Facial aging simulator
considering geometry and patch-tiled texture

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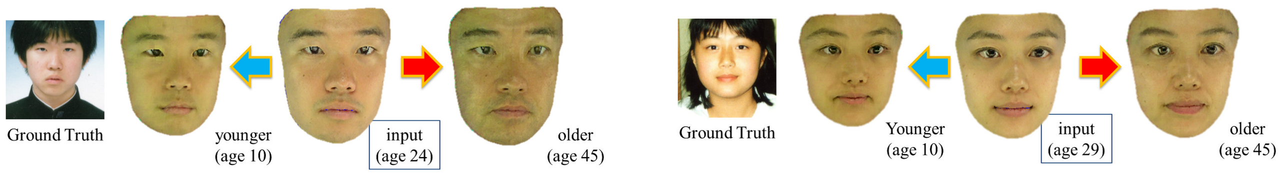


(a) Aging Face Model (male) (b) Aging Face Model (female)

Figure 1: *Synthesized Aging Face Models (a), (b).*

1 Introduction

People can estimate an approximate age of others by looking at their faces. This is because faces have certain elements by which people can judge a person's age. If computers can extract and manipulate such information, wide variety of applications for entertainment and security purpose would be expected.

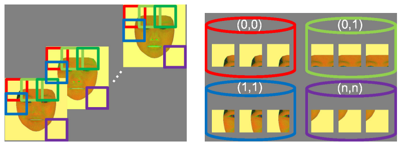
Recently, considerable amount of research has been conducted to quantitatively describe the changes in facial aging. Scherbaum et al. [2004] have developed a method for synthesizing 3D aging faces based on 3D Morphable Model (3DMM). They modeled an individual aging trajectory on the model parameter domain for a given face using non-linear Support Vector Regression. However, it is difficult to represent wrinkles and flecks on an aged face because the proper alignment between textures used for constructing the 3DMM is needed.

In this paper, we propose a method to synthesize face aging or rejuvenation based on geometry modification and patch-tiling based texture synthesis. The advantage of our method is to describe detailed aging skin properties (fine wrinkles and flecks) on a synthesized face while still preserving individuality, because our method has no texture blending such as 3DMM in texture synthesis. Moreover, unlike Scherbaum's approach, our method represents a geometrical aging effect by scaling an accurate 3D range scan-based face model according to the ratio of each facial organ's scale. The experimental result as shown in Figure 1 represents the effectiveness of our method for face aging and rejuvenation.

2 Geometry aging

First of all, we constructed an age-specific 3D face database which consists of 3D face models (239 males/218 females) with their age labels. As preprocessing, for all 3D face models in the database, we calculate width and height of each facial organ including eyes, eye brows, nose, mouth and facial contour using pre-defined landmark vertices on the 3D face models. We then calculate linear regressions which can map an age to width or height for each facial organ. Likewise, we also calculated linear regressions which can map an age to a depth value for each pre-defined landmark vertex on facial organs. At this time, we separated the database into two classes; under 18 and more than 18, because the geometrical changes shift with a change in cranial bone growing at this age.

Given an individual 3D face model with actual age, geometry aging is performed by following procedures. First, the width of an individual 3D face model is calculated by similar way as the preprocessing. Second, the width corresponding to the actual and the desired age is estimated by linear regressions, then the x-scaling ratio between the estimated and the actual age's width is calculated for each facial organ. At this time, y and z scaling ratio are also calculated by same manner as mentioned above. Finally, each vertex of the input face model is scaled according to each facial organ's scaling ratio.



(a) generate patch (b) patch database

Figure 2: *Texture aging method*

3 Texture aging

Texture aging is performed by the tile-based texture synthesis [Mohammed et al. 2009] as following procedures. As a preprocessing, all faces of the same age category in the database are geometrically aligned along the average face of the age and then normalize textures are generated. Then, age-specific texture patch database is constructed from normalized textures for each age group. Given an input texture, a base texture is firstly generated by mapping the input face texture to the average face model of the desired age. Next, the base texture is converted from the RGB to the HSV color system then divided into patches (Figure 2). After that, utilizing the base texture as a global constraint to conserve the relative location of face parts, texture patches of the desired age are placed onto the base texture by same manner of the tile-based texture synthesis. As a result, the input texture is transformed to the desired age's texture.

4 Results And Conclusion

Finally, face aging or rejuvenation can be performed by integrating both results of geometry and texture aging. Figure1-(a) and (b) show the results of face aging and rejuvenation in male and female case. From this result, we found that our method can represent the variation of the skin texture such as wrinkles due to the aging. Thus, we conclude that the proposed method is effective for simulating face aging and rejuvenation. As a future work, we plan to model the individual aging changes.

References

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