

Using 3D worlds in an educational network

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Abstract

Based on their ability to represent reality in micro or macro scale, 3D representations have been extensively used as main or supporting educational tools. Researchers, educational institutes and organizations confirmed the usefulness of virtual environments as educational tools, either by developing 3D environments tailored to their needs, or by exploiting existing infrastructure and platforms. This paper presents how a general purpose 3D virtual environment can assist as an educational tool. More specifically, we describe the deployment of a course in a 3D virtual environment focusing on the technical aspects and on the required preparations. The outcomes of this work can be employed by researchers and educators, who plan to deliver their courses in a 3D virtual environment. Finally, this work can be scaled up to a virtual educational environment for the Greek University or School Networks.

Keywords: virtual learning communities, 3D virtual environments, Open source

1. Introduction

Recent improvements in ICT, such as broadband connections and powerful processors, which are nowadays available in most universities and secondary schools, have created new opportunities for educational software. High quality multimedia applications that utilize 3D graphics and real-time simulation and 3D virtual environments (3DVEs) are useful tools in teachers' hands. Undeniably, the physical presence of participants and the sense of a shared experience inside the classroom is an integral part of the educational process. However, 3DVEs offer new opportunities in combining the training capabilities of distant and synchronous communication with the common sense of presence and active participation. In a 3DVE for education, students create their virtual personas, join the virtual world, interact with objects and collaborate in order to carry out educational tasks. Depending on students' awareness of the platform, the tutor can be present and act as presenter, advisor or facilitator or can be absent, thus allowing students to act freely. In any case, learning in classroom cannot be replaced but can be supplemented or enhanced by student-oriented collaborative activities in the virtual world.

The aim of this work is to present our experiences from employing 3DVE as part of a blended learning process in secondary education. Part of this work is to provide comparative evidence on several state-of-the-art 3DVEs and suggest a solution that

can be easily adopted by the Greek University or High School Network. In this direction, we provide details on the prototype deployment of the selected 3DVE in the intranet of a high school. Finally, since learning in a virtual environment is a collective work, we illustrate further the structure of the virtual educational community and the roles of students and educators.

In the following section, we present an overview of 3DVEs and justify our selection. Section 3 provides details on the design of the prototype online course. Section 4 presents related work and section 5, our conclusions from the use of the 3DVE.

2. Choosing the appropriate 3DVE

Having in mind the requirements for a 3DVE platform used for education -openness, availability, re-usability of content and portability- we reviewed several platforms.

Active Worlds is a general purpose 3DVE, which offers a specialized educational community (AWEDU). However, it is not open source and full capabilities, such as object creation and composition, file exchange, synchronous and asynchronous text and voice based communication, one needs to pay a registration fee. Nevertheless, several research works [Dickey (2005), Ang & Wang (2006), Corbit (2002)] agree that AW can support formal or informal learning in different age groups. Project ***Wonderland*** is a Java Toolkit for building 3DVEs. Although it is open source and employs Darkstar [Burns, 2007], a 3D engine with many capabilities, it is still in an early version (v0.5). ***Croquet*** project and its successor ***Open Cobalt***, offer many communication, visualization and virtual learning solutions and have been used by several universities, such as the University of Minnesota, the University of British Columbia [Smith & Kay (2003)] etc. Cobalt is based on a peer-to-peer architecture and runs in its own virtual machine. However, it is in the pre-alpha version too. ***Second Life*** (SL) is the most popular 3DVE. It is mainly a consumer application but has been used extensively by universities (e.g. MIT, Harvard, Edinburgh University etc.). It offers distant learning capabilities that allow teachers to design, implement and support online courses easily. SL allows public access and thus follows a restrictive policy for non-adult members, which requires a costly and complex registration process. ***OpenSim*** is another open source solution, which offers high compatibility with SL and communication protocols for other platforms. Although, it is yet in the alpha phase of development, it is used extensively by universities and big companies (such as IBM, Microsoft, etc). Table 1 summarizes the platforms' features.

The 3DVE platform must be free and open source so that it can be adapted to the community needs. Content creation should be easy for non-experts and the ability to import content from external libraries is desirable. Finally, it should allow web browsing, text and voice communication and file sharing capabilities. SL is the most popular of the platforms but it is not open source. Cobalt and Wonderland are mostly APIs than virtual environments and are not simple in their use. Finally, Active Worlds

is a rather old platform with limited capabilities. OpenSim's interface and engine are similar to SL, and moreover, it is open source and supports script imports. For all the above reasons, it became our selection for the community.

Table 1. Characteristics of the 3D platforms

	Active Worlds ¹	Wonderland ²	Croquet ³ Cobalt ⁴	Second Life ⁵	Open Sim ⁶
Open source	No	Yes	Yes	No	Yes
Free Client/Server	As guest/Yes	Yes/Yes	Free peer	As guest/No	Yes/Yes
Objects' Library	RenderWare TrueSpace script		Google 3D	Proprietary	OpenSim forge, Google 3D ,SL
Language	C	Java	Smalltalk	C++	C#
Focus	Education (AWEDU)	Any	Any	Business	Any
Capabilities	web browsing, voice chat, basic instant messaging				
	-	application sharing		easy content creation, uses scripts	

¹<http://www.activeworlds.com>

²<https://lg3d-wonderland.dev.java.net>

³<http://www.croquetconsortium.org>

⁴<http://www.duke.edu/~julian/Cobalt/Home.html>

⁵<http://www.secondlife.com>

⁶<http://opensimulator.org>

3. Deploying and running a prototype course

3.1. Client/Server Deployment

The number of terminals and the size of the world set the requirements for the OpenSim server. For a virtual area of 10000 objects, of similar numbers of images and scripts, accessed by 10-15 clients, we need 5-10 GB of hard disk space at least 512MB of RAM (the more the better) and a dual core processor for the server. The installation of the OpenSim server was performed on the lab's server, which had an AMD x2 2,3 Ghz processor, 2 GB RAM, 500 GB Hard disc space, onboard graphics card and was running Windows XP SP3. The Hippo OpenSim client software was installed on every terminal in the computer lab, which had an AMD x2 processor, 1GB RAM and an Nvidia onboard graphics card. A MySQL database on the lab's server was used to store the world's 3D objects and the objects (and avatars) created by the students. The prototype configuration faced no performance problems even when all nine terminals accessed the server concurrently.

When the requirements from the server increase, OpenSim enables to interconnect more than one server to a collaborative grid. Servers can be located on distant places, thus allowing more than one classes or schools to connect to the same 3DVE.

3.2. Content and activities design

The next step is the design of the 3D world, which can be significantly accelerated by the use of open source 3D templates for buildings and auxiliary spaces. Objects from previous courses in SL have been imported and re-used in the prototype course.

Additional 3D objects required for our activities were created by combining basic shapes (such as squares, balls or pyramids) and formatting their properties (i.e. size, appearance, material, object's attributes, etc.). Finally, existing content, such as text, images and multimedia presentations have been embedded in the 3DVE. The students had the ability to interact with the 3D objects and read information about their role and function by clicking with their mouse on each object. Simultaneously, the students were enabled to watch an online slide presentation in the 3D environment.



Figure 1. Open Sim course

3.3. Members training and facilitation

Since the virtual environment can be demanding for novice users, it is necessary to allow teachers and students to become familiar with it. Although the environment is not very complicated and the composition of scripts is fairly simple, teachers with no or little previous experience of using 3DVEs need to spend some time in order to get use to navigation, use of objects, communication etc. Some additional training on how to create content and activities specialized to the 3DVE will be helpful. In our prototype course, a short seminar on the use and characteristics of the environment and an experimentation session where students created their avatars and explored the world were enough for the students to get accustomed to the environment.

4. Related Work

The supporters of 3DVEs claim that the use of 3D representations and the ability to interact with objects, favors constructivist learning [Bricken & Byrnes (1993), Winn (1997)]. Their antagonists claim that the absence of physical contact and the restricted capability to convey non verbal messages hinders the educators' mission. Although

3DVEs cannot replace physical contact and real life experiences, they can be inexpensive yet valuable solutions for teachers, and they can be used as a basis for creating richer forms of interaction [de Freitas (2008), Tsiatsos & Konstantinidis (2007)]. They can also be used for building persistent learning spaces, where students may interact without the presence of their teachers [Dawley (2007)]. In all cases, the comparison between traditional, online and blended learning is outside the scope of this work.

5. Conclusions

Students' comments suggest that they found the 3D environment interesting and amusing. It improves the ability of students to construct objects, to learn and share their knowledge. It allows collaborative tasks to be assigned to student groups and educators to co-ordinate and support students' activities. The ability to interconnect virtual world in OpenSim gives the opportunity to create a wider grid for communication among distant school units of the Greek school network which could become a virtual educational community for both students and teachers. The next steps of our work is to attempt to deploy the same course across more than one schools thus allowing students from different backgrounds to interact in the same virtual environment.

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