Chapter 59

Making Lifelike Medical Games in the Age of Virtual Reality: An Update on "Playing Games With Biology" From 2013

Thomas B. Talbot
University of Southern California, USA

ABSTRACT

Medical simulations differ from other training modalities in that life processes must be simulated as part of the experience. Biological fidelity is the degree to which character anatomical appearance and physiology behavior are represented within a game or simulation. Methods to achieve physiological fidelity include physiology engines, complex state machines, simple state machines and kinetic models. Games health scores that can be used in medical sims. Selection of technique depends upon the goals of the simulation, expected user inputs, development budget and level of fidelity required. Trends include greater availability of physiology engines rapid advances in virtual reality (VR). In VR, the expectation for a naturalistic interface is much greater, resulting in technical challenges regarding natural language and gesture-based interaction. Regardless of the technical approach, the user's perception of biological fidelity, responsiveness to user inputs and the ability to correct mistakes is often more important than the underlying biological fidelity of the model.

INTRODUCTION

Videogames have been in the life or death business since their inception. Players 'die' or suffer injuries in games as a routine matter. Some of these approaches are very simple, such as when Mario is hit by Donkey Kong's barrel (Donkey Kong, Nintendo Corp.). Others are a bit more sophisticated, such as the progressively bloodied character depictions in Wolfenstein 3D and Doom (id Software). The medical education folks are constantly creating new simulation experiences with ever higher fidelity. The question is, can we adapt approaches from entertainment games to medical simulations or even better, create compelling and realistic medical games? Are there parts that are medically unique? If so, how do we

DOI: 10.4018/978-1-5225-5469-1.ch059

simulate this with an interactive experience? When it comes the biological parts, how much fidelity is optimal? This paper explores the question of simulating the biological processes that make something appear lifelike and medically convincing. The intent is to contrast approaches based upon type of training, development effort and impact on the learner. This is particularly relevant to consider given maturation of virtual patient technology in the last three years along with ongoing rapid advances in virtual reality. Even with new technology, the principles outlined in the original 2013 version of this article (Talbot, 2013a) remain as relevant now as they were then.

Physiological Fidelity

Many training scenarios involve demonstrations of physiological action with an expectation that the learner diagnose a condition based upon the demonstrated physiology, make interventions and receive a realistic physiological response as would be seen in a patient encounter. A variety of mechanisms exist that can do with tradeoffs in the fidelity, dynamism and effort involved in their creation.

Complex Fidelity: Physiology Engines

A sophisticated and scientifically valid experience with complex fidelity can be achieved through physiology engines. Physiology engines are computer coded mathematical models that simulate body systems. Basic physiology engines replicate the cardiovascular system and the effects of hemorrhage, fluids and medications on the model. Some manikins include such engines (Cooper & Taqueti, 2008). More complex physiology engines are multi-system with large pharmacology libraries and multi-drug interactions. An example of a multi-system model is BioGears [Figure 1], created by the Applied Research Associates

Figure 1. BioGears physiology engine capability set
Image courtesy Applied Research Associates.