An Improved Rendering Technique for Active-Appearance-Model-Based Automated Age Progression

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1 Introduction

Age progression is the process of creating images that suggest how a person may appear in a certain amount of time based on the effects of the aging process. Traditionally these images have been created manually by forensic artists who use both art and science to guide how representations appear, whether drawn or photo-manipulated. Automated age-progression seeks to use algorithmic methods to create accurate images of how the individual in a photo could appear after aging effects. It is still a fairly young area of research, but one promising technique suggested so far has been to use parametrically driven face models such as Active Appearance Models to modify the face appearance in an image based on a data-driven model of face aging. These can be successful but tend to suffer from reconstructed texture artifacts.

2 Background

The AAM is a well known technique for both fitting face landmarks and for representing a face parametrically by a single vector of coefficients [Matthews and Baker 2004]. In age-progression, we are most interested in using the AAM as a means to represent both the shape and texture of any new face image so that the image can be modified in a believable and data-driven manner. An AAM trained on many representative faces, which in our case may be chosen to represent face aging specifically, is able to represent or reconstruct a face image using its parameter vector. This vector can be updated and reconstructed to create an age-progressed image [Patterson et al. 2009; Lanitis et al. 2002].

3 Previous Technique

An age-model is built by creating an AAM using a multitude of face images across the span of adult ages and then using Support Vector Regression (SVR) of the face-parameter vectors versus their related ages to learn the "aging function." Monte Carlo simulation follows to create an age-table of prototypical face-age vectors. A difference of target and source age vectors may be added to an original face-image vector to generate a target vector, which in turn is reconstructed to build the age-progressed face image. Because this is only treating the face region in an image, it is often reconstructed as a separate face oval or directly drawn atop the original photo, often resulting in an artificial look.

4 New Technique

The new technique is driven by the concept that the AAM may be used with its two parts of shape and texture to determine the age-related changes in a face image but not to draw them directly, thus mitigating the texture weaknesses of a reconstructed image. The original-face AAM vector and age-progressed target vector are determined as before, however the age-progressed image reconstruction of the target vector is not calculated to draw back on top of the original photo as in earlier approaches. Instead, the reconstructed age-progressed image is instead warped back to the original face image's shape (temporarily un-doing age-related shape changes in the face). The difference of the age-progressed image now in original-face-shape space and the AAM-reconstructed version of the original face image, also in original-face-shape, is then calculated. This texture difference is added to the original photo's pixels, generally causing the appearance of nasolabial lines, forehead lines, etc.; however the shape is not yet correct for the calculated age-progression. To complete the process, the face-shape area of the original image is then warped to the shape of the reconstructed age-progressed face shape representation, reintroducing age-related shape changes for the final rendered age-progression image.

Figure 1. *An original photo followed by the old age-progression technique in the middle, then the new on the far right.*

5 Conclusions

This novel method can result in more realistic age-progression images that do not require manual compositing for pleasing images. There are still some weaknesses with texture artifacts and warping as well as the lack of age-progressed update of hair, neck, etc., but future work may solve these issues.

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