A Realistic Human Face Modeling from Photographs by Use of Skin Color and Model Deformation

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Abstract. This paper presents a novel approach to produce a realistic 3D face model from multi-view face images. To extract facial region and facial feature points from color image a new nonparametric skin color model that is proposed. Conventionally used parametric skin color models for face detection have lack of robustness for varying lighting conditions and need extra work. To resolve the limitation of current skin color model, we exploit the Hue-Tint chrominance components and represent the skin chrominance distribution as a linear function. Thus, the facial color distribution is simply described as a combination of the maximum and minimum values of Hue and Tint components. Moreover, the minimal facial feature positions detected by the proposed skin model are adjusted by using edge information of the detected facial region along with the proportions of the face. To produce the realistic face model, we adopt log RBF(Radial-Based Function) to deform the generic face model according to the detected facial feature points from face images. The experiments show that the proposed approach efficiently detects facial feature points and produces a realistic 3D face model.

1 Introduction

The requirements of a realistic and feasibly animated facial model have been increased because facial modeling has been an important field of diverse application areas such as virtual character animation for entertainment, 3D avatars in the internet, 3D teleconferencing, and face recognition. Since Frederic I. Parke's[1] the pioneering work in animating face in the early 70's, many significant research efforts have tried to create the realistic facial model. Unfortunately, because of an extremely complex geometric form, countless tiny creases and wrinkles in the face, and subtle variations in color and texture, the realistic facial modeling system has not been developed yet.

Most of the facial modeling techniques rely on measured three-dimensional surface data. Surface measurement techniques fall into two major categories, one based on 3D scan system and the other based on photogrametric techniques. Unfortunately, not everyone has access to 3D scan systems, and an alternative surface measurement approach is through the use of photogrametric approach. The basic idea is to take multiple simultaneous photographs of a face, each from a different point of view.

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Parke [2] improves a simple photogrametric method that uses orthogonal views of the face. Pighin et al. [3] have used an approach for creating photo-realistic textured 3D facial models from photographs of a human subject, and for creating smooth transitions of different facial expressions by morphing these different models. V. Blanz [4] proposes an approach that uses only a single photograph and a database of several hundred facial data and R. Enciso et al. [5] uses an approach that is based on computer vision techniques in which different pairs of stereo images are used to create precise geometry. But these approaches require physical markers on the face, extensive human intervention because of correspondence or the need for a huge database of human faces.

Meanwhile, the analysis of facial information has been one of the challenging problems in computer vision field. Especially, the facial region and feature detection is considered a critical work for developing various face recognition and face modeling systems. However, due to variations in illumination, background, and facial expression, the face detection and recognition have complex problems. Many of the works to detect facial region can be broadly classified as feature-based methods and image-based methods [6]. The feature-based methods make explicit use of face knowledge and follow the classical detection methodology in which low-level features are derived prior to knowledge-based analysis. Skin color segmentation can be performed using appropriate skin color thresholds where skin color is modeled through histograms. Skin color model, which are very efficient for detecting face from color images, have some difficulties in robust detection of skin colors in the presence of complex background and light variations [7].

In this paper we propose an automated 3D face modeling from color face images. The process includes a novel approach to detect facial region based on a new HT skin color model and to deform the 3D face model with log BRF. The proposed method shows efficiency for detecting face and facial feature points guided by MPEG-4 and is robust to various lighting conditions and input images. The facial feature points are subsequently used to create a realistic 3D face model. Figure 1 shows the block diagram of the proposed system.

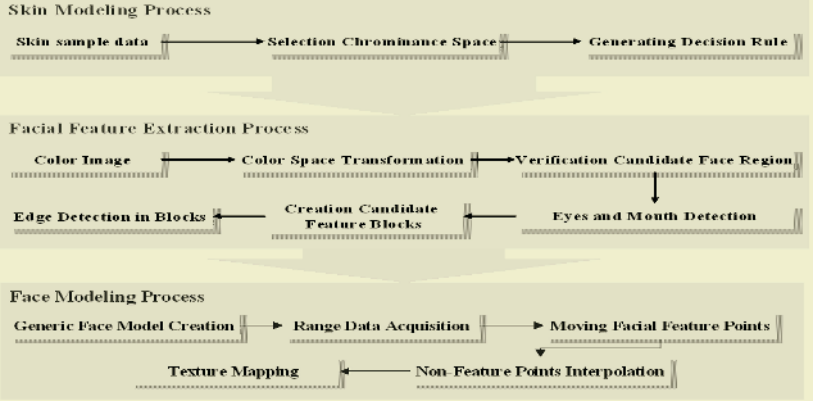

Fig. 1. Overview of the 3D Face Modeling Process