Chapter 27
Stakes and Issues for Collaborative Remote Laboratories in Virtual Environments

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ABSTRACT

The mainstream adoption of remote laboratories and 3D virtual environments for teaching in the field of electrical and electronic engineering education is continuing to grow. This chapter will investigate opportunities and issues related to the integration of remote laboratories and virtual worlds in this context. Some practical implementations of this integrated approach using the Sun Wonderland project and Second Life will be discussed with a particular focus on the perceived advantages of virtual worlds, e.g. collaborative group working, group awareness/interaction, and the 3D Graphical user interface. From this discussion initial guidelines related to creating a standardized architecture for integrating remote labs into virtual worlds are presented and the role of each individual component of the architecture catalogued.

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INTRODUCTION

Remote laboratories allow diversely located users to access and perform remote experiments on a broad range of real hardware devices from a distance, reducing the need for travel to access on campus resources. However, remote laboratories are not meant to fully replace traditional on campus laboratories but to complement existing resources offering a blended learning solution where remote access is sometimes seen as "Second best to being there" (Aktan 1996).

Online Laboratories in this context are usually categorized as follows:

- *Virtual Laboratories*, which do not use real hardware devices but use simulators to emulate real physical phenomena,
- *Remote Laboratories*, which entails the remote access and control of real hardware devices over the Internet,
- *Hybrid Laboratories*, which are typically an integration/mash-up of virtual and remote laboratories where elements of the user experience is simulated.

This paper focuses on the area of remote laboratories where the majority of existing laboratories are Web-based using client side, lightweight Graphic User Interfaces (Gravier 2008, Gonzalez-Castanoa 2001, Schmid 1999). From the perspective of this chapter this two dimensional representation of remote laboratories, while both functional and accurate, can limit the user's overall experience, restricting their interactions to interfaces which recreate the physical attributes of a piece of test equipment or instrumentation but do not allow the presentation, manipulation and interpretation of remote data resources in new and engaging ways. The current trend in this area is to accurately recreate the Graphic User Interface of the remote device to ensure the user learns how to use the device remotely and can subsequently transfer these skills to real physical laboratories. This approach is useful in the majority of cases e.g. testing a device before purchasing it, but does not maximize the possibilities that new and emerging web based technologies now offer.

There is a lot of common ground in the use of remote laboratories and 3D virtual worlds in an educational context. In the majority of cases, the primary objective in both instances is to recreate the positive aspects of physical classrooms and laboratories remotely e.g. peer support, collaborative learning, non-task oriented discussions and creation of social network for learners'. This follows a social constructivism theoretical approach which states that a strong supporting social aspect to learning, particularly in the case of scientific materials is essential (Roussos 1997, Gravier 2009). From this perspective peer support is extremely important for learners and as educators we should ensure that these elements of campus based learning are facilitated/recreated as much as possible in remote laboratories. This is a key theme of this chapter i.e. how to successfully recreate the benefits of classroom based learning in remote laboratories.

Virtual worlds continue to be increasingly mainstream and are used in many domains and applications ranging from entertainment (Castronova 2005), serious gaming, learning (Fox 2009, Cheney 2007, Farr 2009), social networks, medical applications (Diener 2009) and robotics (Prattichizzo 2009) amongst many others. A key element of the virtual world experience for users is their virtual representation or avatar in a virtual space. The virtual embodiment of their physical self is important in virtual spaces as it is represents and presents a sense of presence to other users clearing stating the user's in-world identity. It also gives users a "sense of being there" in a virtual space, facilitating a diverse range of avatar interactions and a sense of group awareness. As a direct consequence it seems the next logical step to investigate the integration