, like forehead, cheeks, regions around eyes etc. Studying these areas, the human age is identified and classified. Here we use the method of Hough Transform for feature extraction and Polynomial Regression for age classification.

Keywords-Color *Models; Feature Extraction; Geometrical Feature Extraction; Hough Transform; Illumination Normalization; Polynomial Regression; Textural Feature Extraction*

I. Introduction

You can never see the same face twice. This statement is true because facial arrival varies more dynamically as it is affected by several factors including pose, facial expression, head profile, illumination, aging, occlusion, mustache, beards, makeup (cosmetics), and hair style. Major factors that influence facial aging include gravity, exposure to ultraviolet (UV) rays from the sun, maturity of soft tissues, bone re-structuring, and facial muscular activities [1]. These factors cause variations in face appearance. For instance, a face seen in blue light illumination is totally different from one seen under red light illumination. Another factor that constantly and permanently causes variations in facial appearance is age. Aging is an inevitable stochastic process that affects facial appearance. Aging involves both variations in soft tissues and bony structure on the human face. A face seen at one age is totally different from the face of same separate at a different age. Therefore, these age-introduced variations could be learned and used to estimate facial age.

Human face has lot many features hidden in it which can be exploited for determining the identity of the person, age of the person, gender

of the person etc. The proposed system is used to determine the human age. It has so many real world applications. The first and the main is in the internet usage. There are so many sites available nowadays which should not be allowed to access by children. Likewise vending machines. There are so many vending machines which lends drug related items like cigarettes, alcohols etc which should atleast be not allowed to use by children. These systems are only examples which can make use of the proposed system. If these applications capture the image of the user and will be allowed to proceed only if the calculated age of the user is above an age limit, we could solve the problem to a limit.

The age and gender of a person is categorized by visual observation of images, where it is difficult in the computer vision. The face is recognized by considering features like eye distance, nose length, lip distance etc. The gender is classified by determining the features like mustache region, eye distance, total number of pixels of skin color etc. The age is identified using forehead region, right and left cheeks, eyelid region etc. As our aim is to determine the age of a person, we can concentrate on the features that can be extracted for age estimation. As we all know, age of a person affect his face in two main forms. One is the Geometrical Feature Variation where the size and shape of the face changes as he grows. If we use this information of the face, we can see that this change is gradual and most of the size variation stops at certain age. Even worse condition occurs in some case where the facial size gradually decreases when he reaches the old age. So using this method of Geometrical Feature Variation is challenging. But of course, this method can be used to classify the age broadly into three main classifications like baby, youth and adult. Another method is Textural Variation method, where the human skin texture is affected as he grows. Of course, as we can see, from the very birth till the death of a person, his skin texture is gradually affected, although it is visible strongly during adulthood. So for our method of human age prediction and classification, we use the textural variation method.

II. Existing Methods

Age classification algorithms were first detailed and developed by Kwon and Lobo [8].They classified facial images to three age groups: babies, young adults, and senior adults. They utilized geometrical ratios to distinguish babies from two other groups after the facial features have been located. The results have shown that the performance to classify babies were less than 68%. Next, young adults were distinguished from senior adults by utilizing energy functions and so-called snakelets.In [1], authors proposed a new framework for face-image-based automatic age estimation. A manifold learning method was introduced for learning the low-dimensional age manifold. The Support Vector Machine and Support Vector Regression methods were investigated for age

prediction based on the learned manifolds. To improve the age estimation performance and robustness, a Locally Adjusted Robust Regressor (LARR) was also designed. Anil Kumar Sao and B. Yegnannarayna [6] proposed analytic phase based representation for face recognition to address the issue of illumination variation using trigonometric functions. To decide the weights to the projected coefficients in template matching, eigen values were used. Authors in [4] combined the local and holistic facial features for determining the age. They used combined features that roughly classify a face as young (0-20) or adult (21-69). In most of the previous studies the age groups are not arranged properly. Another related work in the age estimation selects discriminative features to estimate face age. Primary studies on age estimation coarsely divided human faces into groups based on facial and marks and wrinkles. Most recent approaches considered the continuous and temporal property of face age and formulated age estimation as a regression problem. Researchers explored different features, including AAM coefficients, image intensities features designed heuristically, and adopted various regression methods, such as quadratic function, piecewise linear regression, multi perceptron projection, etc. differently from the above mentioned methods.Geng [7] defined an aging sequence as an aging pattern and estimated age by projecting a face instance onto appropriate position of a proper pattern [11]. In [2], the authors use the anthropometric models for determining the age of facial images. Their approach demonstrates that precise feature selection can help classifiers to categorize the images with high accuracy. They use geometrical ratios calculated based on the distance and the size of certain facial features to distinguish age groups. They evaluate the age differentiation capability of the individual features and various combinations of the features using three different classifiers, namely, neural network classifier (NNC), Support vector classifier (SVC), and normal densities-based linear classifier (LDC).In [3], the author proposed automatic age estimation of aging effects on face image. The age group labeling was based on the training data and testing data on 720 and 580 images respectively. The facial feature was
extracted based on the geometric feature based method and principal component analysis (PCA) method. Based on the study we could conclude that there can be three methods of classifications for age determination. First method, called Geometrical Variation extraction appr oach, which exploited the fact that geometrical ratios of human face changes as he grows from childhood to adulthood. Second method is Textural Variation extraction method, which exploited the act that facial skin texture changes gradually from childhood to adulthood. Third method utilized a combination of the above two methods.

III Age Features Attribute

Facial Aging:

Aging is a stochastic, uncontrollable, inevitable, and irreversible process that causes variations in facial shape and texture. Although aging is stochastic with different people having different aging patterns, there are some general variations and similarities that can be modeled [12, 13]. There are two stages in human life that are distinct with regard to facial growth: formative or childhood stage and adulthood or aging stage [14].Aging introduces significant change in facial shape in formative years and relatively large texture variations with still minor change in shape in older age groups. Shape variations in younger age groups are caused by craniofacial growth. Craniofacial studies have shown that human faces change from circular to oval as one ages. These changes lead to variations in the position of fiducially landmarks. During craniofacial development, the forehead slopes back releasing space on the cranium. The eyes, ears, mouth, and nose expand to cover interstitial space created. The chin becomes protrusive as cheeks extend. Facial skin remains moderately unchanged than shape. More literature on craniofacial development is found in.As one ages, facial blemishes like wrinkles, freckles, and age spots appear. Underneath the skin, melanin-producing cells are damaged due to exposure to the suns' ultraviolet (UV) rays. Freckles and age spots appear due to overproduction of melanin. Consequently, light-reflecting collagen not only decreases but also becomes non-uniformly distributed making facial skin tone non-uniform. Parts adversely affected by sunlight are the upper cheek, nose, nose bridge, and forehead. The most visible variations in adulthood to old age are skin variations exhibited in texture change. There is still minimal facial shape variation in these age groups. Biologically, as the skin grows old, collagen underneath the skin is lost. Loss of collagen and effect of gravity make the skin become darker, thinner, leathery, and less elastic. Facial spots and wrinkles appear gradually. The framework of bones beneath the skin may also start deteriorating leading to accelerated development of wrinkles and variations in skin texture. More details about face aging in adulthood is found in . These variations in shape and texture across ages could be modeled and used to automatically estimate someone's age. We refer readers to for more details on facial aging. Facial aging has three unique attributes:

1.Aging is inevitable and uncontrollable. No one can avoid aging, advance, or delay it. The aging process is slow but irreversible.

2.Aging patterns are personalized. People age differently. Individuals' aging pattern is dependent on her/his genetic makeup as well as various extrinsic factors such as health, environmental conditions, and lifestyle.

3.Achieved aging patterns are temporal. Facial variations caused by aging are not permanent. Furthermore, facial variation at a particular point in time affects future appearance and does not affect previous appearance of these faces.

These facial aging attributes, among other factors, make automatic age estimation a

difficult and challenging task. Since individuals cannot voluntarily control aging, automatic age estimation data collection becomes a hard task to do. This problem was slightly alleviated by dissemination of FG-NET Aging Dataset in 2002. Although this dataset has images of subjects at different ages, there are several missing images hence making the aging patterns incomplete. Fortunately, we do not need a complete aging face dataset since people, who computers try to mimic, also learn how to process face image patterns from incomplete patterns. Age estimation technique should be capable of considering various aging patterns since each individual has his/her own aging pattern.

IV.Age Estimation Application Areas

Characterizing variations in facial appearance across age has many significant real-world applications. Computer-based age estimation is useful in situations where one's age is to be determined. There are several application areas for age estimation including the following:

1. Age simulation

Characterization of facial appearance at different ages could be effectively used in simulating or modeling one's age at a particular point in time. Estimated ages at different times could help in learning the aging pattern of an individual, which could assist in simulating facial appearance of the individual at some unseen age. By observing aging patterns at different ages, unseen appearance could be simulated and used to find missing persons. By observing aging patterns at different ages, unseen appearance could be simulated.

2. Electronic customer relationship management (ECRM)

ECRM is the use of Internet-based technologies such as websites, emails, forums, and chat rooms, for effective managing of distinguished interactions with clients and individually communicating to them. Customers in different ages may have diverse preferences and expectations of a product Therefore, companies may use automatic age estimation to monitor market trends and customize their products and services to meet needs and preferences of customers in different age groups. The problem here is how to acquire and analyze substantive personal data from all client groups without infringing on their privacy rights. With automatic age estimation, a camera can snap pictures of clients and automatically estimate their age groups in addition to collection of demographic data.

3 Security and surveillance

Age estimation can be used in surveillance and monitoring of alcohol and cigarette vending machines and bars for preventing underage from accessing alcoholic drinks and cigarettes and restricting children access to adult websites and movies .Age estimation can also be significant in controlling ATM money transfer fraud by monitoring a particular age group that is apt to the vice. Age estimation can also be used to improve accuracy and robustness of

face recognition hence improving homeland security. Age estimation can also be used in health-care systems like robotic nurse and doctors expert system for customized medical services. For instance, a customized avatar can be automatically selected from a database for interacting with patients from various age groups depending on preferences.

4. Biometrics

Age estimation via faces is a soft biometric that can be used to compliment biometric techniques like face recognition, fingerprints, or iris in order to improve recognition, verification, or authentication accuracies. Age estimation can be applied in age-invariant face recognition ,iris recognition, hand geometry recognition, and fingerprint recognition in order to improve accuracy of hard (primary) biometric system.

5 Employment

Some government employments like the military and police consider one's age as a requirement. Age estimation systems could be used to determine age of the recruits during recruitment process. It is also a policy of several governments that employees should retire after reaching a particular age. Age estimation systems could also play a significant role in finding if one has reached retirement age.

6 Content access

With the proliferation of diverse content in televisions (TV) and the Internet, age estimation can be used to control access to unwanted content to children. A camera could be mounted on a TV to monitor people looking at it such that it switches off the TV if at a particular time unwanted content is streamed and people watching are children.

7 Missing persons

Age estimation role in age simulation go a step further in aiding identification of missing persons. Age simulation can be used to identify old people from their previous images for purposes of identification.

V. Conclusion

There are so many areas where we could make use facial image analysis, like face recognition, age detection, gender detection etc. But the area which is least exploited is age detection. Because there are so many limitations for this area. Age is affected by many factors like living place, living condition, health, use of cosmetics etc. There is also variation in male and female aging. But nowadays this is a more exploited area. We made use of textural variation of facial skin to determine the age. Comprehensive survey of various techniques and approaches used for age estimation has been presented. There has been enormous effort from both academia and industry dedicated towards modelling age estimation, designing of algorithms, aging face dataset collection, and protocols for evaluating system performance. Summarizes the findings of recent studies in age estimation, evaluation protocol used, dataset used, age estimation approach used

(regression, classification, or hybrid), and feature extraction or age face representation used.

REFERENCES

[1] Gudong Guo, Yun Fu,Charles R. Dyer, Thomas S. Huang, "Image-Based Human Age Estimation by Manifold Learning and Locally Adjusted Robust Regression", IEEE Transaction On Image Processing, vol. 17, (2008).

[2] Shima Izadpanahi, Onsen Toygar, "Geometric Feature Based Age Classification Using Facial Images", IET Conference on ImageProcessing, (2012).

[3] Hlaing Htake Khaung Tin, "Subjective Age Prediction of Face Images Using PCA", International Journal of Information and Electronics Engineering, vol. 2, no. 3, (2012).

[4] K. Luu, T. D. Bui, C. Y. Suen, K. Ricanek, "Combined local and holistic facial features for age determination", ICARCV, pp. 900-904,(2010).

[5] J. l. Suo, Song-Chun Zhu, S. Shan, and X. Chen, "A Compositional and Dynamic Model for Face Aging", IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 32, no. 3, 2010.

[6] A. K, Sao and B. Yegnannarayna, "Analytic phase-based representation for face Recognition", Seventh International Conference on Advances in Pattern Recognition, pp. 453-456, 2009.

[7] X. Geng, Z. Zhou, and K. Smith-Miles, "Automatic Age Estimation Based on Facial Aging Patterns" IEEE Trans. Pattern Analysis and Machine Intelligence, vol. 29,no. 12, pp. 2234-2240, 2007.

[8] Y. H. Kwon and N. da Vitoria Lobo, "Age classification from facial images", Computer Vision and Image Understanding Journal, vol.74, no. 1, pp. 1-21, (1999).

[9] N. Ramanathan, R. Chellappa, "Modeling Age Progression in Young Faces", IEEE Computer Vision and Pattern Recognition (CVPR),vol. 1, pp. 387-394,(2006).

[10] W. B. Horng, C. P. Lee, C. W. Chen, "Classification of age groups based on facial features", Tam kang Journal of Science and Engineering, vol. 4, pp. 183192, (2001).

[11] The FG-NET Aging Database [Online], http://www.fgnet.rsunit.com/

[12] LA Zebrowitz, Reading Faces: Window to the Soul (Westview Press, Washington DC,1997).

[13] AM Alberta, K Ricanek, E Pattersonb, A review of the literature on the aging adult skull and face: implications for forensic science research and applications. Forensic Sci. Int.172:, 1–9 (2007).

[14] LS Mark, JB Pittenger, H Hines, C Carello, RE Shaw, JT Todd, Wrinkling and head shape as coordinated sources for age-level information. Percept. Psychophys.27: 117–124 (1980)