Chapter 14
Designing Socially Expressive Character Agents to Facilitate Learning

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ABSTRACT

This chapter discusses the design and implementation issues around creating an expressive but easy-to-author 3D character-based system. It then describes several application spaces, including simulated face-to-face collaboration, adaptive socially-based presentations in informal learning settings such as public aquariums and science museums, and multi-user, avatar-based distance education scenarios.

INTRODUCTION

Most computer-based communication and learning systems, such as web sites, information kiosks, or e-books, are informational in nature rather than socially-based. However, many educators prefer socially-based techniques to convey their message – they rely on narrative techniques, detailed lesson plans, flexible content, eye contact, humor, and voice modulation. Socially-based techniques, using a communicative face-based computer character system, can open up more engaging and human-centric applications in many formal and informal technology-supported learning areas.

This chapter first discusses the design and implementation issues around creating an expressive but easy-to-author character-based system, then provides details for several application spaces including simulated face-to-face collaboration, adaptive socially-based presentations in informal learning settings, and multi-user, avatar-based distance education scenarios.

BACKGROUND

The last decade of the twentieth century experienced the merging of traditionally separate forms of audio-visual art and entertainment-based media. Boundaries separating media types such as live-

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action feature films, animation, simulations and games have begun to disappear, as these media overlap in many areas and coalesce. The key to the newly-forming comprehensive medium is interactivity. Advances in computer hardware and software have introduced the interactive multimedia presentation as a common base for a variety of audio-visual applications, including learning systems, with computer-generated facial and character simulation as a rapidly growing part of such presentations. For instance, current computer games make limited use of facial expressions, but next-generation computer platforms will provide hardware that is capable of delineating more complex characters.

One of the main objectives of designers is to introduce more realistic characters who can change expressions more frequently, demonstrate personality traits more clearly, and behave more interactively. With such innovation, typical gaming systems open up to wider, more socially-based application spaces. Besides more dramatically engaging gaming and conversational applications, socially expressive character agents are starting to show up in learning situations, including informal learning kiosks in zoos, museums, and aquariums as well as in online and computer-based traditional learning systems.

Some of the issues facing content and application developers developing face-based socially expressive character agents are:

- **Behavior:** Designing different facial actions, expressions, and personality traits is usually a painstaking and time-consuming process, where artists create the related animation using conventional 3D software and defining key frames for the movement of each facial feature. This is one of the major difficulties of increasing the number of moveable features (and also the visual and social realism).
- **Re-usability:** Designs for one head model are not generally usable on another model. As a result, even a similar action on a new head requires the design process to be repeated.
- **Interaction:** The need for a detailed design process limits the amount of interactivity and dynamic behavior a character can have at run-time. The characters cannot be completely autonomous.
- **Programmability:** There are few programmable components that can be reused in new applications to provide facial animation capabilities. Each application has to be developed by implementing such functionality from scratch.
- **Level of detail:** Developers, especially when using conventional graphics software, have to deal with all the details of a head model to perform actions. Intelligent software that is aware of head regions and their functions can hide the details unless necessary, by performing group actions on all the points that are functionally related. For example, averting the gaze direction is a simple action that should involve only a single input as new direction. The rest, such as rotating eyeball points, should be taken care of by the software. This feature is missing in most design and runtime environments because they are not customized for face animation.

In the next part of this chapter, we will discuss **the design and implementation issues** of our *FaceSpace* system, which provides solutions to these problems in a unified face animation and simulation framework. *FaceSpace* parameter spaces allow designer to effectively control facial geometry, perform MPEG-4 compatible facial actions (Battista, Cassalino, & Lande, 1999), show expressions, and display behaviors based on definable personality types. All of these are encapsulated within a face multimedia object (FMO) that can be used in several different kinds of learning applications through programming interfaces. We