Facilitating 3D Virtual World Learning Environments Creation by Non-Technical End Users through Template-Based Virtual World Instantiation

Chang Liu, School of EECS, Ohio University, Athens, OH, USA
Ying Zhong, School of EECS, Ohio University, Athens, OH, USA
Sertac Ozercan, School of EECS, Ohio University, Athens, OH, USA
Qing Zhu, School of EECS, Ohio University, Athens, OH, USA

ABSTRACT

This paper presents a template-based solution to overcome technical barriers non-technical computer end users face when developing functional learning environments in three-dimensional virtual worlds (3DVW). iVirtualWorld, a prototype of a platform-independent 3DVW creation tool that implements the proposed solution, facilitates 3DVW learning environment creation through semantics-based abstract 3DVW representation and template-based 3DVW instantiation. iVirtualWorld provides a wizard to guide the 3DVW creation process, and hide low-level programming and 3D design details through higher-level abstracts supported by pre-defined templates. Preliminary evaluation of the effectiveness of iVirtualWorld showed positive results. The contribution of this study is threefold: 1) It provides a paradigm for investigating and developing 3DVW building tools from end users’ perspective; 2) It develops a prototype of a 3DVW building tool, which gives educators a framework to easily create educational virtual worlds using domain-specific concepts; 3) It conducts empirical research and collected preliminary experimental data for evaluation.

Keywords: 3D Virtual Worlds, End-User Development, Human-Computer Interface, Human Factors, Learning Environments, User-Centered Design, User Interface Design

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INTRODUCTION

Virtual worlds are online multi-user computer programs that mimic the real world. With technology advancements in computer graphics, multimedia, and broadband networking, today’s virtual worlds are capable of simulating the real world on computer screens in 3D. Each user joins a 3D virtual world (3DVW) through a visual representation called an avatar, which improves the presence of users inside 3DVW and motivates users to play with 3DVW (Mikropoulos, 2006). Inside 3DVW, avatars have the capabilities of navigating throughout the world; creating and manipulating objects; and communicating with each other. The object-creating, communicating, and collaborating features of 3DVW have attracted millions of individuals to play around inside 3DVW (Messinger et al., 2009). Virtual worlds can be applied in training because they resemble real environments. For example, workers in dangerous environments such as underground mining could benefit from virtual world-based training (Nutakor, 2008). Virtual worlds provide a social platform for users to express their creativity, share information, and communicate with each other. Since their emergence, virtual worlds have also been appealing to educators because of their capabilities to foster and facilitate online learning, collaborative learning, and immersive learning in both K-12 and higher education (Choi, 2010; Collins, Bently, & Conto, 2008; Hew & Cheung, 2010; Messinger et al., 2009; Styliani, Fotis, Kostas, & Petros, 2009; Turkay, 2010). The avatars of the 3DVW increase students’ “sense of personal presence” in the learning environments, which helps them perform learning tasks successfully (Mikropoulos, 2006). The interactivity and three-dimensionality of 3DVW could increase students’ understanding of some concepts and motivate them to study the theory behind those concepts (Trindade, Fiolhais, & Almeida, 2002). Three-dimensional Virtual Worlds could also help more students understand science better and, in turn, attract more students to consider science related career (Turkay, 2010). The benefits of applying 3DVW in education motivate teachers and researchers to work together for a better combination of technologies and pedagogies.

Previous studies have shown both benefits and problems of using 3DVW in educational settings. One concern was the technological difficulties in creating and using virtual worlds (Chou & Hart, 2010; Woodfield et al., 2005). In order to render simulated scenes on computer screens that are similar to the scenes in the real world, virtual worlds apply advanced computer graphics and related technologies. Computer graphics concepts were integrated into virtual world building tools and were difficult to understand by average educators and other non-technical users. In addition, enabling animation and interactive features provided by virtual worlds requires certain programming skills. Average users do not have the background knowledge and training in programming and seldom have sufficient time and talent to learn, write, and debug scripts used in 3DVW. The steep learning curve of virtual world technologies has become a barrier faced by non-professional users of 3DVW (Chou & Hart, 2010; Indraprastha & Shinozaki, 2009). Michael Dowdle, the Vice President of Business Development with Kaneva, commented on Second Life, one of the most popular virtual worlds: “Second Life … is a complex open platform to be creative and for building 3D spaces and items. However for the masses, it can be difficult to use with its steep learning curve for creating virtual items.” (combinedstory, DMD New York, & Market Truths, 2007) New Media Consortium (NMC), an international nonprofit consortium of learning-focused organization, conducted an online survey concerning educators’ point of view of the current status of virtual worlds, which collected 273 responses. In the answers to the question “What is the number one barrier to broader adoption of virtual worlds by your institution?”, “learning curve” is identified by most respondents (Levine, 2010).

A steep learning curve implies that virtual world building tools are difficult for novices to learn and grasp because of the complexity of the environments and high technical require-
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