Production interface for web-deliverable realistic interactive 3D facial animation

Nicoletta Adamo-Villani
Department of Computer Graphics Technology,
Purdue University
401 N. Grant Street
West Lafayette, IN
USA (47907-2021)
nvillani@tech.purdue.edu

Amit Chourasia
Visualization Scientist
Supercomputer Center
UC San Diego MC 0505
9500 Gilman Drive
La Jolla, CA
USA (92093-0505)
amit@ucsd.edu

Clark Cory
Department of Computer Graphics Technology,
Purdue University
401 N. Grant Street
West Lafayette, IN
USA (47907-2021)
cacory@tech.purdue.edu

ABSTRACT

We present a new interface for producing high quality web deliverable interactive 3D facial animation. We aim at providing visual artists with established 3D character animation tools and techniques not currently supported by web 3D technology. Such techniques are crucial to the creation of visually appealing web 3D content. We have developed a production tool (the Web Facial Expression Editor-WFEE) which allows: (1) animation of web deliverable facial deformations using optimal animation methodologies such as single and multiple target morphing, reactive animation and custom defined attributes; (2) applicability to most face models developed in most commercial 3D software packages; (3) support of any facial skeletal structure; (4) extensibility to full-body animation. As the platform of choice we have focused on Maya 5.0 and Macromedia Director MX Shockwave Studio. However, due to its simplicity, the interface is easy to implement on different platforms using other programming languages.

Keywords

Animation, web3D, Interfaces

1. INTRODUCTION

1.1 Background

Web deliverable interactive 3D character animation has many applications: (1) e-merchandising (virtual sales representatives); (2) e-learning (interactive virtual teachers); (3) online entertainment (interactive storytellers and interactive games); (4) newscasting (virtual anchors), and others. The most common examples of interactive 3D characters consist of animated faces ("talking heads") that use some kind of text-to-speech and dialog manager software to drive "intelligent" conversations with the user or to present information [Lau03a]. Examples of interactive web 3D characters can be found at http://www.signingavatar.com ; http://pulse3d.com; http://www.lifefx.com; http://www.haptek.com; http://www.famous3d.com/web/index.html.

1.2 Current state-of-the-art in web 3D character animation technology

As web 3D technology evolves, new web character animation systems are being explored and developed.

One approach is the creation of 'ad hoc stand alone solutions' designed for a specific purpose and not integrated with the most widely used 3D technologies. Examples of such tools include: Pulse's technology (Pulse Veepers™); Lifefx; Famous3D. These technologies enable customers to transform a digital image into an interactive, animated 3D character who speaks the text typed by the user.

Another approach is the development of standard systems. By standard system we mean a system which is integrated with industry-leading 3D technology solutions to ensure that existing 3D developers can publish their content to the Web using an established, pervasive platform.

One example of standard web 3D solution is the MPEG-4 Facial animation technology [Pan02a]. A second example is Macromedia Director MX Shockwave Studio technology.

We believe that one of the most critical characteristics of web deliverable interactive 3D character animation is its visual quality. The real implication of this requirement is that any successful standard system should provide means for visual artists to design models and animations using tools and techniques they are familiar with [Pan02b].

Currently web 3D technology does not support many of the methodologies used traditionally in 3D character animation. Therefore, producing high quality web 3D interactive character animation is a difficult and time consuming task and visual quality is often hard to achieve.

Focusing on the need of providing the artist with the methods she is used and comfortable with, we have designed a new production interface (the Web Facial Expression Editor-WFEE) which enables the animator to create convincing web interactive facial animation using established techniques such as: (1) single and multiple target morphing, (2) reactive animation, (3) custom-defined attributes.

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2. THE PROBLEM CONSIDERED

As previously mentioned, current web 3D technology does not support many of techniques commonly used in 3D facial animation. When creating interactive facial animation to be published on the web, the artist needs to manipulate each individual CV or joint to deform the mesh. CVs and joints can be difficult to see and time-consuming to select and transform in the 3D scene. After much manipulation, the achieved facial pose can be keyed but not saved for later use. Each time a particular facial pose is required, it needs to be created from scratch. The only way to transition between different facial poses is to key them at different points in time. It is not possible to interpolate between different facial poses because morphing is not available.

We present a method which allows the animator to: (1) easily and quickly control facial deformations using bone deformers controlled via sliders; (2) create and save a library of facial poses (presets) equivalent to morph targets and/or custom defined attributes produced with reactive animation; (3) morph between base and preset and between different presets to create an infinite number of facial expressions; (4) key the morphing for animation; (5) set the resulting facial expression animation in web deliverable format.

3. METHODS

3.1 Tools

Our approach is based on Maya 5.0® (Alias/Wavefront®) and Macromedia Director MX Shockwave Studio® technology. However, due to its simplicity, the new interface is expected to be easy to implement on different platforms using other programming languages.

The facial rig makes use of bone deformers, a common technique utilized in character animation for video game production [Moo01a]. Any number of joints, any skeletal hierarchical structure and any polygonal 3D model can be used.

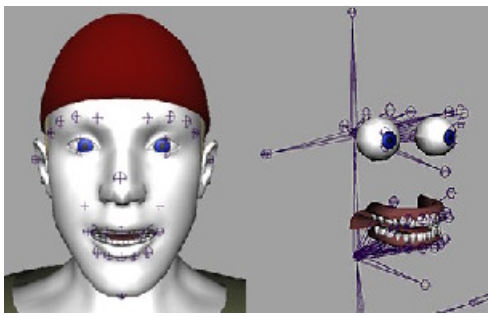

Figure 1. Skeletal setup of the face

3.2 Description of the interface: the Web Facial Expression Editor (WFEE)

As mentioned earlier, for this work we have used Maya 5.0 as the 3D modeling/animation software. We have designed a production interface using MEL (Maya Encrypted Language) [Gou03a] as a first step for testing the development of tools for creation of high quality web 3D content.

The interface is graphically very simple. It consists of only one window: the “Web Facial Expression Editor” (represented in Figure 2). The main components of the WFEE are: (1) The 3 sliders (at the top) which control the transformation values of the selected item/s. (2) The “Transformation” frame which contains three buttons used to select the intended transformation. (3) The frame “Standard Controls”, which allows the user to: Reset, Undo/Redo, Select/Deselect items (joints/presets), Set keyframes and Edit the animation curves. (4) The “Presets” frame used to create, delete and edit presets. (5) The “Morph Controls” frame used to create and delete morphs. (6) The “Mouth”, “Cheeks/ Chin/Ears/Nose” and ”Eyes” frames which contain buttons used to select the facial joints.

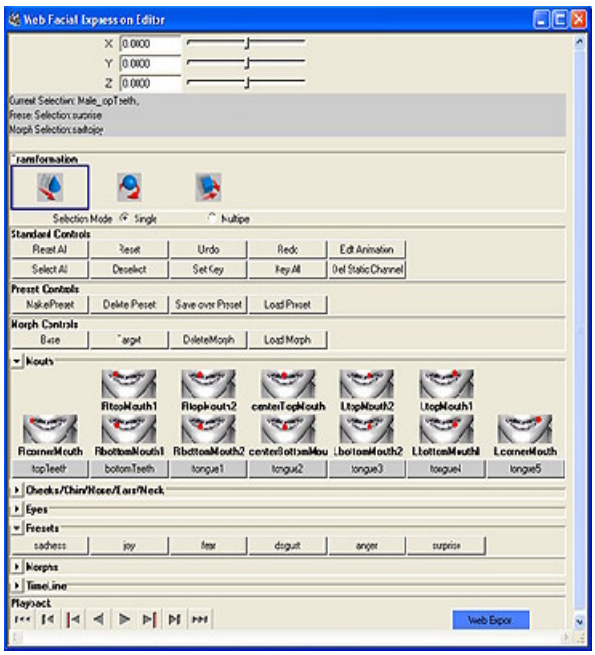

Figure 2. The Web Facial Expression Editor window

At the bottom of the window, a time line shows the frames of the animation and standard playback controls can be used to play and step through the animation. The "web export" button, in the bottom right corner of the WFEE window, sets the animation into web deliverable format.

The major challenge faced during the development of the WFEE has been providing the artist with the ability to save a facial expression to a *preset*, transition between presets (the transition between two presets is called a *morph*) and interpolate between different morphs. Whenever the animator reaches a desired facial pose, the pose can be captured and stored. This is possible because the program saves the transformation values of each facial joint to an external file (the preset file). Similarly, whenever a morph is created, the interpolated joint transformation values, produced by the transition between base and target, are saved to an external file. The preset and morph files can be loaded into the WFEE during initialization or on demand. It is possible to interpolate between morph files to create an unlimited number of combinations of joint transformation values corresponding to an infinite number of facial configurations.

3.3 Advantages of the WFEE

The main advantages of the WFEE are: (1) ease and speed of joint selection and manipulation. Every joint can be quickly selected by clicking a button showing the position of the joint relative to the face. Each joint can be easily transformed using a slider. (2) Ability to create an unlimited number of facial poses and save them for later retrieval. Presets and morphs can be concurrently loaded in different scenes so various animators can share the same facial poses and thus enhance production time. (3) Ability to key the presets and/or morph between presets and key the morphing to produce animations exportable to the web. (4) Availability of multiple-target morphing. The ability to mix facial poses is crucial to the creation of convincing facial animation. Being limited to a single set of phoneme shapes (as in single target morphing) results in production of mechanical–looking, lifeless characters [Mae02a]. Current web 3d interactive characters suffer from this limitation which causes lack of variety and asymmetry in facial expressions. The WFEE allows mixing of the morphs to create a large variety of mouth shapes and facial expressions and therefore produce lifelike, believable web 3Dcharacters.

Figure 3 shows the 6 basic facial expressions produced with the Web Facial Expression Editor.

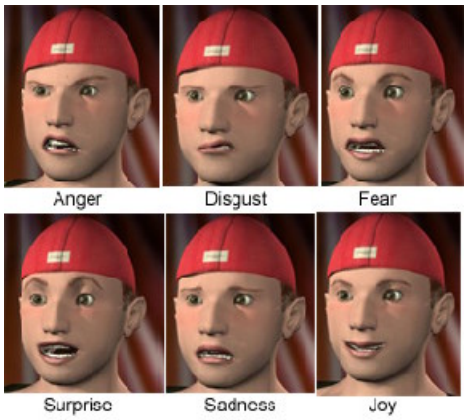

Figure 3. The six standard facial expressions produced with the WFEE

4. CONCLUSIONS

In this paper we have considered the need of producing convincing, natural-looking web 3D interactive facial animation. In order to achieve high visual quality we have provided the artist with an interface that gives her access to established character animation techniques not yet supported by current web 3D standard technologies.

Using Maya 5.0 and Director MX Shockwave Studio we have developed a web 3D production tool whose major strengths are: (1) appeal to visual artists, as it allows them to animate facial deformations using optimal animation techniques - this is a major requirement for production of quality content-; (2) applicability to any face model developed in most commercial 3D software packages; (3) applicability to any skeletal structure. The geometrical parameters of the skeleton, i.e, length of the links (bones), the number of joints, skeleton hierarchical structure and naming convention are irrelevant; (4) extensibility to full-body skeleton; (5) easy implementation on different platforms using other programming languages.

Many examples of Graphical User Interfaces (GUI) which facilitate 3D character animation production can be found in the animation literature [Kun02a]. Though none of these examples has been targeted to *web-deliverable* interactive 3D facial animation, we believe that the novelty of our work does not lie solely in the creation of an easy-to-use facial animation production interface. The main merit lies in the *development of an interface which brings fundamental animation methodologies to web 3D* thus allowing quick and easy creation of visually appealing web content.

The major strength of the WFEE is the ability to create presets and transition between them. We note that our presets are more efficient than traditional morph targets.

A morph target is created as a result of a change of shape of the surface. A change of shape is defined as a modification of the configuration of the surface produced by altering the position of the points that define the surface (control points or vertices) [O'Ro02a]. Any transformation at the object level (translation, rotation, scaling) is not considered a change of shape. For example, in stylized animation, to make a character blink we rotate the eyelids (usually the eyelids are lofted surfaces or half spheres). The closed position of the eyelids cannot be saved as a morph target since it does not involve a change of shape. To make the character blink the animator usually creates a custom defined attribute (i.e., "Blink") whose value drives the rotation of the eyelids surfaces. To animate the blink action the animator will use a morph target to slightly squint the eyes and the "Blink" attribute to close the eyelids. Typically this procedure involves keying two objects.

In contrast, our WFEE allows the artist to create one single preset which saves both the closed position of the eyelids and the change of shape of the eye area produced by the squinting. This is possible because our presets can save changes of shape as well as transformations at the object level. Thus, in the case of the blink, the animator would have to key only one object, the preset, to make the character blink.

As we have indicated, so far our application has been limited to Maya 5.0; we have left for future development the portability of the method across modeling/animation platforms. Future work involves the creation of tools for easy and quick production of high quality web 3D interactive full-body animation.

5. ACKNOWLEDGEMENTS

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