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Study of Face Aging Effect Simulation Using Sparse Representation

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Abstract— Aging as the name suggests is the process of becoming older. In the world of photography, the face aging simulation has received rising investigations nowadays, whereas it still remains a challenge to generate convincing and natural age-progressed face images. Here, we present a novel approach to such an issue using sparse representation. In contrast to the majority of tasks in the literature that integrally handle the facial texture, the proposed aging approach separately models the person specific facial properties that tend to be stable in a relatively long period and the age-specific clues that gradually change over time. It then transforms the age component to a target age group via sparse reconstruction, yielding aging effects, which is finally combined with the identity component to achieve the aged face. Thus, the simulator gives the face of the person with aging effects.

Index Terms— Aging, face, image, photography, representation, sparse, texture.

1 INTRODUCTION

The human face conveys rich information such as age, gen der, emotion, ethnicity, attitude and so on [1]. In the past years, great efforts have been made to make the machine based face analysis easy. The machine based analysis requires the machine learning. As person grow old, the features of face changes in some manner. The wrinkles and dark circles may grow. Thus the face looks old. Today's world of photography has grown up to great extent that it make the old face to look younger and vice versa. This can be done by using the face aging effect simulator [2] [3] [4]. The changes in the captured image can be due to more or less exposure to light or due to pose changes. This also involves the age invariant face recognition [5] [6] [7], age estimation [8] [9] [10] etc. Particularly, face aging simulation has been given increasing attention in these years, since the solution to this complex issue benefits many attractive applications [11], [12], [13]:

1) Multi-Media and Entertainment: Along with the flourish of the film industry, generating visual effects by computers has become essential. The aging and rejuvenating processing on the human faces via computer-aided approaches makes it possible to achieve fantastic rendering to the audiences without consuming so much time and material. With regard to the ordinary people, face beautification softwares are common, and some are among the most popular ones in the mobile application store. They are highly related to face rejuvenation techniques. Likewise, appearance prediction of an old age would inspire people's curiosity and interest.

2) Aging Compensation in Face Analysis: Aging is always considered as a challenge in face recognition, and aging effect simulation thus deserves thorough studies to compensate such variation in automatic face recognition systems. Furthermore, face aging synthesis also contributes to forensic art, face image retrieval across age, automatic update of face databases, and provides useful references for seeking the missing individuals.

Sparse approximation processing: Key idea: approximate signals f as a sparse decomposition in a dictionary of waveforms. The signal is characterized by fewer coefficients : – Compression capabilites – Fast algorithms and memory saving – Estimation of fewer coefficients for:

- noise removal
- inverse problems
- pattern recognition

2 LITERATURE REVIEW AND RELATED WORK

Face aging simulation has experienced a gradual transition from computer graphics to computer vision. According to the studies in [14], [15], and [16], human face age progression can be generally summarized as two stages, i.e., child growth and adult aging. The skeletal growth plays a dominant role from infancy to grown-up, while the texture details (e.g. wrinkles) distinguish seniors from young adults. Inspired by these observations, some approaches based on crania development theory and skin wrinkle analysis have been investigated in recent years, and the previous work roughly develops in three directions:

i) Coordinate Transformation Based: The early efforts mainly focused on skin's anatomy structure and facial muscle changes, and some physical measurements and anthropometry driven methods were proposed. In [17], a computable growth model of human heads was introduced by Todd and it was simulated in a geometric procedure, namely revised cardioidal-strain transformation [18], [19] presented a 3-layered skin model, and the wrinkles were obtained by relative motion between layers under the definized interlaminar constraints. O'Toole [20] calculated the average of a certain number of sample faces captured by the 3D laser scanner, and the face appeared older or younger by adjusting the distance between any test face and the average. Ramanathan and Chellappa described a craniofacial growth model for facial appearance prediction of young people, characterizing growth related shape variations by means of the parameters defined over a set of facial landmarks, and further extended their work for adult age progression. The mechanical synthesis methods are dedicatedly designed; however, they are computationally complex, and the synthesized faces are lack of realness.

ii) Texture Transplanting Based: In such approaches, age progression is conducted by transferring the age-related texture cues to the given face. Shan presented an image based method to transfer the geometric details from one surface to another where both face aging and rejuvenating effects were simulated. Tiddeman [2] claimed that the aged texture from a single training image led to a lack of statistical validity and the unrealism of the synthesized face, and they thus captured the mean differences between the images of two age groups.

iii) Aging Function Based: They are mostly example-based, and involve in another significant and closely related issue, i.e., age estimation. The aging function reveals the relationship between the facial texture and the age. Lanitis built a statistical face model in which the distinctive aging patterns of different individuals were learnt so that unique simulation was applied to the given face. In long-term age, progression was modeled by connecting sequential short-term patterns following the Markov property of the aging process, and the function-based method was exploited to extract the short-term appearance changes. Park [5] extended this kind of approaches to the 3D space, and applied a 3D-assisted face model to offset the texture and shape changes of probe faces caused by aging. With the view-invariant 3D face model recovered from a given 2D image, they separately considered the shape and texture changes, and the aging pattern was approximated by a weighted average of the ones in the training set.

3 Analysis of problem

In spite of the encouraging progress achieved in face aging simulation, it is still challenging to synthesize ideal age transformations due to some issues as follows:

a) Complexity in Aging: Face aging involves in both the common rules and distinct patterns. People share similar age-related attributes, *e.g.* the aggravation of wrinkles and the growth of profile; whereas various genetic factors introduce the stochasticity and diversity of different individuals, making the aging process differ from each other. Furthermore, a number of external factors also have impact on it. For example, lifestyle would retard or accelerate the aging rate of one person, and the makeover together with accessories tends to incur the deviation between the facial appearance and its actual age. These causes above raise the uncertainty during age progression and the difficulty in appearance prediction.

b) Data Collection: Most of the recent age progression approaches are data-driven, where aging patterns and age related features are learnt from training samples. Data collection is thus extremely crucial to generate such statistical models. Only on the premise that enough aging variations and skin details are covered at the training stage, the synthesis results are significative and credible. Either due to lacking of images of the elderly people or the long-term aging sequence from a single individual, the existing facial aging databases publicly available are far from sufficient.

c) Other Interferences: Another reason is that the faces in the real world usually undergo variations in expression, pose and lighting, and a robust aging model is thus expected to take them into account. For the existence of the unsolved complex aging model mentioned above, most of the other interferences are still strictly restrained in current aging simulation studies.

4 Proposed Work and Objectives

Every face image in the data base undergo pre processing steps which include face detection face alignment and facial land mark detection. From the detected face five local patches are extracted including two eyes, nose and mouth corners. LBP (Local binary pattern) feature is extracted from these five local patches. LBP has the unique advantage that it is Independent of color or light variation in the image hence it is used for race (Asian or European) detection. From the LBP sparse code word is generated for each image and it saved in the race database. For gender detection, query image after pre-processing goes through gender detection steps such as differential excitation, Gradient orientation and building histogram. Finally the value is stored in the database for gender. The classifiers (1 &2) are minimum distance classifiers which find the difference between query image and database image output the image which has minimum difference as first and accordingly ranks the result. For age calculation, a face triangle is formed taking centre of two eye and centre of mouth has three points. As the age progress the face angle also changes. So by calculating face angle we can estimate approximate age of query image. The same detected eyes and mouth area used for LBP feature extraction is also used for age group estimation. By using three coordinate points left eye centre, mouth and right eye centre, can form a triangle called face triangle. Face angle is the angle formed between left eye centre mouth and right eye centre [21]. As the age progress the face angle also changes. The proposed work includes showing the age and gender of the person with his or her image.

5 Desired Implications

The desired implications are to show the age of the person and the gender also. The aging effects can be applied to the original image and we can get the image with the expected age of that particular person. For example, if a girl of age 23 wishes to see how she will look after 30 years then the face aging effect will be applied and then she will be able to see her image with age of 53 years. Thus, the proposed technique works.

6 Conclusion

Thus we have successfully studied about the face aging effects by using the sparse representation method.

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