INTRODUCTION

The first 3D virtual human model was designed and animated by means of the computer in the late '70s. Since then, virtual character models have become more and more popular, making a growing population able to impact the everyday real world. Starting from simple and easy-to-control models used in commercial games, to more complex virtual assistants for commercial or informational Web sites, to the new stars of virtual cinema, television, and advertising, the 3D character model industry is currently booming.

Moreover, the steady improvements within the distributed network area and advanced communication protocols have promoted the emergence of 3D communities and immersion experiences in distributed 3D virtual environments.

BACKGROUND

Animated Characters and 3D Standards

Creating, animating, and most of all, sharing virtual characters over Internet or mobile networks require unified data formats. If some animation industry leaders try—and sometimes succeed—to impose their own formats in the computer world mainly by making available powerful authoring platforms, the alternative of an open standard is the only valid solution ensuring interoperability requirements, specifically when hardware products are to be built.

A dream of any content producer can be simply formulated as “creating once and reuse for ever and everywhere, in any circumstances.” Nowadays, content should be carried by heterogeneous networks (broadcast, IP, mobile), available anywhere and for a large scale of devices (PCs, set-top boxes, PDAs, mobile phones), and profiled with respect to user preferences. All these requirements make that the chain where content is processed more and more complex, and a lot of different actors must interfere: designers, service providers, network providers, device manufacturers, IPR holders, end-users, and so on. For each one, consistent interfaces should be created on a stable and standardized basis.

Current work to provide 3D applications within a unified and interoperable framework is materialized by 3D graphics interchange standards such as VRML and multimedia standards such as MPEG-4. Each one addresses, more or less in a coordinated way, the virtual character animation issue. Moreover, some research groups proposed dedicated languages for modeling virtual faces and bodies, such as Face Markup Language (FML) and Virtual Human Markup Language (VHML). In the VRML community, the H-Anim group released three versions of their specifications (1.0, 1.1 and 2001), as did the SNHC sub-group of MPEG: MPEG-4 Version 1 supports face animation, MPEG-4 Version 2 supports body animation, and MPEG-4 Part 16 addresses the animation of generic and articulated virtual objects (including human-like). In MPEG-4, the specifications dealing with the definition and animation of human avatars are grouped under the name FBA—Face and Body Animation—while those referring to generic models are called BBA—Bone-Based Animation. The next section analyzes the main similarities and differences of these two standardization frameworks: VRML and MPEG-4.

The VRML standard provides a textual description of 3D objects and scenes. It focuses on the spatial representation of such objects, while the time behavior is less supported. The major mechanism for supporting animation consists of defining it as an interpolation between key-frames.

The MPEG-4 standard, unlike the previous MPEG standards, does not only cope with highly efficient audio and video compression schemes, but also introduces the fundamental concept of media objects such as audio, visual, 2D/3D natural, and synthetic objects to make up a multimedia scene. As established in July 1994, the MPEG-4 objectives are focused on supporting new ways (notably content-based) of communicating, accessing, and manipulating digital audiovisual data (Pereira, 2002). Thus, temporal and/or spatial behavior can be associated with