Chapter 70
The Rise of the Virtual Human

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ABSTRACT

Virtual Humans are here to stay. From the voice in your satNav to Apple's "Siri", we are accustomed to engaging in some level of conversation with our technology, and it is rapidly becoming apparent that natural language interfaces have potential in a wide range of applications. Whilst audio-only communication has its place, most natural conversations take place face to face, and believable embodiment of virtual humans is the necessary next step for them to be fully integrated into our lives. Much progress has been made in the creation of relatable characters for film, but real-time facial animation presents a unique set of design challenges. This chapter examines the role of the virtual human, its history, and approaches to design and creation. It looks at ways in which they can be brought to life, interacting, assisting and learning. It concludes with a view into popular culture and perceptions of the future, where fact and fiction meet.

INTRODUCTION

With the rapid advances in technology in the past 40 years, the vision of the virtual human is coming closer to reality, with improvements in visual appearance, speech and emotion, and in the application of this into real-world settings. As can already be observed in pre-rendered animations, near-photorealism is now possible, with some avatars almost indistinguishable (Alexander, Rogers, Lambeth, Chiang & Debevec, 2009; Borshukov, Piponi, Larsen, Lewis & Tempelaar-Lietz, 2005). Although total realism not yet possible, many studies are working toward this goal, with even real-time avatars slowly becoming more and more realistic. This chapter introduces a range of virtual humans currently in development or

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being used in real-world interaction. The history of animated humans and the recent rapid advances are discussed. The chapter will then examine some of the technical challenges involved in creating virtual humans, particularly with regards to facial expression and speech. Finally, the role of the virtual human in popular culture is explored, looking at fears and hopes for the future, and how perceptions are changing over time.

BACKGROUND: THE ROLE OF THE VIRTUAL HUMAN

This section will take a look at avatars already being used in real-life settings, interacting independently with users, learning and remembering information, and even assisting in the treatment of patients.

Avatars Who Interact

Since the early days of computing there has been a fascination with the concept of communication between computers and human beings. As early as 1950 Alan Turing raised the question of whether a computer could appear to think like a human (Turing, 1950), and even today the 'Turing Test' is considered to be a benchmark by which we measure the success of virtual humans. Whilst early work focused on text-based communication due to the poor quality of speech generation and animation, improvements in technology have raised our expectations to the point where we anticipate that a humanised avatar could pass the Turing test within the next generation.

Early research on avatar development and behaviour focused mainly on speech, with the eyes and the motion of the head receiving little attention. However, in a 2004 study, a group developed an avatar to interact with video feeds rather than directly with humans, watching and following movement in a variety of situations. The team used a neurobiological model of visual attention in order to create realistic avatar eye and head animation (Itti, Dhavale & Pighin, 2003). They postulated that this type of non-verbal communication was an essential part of human interaction, and aimed to recreate this digitally in the most realistic way possible, using a procedural, science based approach. A reflexive approach was used to guide the avatars attention toward visual targets, in the form of either video recordings or video game output. Automatically generated eye blinks were added to aid realism, as well as accurate deformation of the facial tissue during movement, and a photorealistic facial model. Although the avatar was not always human-like in its point of focus, results of this early work showed potential, in using attention-directed behaviour to enhance the realism of a virtual human.

More recent work saw the development of virtual twins Ada and Grace (Figure 1), who were deployed in a museum to interact with each other and with visitors using both verbal and non-verbal communication (Swartout et al., 2010).

To communicate with the characters, the operator could push a button then speak into a microphone. The audio was then sent to an automatic speech recogniser (ASR), which translated the speech into text, sending this on to a language understanding module. An algorithm used the text to select an appropriate response for the characters to use. The characters have a set of about 400 responses to draw from, with dialogue management software ensuring that responses are not repeated. Animation sequences were also created and stored, with these being called upon at the same time as the responses, with the relevant animations being called upon dependent on the response. Viewing video footage of Ada and Grace being posed questions by museum visitors (USC ICT, 2010), it can be seen that there is rapid retrieval of