Chapter 15
Using Simulators for Training

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ABSTRACT

Virtual Reality (VR) simulators represent a powerful tool for training humans to perform tasks which are otherwise expensive or dangerous to duplicate in the real world. The idea is not new; flight simulators have been used for decades to train pilots for both commercial and military aviation. These systems have advanced to a point that they are integral to both the design and the operation of modern aircraft (Mastaglio and Callahan, 1995; Adams et al, 2001). This technology has been successfully extended and utilised in other industries in a range of successful applications (Bise, 1997; Denby & Schofield, 1999; Henning et al, 2002; Schofield, 2005; Dunkin et al, 2007; Smith, 2009)

Rather than focusing on the pedagogical aspects of learning in Virtual Environments (VE), this chapter will introduce a number of lessons that can be learned from industries that have successfully utilised virtual technology for a number of years. Specific rules of thumb regarding the specification, development, application, and operation of these simulators that can be garnered from these specific industrial training systems will be examined in a wider context. This chapter intends to discuss some of these generic rules in the context of a number of recently developed training applications.

INTRODUCTION

Inevitably the future will be digital. The continuing digital revolution has had an enormous impact on the way training is undertaken and safety information disseminated. A wide range of digital media is already being used, to varying degrees in training centers around the world. Unfortunately however, in many industries around the world the acceptance of innovative training technology can be slow (Schofield et al, 2002).

Advanced three-dimensional computer graphics and virtual environment technology, similar to that used by the film and computer games industries have been used to generate interactive learning environments that allow personnel to perform a range of simulated training. Virtual teaching and training applications from a range of industries (flight, surgery and driving simulators to name a few) have proved the value of this technology (Nishisaki et al, 2007; Taylor et al, 2007; Dunkin et al, 2007; Derian, 2009).

Early attempts at building virtual simulators, particularly those which tried to apply three-dimensional computer graphics based technology, were often constrained by lack of realism detail in their graphical interfaces and crude level of simulation (Bell and Fogler, 1995; Denby & Schofield, 1999; Parker et al, 2000; Ponton, 2003; Karweit, 2003; Bell and Fogler, 2004 & Dunkin et al, 2007). However, it has been also noted that even given these limitations, these virtual environments have the potential to allow users to experience situations which would not readily exist within the real world, e.g. to see into a chemical reaction or to cause a major catastrophe through their actions (Schofield et al, 2001 and Nasios, 2002).

The author's experience of building a number of interactive, virtual reality based simulators has demonstrated the enormous benefits of using this type of learning in a range of industrial environments, and also highlighted a few of the potential problems (Schofield et al, 2001; Tromp & Schofield, 2004; Schofield et al, 2005).

In a training environment, there are many potential benefits to reducing lengthy verbal or textual explanations and increasing the use of visual tools (this applies even to simple displays, such as presenting text to a trainee on a screen). Visual displays can often act to improve the viewer's ability to retain the information, maintain an interest in the proceedings, and help them to more fully understand the nature of the training material (Loftus & Loftus, 1980).

Historically, static images such as diagrams and charts have been used to train personnel. Scientific animations or virtual simulations are unique in their ability to visually illustrate and animate the passing of time. This extra temporal dimension can be extremely useful when explaining a chronological sequence of events, such as in the reconstruction of an accident, where the dynamic movement of the objects involved (e.g. equipment, vehicles or people) may be dependent on complicated and difficult to explain engineering or mathematical principles. These virtual environments can also be used to take advantage of their lack of physical restrictions, which may allow the viewer to be placed in a position where it is physically impossible to be with a normal camera, such as inside a piece of equipment or cut-away views of hidden features. One may show views of an incident or accident from previously unseen points of view, or slow down or speed up time (Schofield, 2007).

IMPROVING SAFETY WITH VIRTUAL SIMULATORS

The modern world expects high levels of industrial safety. In general there has been continuous improvement in the safety performance of the developed industrial nations over recent decades. This has been due to a combination of factors including changes in management culture, enhanced design and planning, technological improvements and legislation. All of these factors have tended to

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