Creating the Virtual Self: Re-Using Facial Animation in Different Avatars

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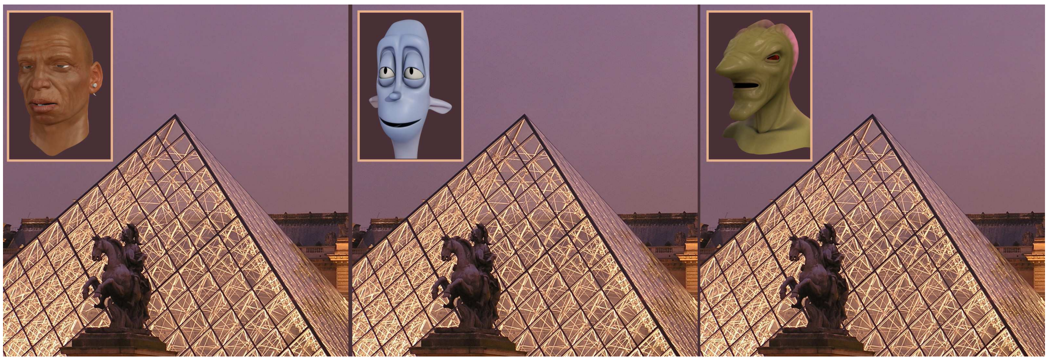

Figure 1: *Source model (left) and target models (middle and right). (Image Louvre Museum from http://www.louvre.fr) (3D models Copyright 2007 Face In Motion)*

Abstract

Creating by hand the facial rig for each avatar is time-consuming. We developed an application, implementing a novel deformation method, that automatically transfers rig and animations between characters, 90-99% faster than traditional techniques. Our technology can be embedded into virtual environment frameworks to quickly create new avatars and easily customize them.

1 Introduction

Modifying how an avatar looks, behaves or can be controlled is critical to the development of collaborative virtual environments. Facial animation of avatars can help communication between the system and the user, provide a lifelike experience by enhancing dialogue and enable casual and naive users to interact in a natural way with complex applications. Common applications include: virtual guides, help desk, website navigation and others. Yet, these virtual characters are not prepared to reproduce strong emotions and the quality hasn't reached the aesthetics that can commonly be appreciated in films.

While trying to develop a new approach to reproduce the subtleties of an avatar's facial animation, we immediately came into a roadblock: creating a sophisticated rig by hand is a very labor-intensive and time-consuming task. To overcome it, we developed a method that automatically transfers the rig and animations of a face from the source to the target model. The rigging process is analogous to setting up the strings that control a puppet. Given a face model we analyze it and create a rig ready to be animated based on the source model information. Our method is general and independent of the model: artists can define their own rig and then quickly apply it to different models, even with dissimilar proportions and look (human, cartoon or fantasy).

We aim to include in virtual environments visual appealing characters capable of transmitting emotion and behavior that would add to current applications a unique experience, which is currently impossible to achieve, due to the lack of a system that can automatically customize different characters on the fly.

2 Background

Facial Animation is based on ideas pioneered by *Parke* [Par72] (for a detailed review see [HTP*04]). Early work includes *Platt and Badler* [PB81], who built a face model capable of simulating and animating non-rigid objects using masses and springs, and classified the units of motion using Facial Action Coding System (FACS) [EF78]. Since then, many approaches have emerged that can be classified into 3D geometric manipulation, like key-frame interpolation, parameterization and physically-based [KHYS02], or 2D image manipulation, like morphing and blendshapes (for a survey on this techniques refer to [NN98]). Our application is related to *rigging* [CBC*05], which benefits from a combination of many of the previous techniques. *Noh and Newumann* [NN01], inspired by motion re-targeting [Gle98], proposed a method for cloning facial expressions from an existing model to a new model using Hardy multiquadrics. *Pighin et al.* [PHT*06] presented a method to interactively mark corresponding facial features in several photographs of a person and to deform a generic face model using radial basis functions, interpolating the poses. None of these methods deals directly with the artists needs, and most are oriented towards human look.

3 Animating Virtual Characters

Today, facial animation of avatars is typically done using pre-rendered animations of each character, including pre-defined phonemes and expressions, which are stored in a database and played back later based on automatic text-to-speech or pre-recorded audio synthesis. With our method, there is no need to create the animations for each character; it allows having multiple models already defined or creating new ones, and instantly animate them on demand.

Our method begins with two 3D face models. The first one, we call *source model*, is rigged and includes a series of attributes: a control skeleton, a number of influence objects that represent animation controls and the inner structure of the face, facial expressions (shapes) and animation scripts. The rig doesn't have initial constrains and can be created by an artist. The second model, we call *target model*, doesn't have a character rig associated to it. The source and target models can have different descriptors: one can be defined as a polygonal mesh and the other as a NURBS surface. Also, the faces do not need to have a point-to-point correspondence (figure 2 shows an overview of the process).

The method is based on geometric deformations techniques, which re-locate and re-shape the source model attributes to fit the target model. As a result, the artist is now free to modify the target model, re-use the animation scripts of the source model or generate animations using both animation controls and sparse data interpolation of the shapes (for a detailed description see [OZS06]).

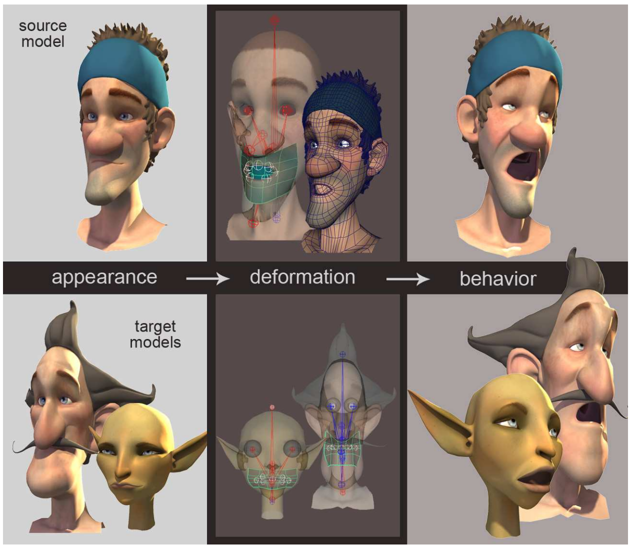

Figure 2: *Overview: define the source and target model; adapt the source geometry to fit the target; transfer attributes and shapes; bind the influence objects and skeleton to the target. The result is a model ready to be animated. (Copyright 2005 Dygrafilms)*

4 Application: Virtual Guides

The primary motivation of our research was to find a solution that speeds up the rigging process for films and videogames. We developed an application based on our method, which is implemented in C++ as a plug-in for Maya 7.0 and can be integrated into animation pipelines. This can serve as the core technology to be applied for the the content creation process of virtual characters, and can lead to to the development of new applications to be integrated into existing virtual environment frameworks. Virtual guides for historical heritage sites or museums are usually limited to a few characters, due to the time it takes to create multiple models. This limitation can be overcome in a three step process. First, the user defines the new 3D character for the virtual guide, which can be created by sculpting it by hand or generated by a scanner. Second, using an application based on our technology, the user can transfer a sophisticated rig to the new character, which becomes ready to be animated. Last, the user can transfer the animations defined in the source model to the virtual guide character, which are later played back during the virtual tour. For instance, the default tour can be guided by an avatar of an old lady, but at the request of the visitor can be instantly changed to an avatar of a cartoon, a small child or a fantastic creature (figure 3 shows how animations can be transferred between characters with different looks). Also, it is very easy to create or change the animations of the source model and quickly propagate them to all avatars.

5 Conclusion

The method automatically transfers rig and animations between models, so new avatars can be instantly created and animated with high quality by only providing the 3D model geometry. This, not only increases the number of avatars that can be available in any virtual environment, like a virtual guide tour around a city, but also greatly augments the range of applications that can use avatars. Our approach allows to animate characters that before were devoid of expression, because of the time it takes to manually create a rig. Suddenly, all those secondary characters and avatars can come alive with the help of our technology.

Figure 3: *Transfer expressions and animations between models: the source (first row) and target have different triangulations. Notice the different proportions of the models: the source has a big nose and skinny face, while one target has a small nose and the other has a fat face. (Copyright 2005 Dygrafilms)*

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