# DELIVERY OF MULTIMEDIA EDUCATION CONTENT IN COLLABORATIVE VIRTUAL REALITY ENVIRONMENTS

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*Abstract -The development of Collaborative Virtual Reality Environment (CVRE) for education is a challenging process. One of the many challenges faced during the development of CVRE is the creation, transfer and delivery of educational multimedia content. This multimedia content could include images, voice, video and their combination.*

The overall goal of this project was to develop a fully integrated system that allows the faculty and students to seamless share multimedia material. This paper describes the system and technology used for its development and its integration with the CVRE used - Second Life. Second Life is an Internet-based virtual world with a downloadable client program that enables its users, to interact with each other.

The results from this project are expected to help other faculty to migrate their current multimedia educational materials using the system described here for the benefit of the students in the classroom.

*Keywords:* Virtual Reality, Multimedia, Learning, Share, Technology

## INTRODUCTION

Graduation from Science Technology Engineering and Mathematics (STEM) programs has declined by as much as 25 percent over the last decade despite a critical need for the next generation of engineers and scientists [1]. Part of the challenge for educators is to find new methods to delivery educational content in a way that is compelling and engaging. New instructional technology is sweeping through the primary schools with the widespread adoption of interactive whiteboards. The British Educational Communications and Technology Agency (BECTA) estimates that as many as two thirds of all primary grade classroom in the UK will have interactive whiteboards by 2010 [2]. This wave of innovation has not reached the college level although many university programs have experimented with Collaborative Virtual Reality Environments (CVRE) as a new similarly revolutionary educational medium. A non-exclusive list of universities which are currently experimenting with Collaborative Virtual Reality as an instructional medium includes Georgia State University, Atlanta, GA; University of Notre Dame, South Bend, IN; University of Louisville, Louisville, KY; University of Edinburgh, Edinburgh, Scotland; University of Hamburg, Germany; Penn State University; Ohio State; and San Jose State University.

Virtual content in CVRE is developed collaboratively by each region's residents. This provides unique opportunities for students to work together in new and innovative ways [3, 4, 5, 6, 7, and 8]. One barrier to wider adoption of CVRE is the level of technical expertise necessary to host a class and present classroom materials to students. For example, in Second Life™, the most widely used CVRE platform for education, setting up presentation materials and multimedia requires quite a bit of expertise, and dynamically changing media in the middle of a presentation is complicated and error-prone even for an expert. This paper introduces new technology that allows non-expert

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instructors to plan, deliver and change on-the-fly multimedia presentation delivered within the Virtual Environment. The aim of this technology is to allow more STEM instructors to experiment with a compelling and engaging new instructional medium.

## Classroom Presentations in Second Life™

First, a quick overview of the various commonly used methods for classroom presentation in Second Life™:

**Posters -** Various images, including PowerPoint slides, can be set up and displayed the environment as shown in Figure 1.  This is accomplished by uploading the images and dragging them onto a flat rectangular object.  This is fine for semi-permanent exhibits but is not very effective for presentation, as the instructor has to hunt for each image individually.



Figure 1 - An example of posters in Second Life™ from the American Chemical Society site.

**Preset Slide Projectors** - An enhancement over the basic poster can be made by placing several images or slides in an object and scripting buttons to advance or reset the presentation as shown in Figure 2.  This is somewhat more effective but requires preparation in advance of each lecture and is more appropriate for a workshop with set content.



Figure 2 - An example of virtual slide presentation from the CVRE 2008 workshop
hosted by the University of Chile [9].

**Video Presentation** - Quicktime videos can be displayed in the virtual environment through manipulation of a region's "media texture" and "media URL".   Rather than displaying the texture Second Life™ displays video content from the media URL.  Second Life clients deliver interactive Virtual Reality by streaming series of commands to central servers at Linden Labs.  Multimedia is delivered to clients by a different

decentralized mechanism. Each client retrieves the media settings and URLs from the avatar's current region. Media is then streamed directly to each client computer without going through the Linden Lab's server. In the case of video, Quicktime output is "scraped" and displayed in the virtual world replacing the media texture with the desired content. An overview of this architecture is displayed in Figure 3. Unfortunately, manipulation of the media texture and media URL requires both expert knowledge and administrative access making classroom use a special event rather than a routinely used tool.
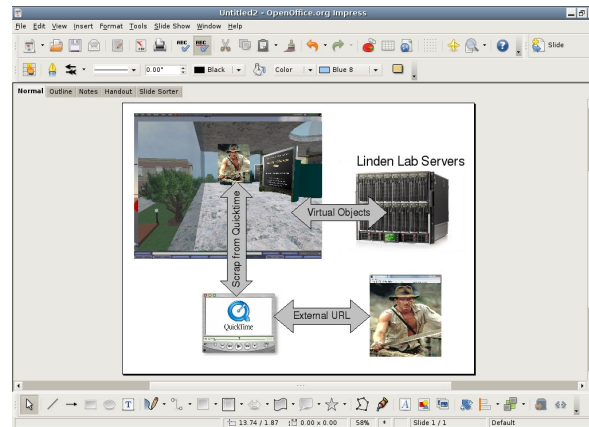


Figure 3 - Architecture of embedded video in Second Life™.

**Web Page Display** - A new feature in Second Life™ allows web page content to be displayed on a texture in the environment. This opens up the possibility for many new types of presentations but as with video presentation setting up and changing a web-based embedded presentation requires direct manipulation of the media texture and URL as shown in Figure 4.
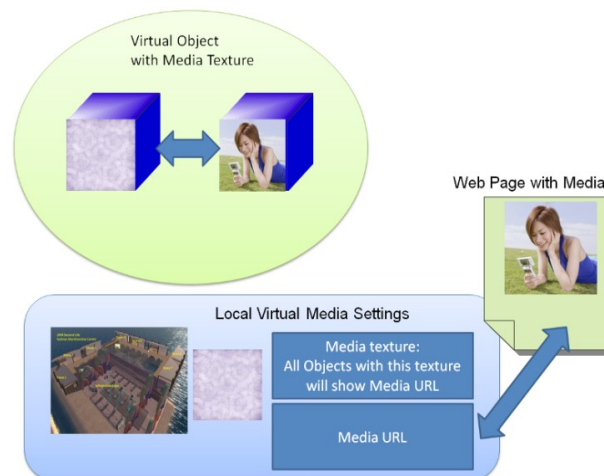


Figure 4 - Architecture of embedded web content in Second Life™.

None of the above methods is really satisfactory for generalized classroom presentation Virtual Reality. This was the motivation for developing a new hybrid presentation technology which provides both easier access and more dynamism to Virtual classroom presentations.

## THE MULTIPURPOSE VIRTUAL MULTIMEDIA SELECTOR (MVMS)

Multipurpose Virtual Multimedia Selector (MVMS) technology consists of several interlocked dynamic components: 1- Administrative Web Portal, 2- Dynamic Virtual Signs, 3- Content Selection Tools and 4- Embedded Multimedia Players,. The basic game plan is to allow the presenter to set content through the web portal, which is

much more intuitive and does not require the presenter to have administrative access to virtual region. Once content is set, dynamic signs can display listings of this content in the environment. Selection tools allow the presenter to dynamically chose the current media. This content is then presented through a variety of media screens. An overview of this architecture is shown in Figure 5.
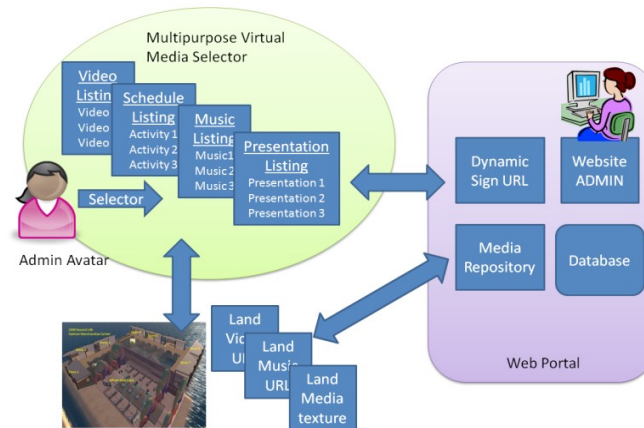


Figure 5 - An overview of Multipurpose Virtual Multimedia Selection Technology.

Administration of a presentation is then achieved through a PHP-based web portal which provides simple entry and upload forms to make presentation elements available in the environment. An example of a web-form from the MVMS portal is shown in Figure 6.



Figure 6 - Web administration of presentation content.

The operation of the "Virtual Sign" is very simple. As the user approaches the Virtual Sign he or she is presented with a dynamic information reflective of the choices made by the presenter through the web portal as shown in Figures 7a and 7b.

Figures 7a and 7b - A dynamic sign that displays content set through the web portal.

This enhancement is made possible by pointing the media URL of a small region around the Virtual Sign to a PHP page that reflects the current presentation choices. A more sophisticated content selection sign which allows the presenter to chose listings of available audio, video and slide presentations is shown in Figure 8.



Figure 8 -A multimedia content selector sign which allows the user to chose from a wide range of media items in different categories (the green and yellow buttons on the left of the sign).

Multi-level content selection is made possible by scripted manipulation of the local media URL and texture that redirects the sign to the selected content. Thus, when the clicks on the "select music" button on the frame of the sign the region media URL is reset to the "displayMusicSelections" communication page. Essentially all the steps taken manually by and administrator are automated with data stored in the web portal. MVMS thus provides educators with the ability to schedule and present in the CVRE without lengthy preparation and in a flexible modifiable-at-a-moment's notice way. Figure 9 shows a typical MVMs presentation environment where multiple people that may be spread over large distances can listen and watch multimedia content while collaborating in the environment.

Figure 9 - A multimedia presentation environment which can dynamically show any content uploaded to the web portal.

For STEM education specifically this opens up new instructional possibilities by enabling new combinations of Virtual simulation and collaborative design with instructional presentation. Figures 10 and 11 show recent example of combinations of virtual reality with MVMS technology for educational presentation.
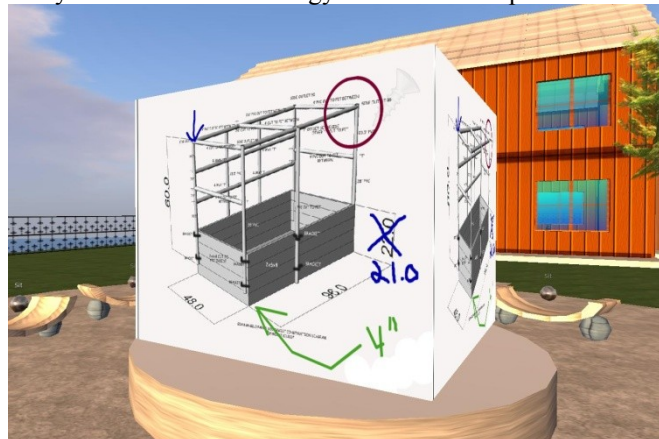
Figure 10 - A Construction Engineering exercise in Collaborative Virtual Reality using MVMS technology.
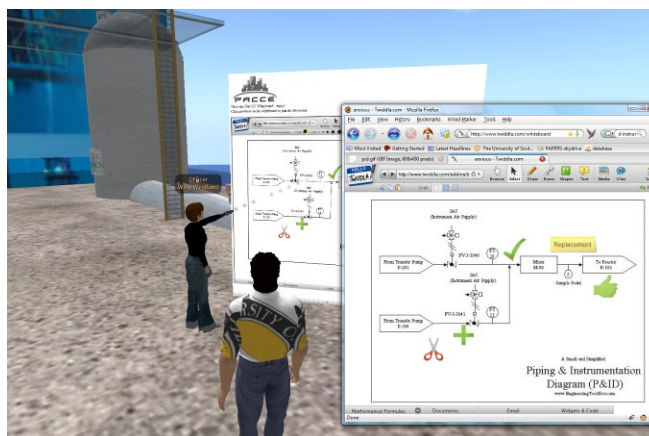


Figure 11 - A Refinery Operation exercise in Collaborative Virtual Reality using MVMS technology.

## SUMMARY

Collaborative Virtual Reality Environments (CVRE) have the potential to revolutionize distance education by allowing users to interact with a computer-simulated environment, be it a real or imagined one  as well as taken advantage of multimedia educational materials including images, voice, videos and their combination.

The approach presented in this paper using Second Life as a platform for the CVRE  and multiple server to store and manage the multimedia content will allow the educators to use their current multimedia material with minimum effort.  Furthermore, the administrative tools developed by the research team allow non-technical people the ability to schedule and present in the CVRE without lengthy preparation.

The results from this project are expected to help other faculty to migrate their current multimedia educational materials using the system described here for the benefit of the students in the classroom.

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