Chapter 39
AutomatL@bs Consortium:
A Spanish Network of Web-based Labs for Control Engineering Education

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ABSTRACT

This chapter describes the effort of a group of Spanish universities to unify recent work on the use of Web-based technologies in teaching and learning engineering topics. The network was intended to be a space where students and educators could interact and collaborate with each other as well as a meeting space for different research groups working on these subjects. The solution adopted in this chapter goes one step beyond the typical scenario of Web-based labs in engineering education (where research-groups demonstrate their engineering designs in an isolated fashion) by sharing the experimentation resources provided by different research groups that participated in this network. Finally, this work highlights the key points of this project and provides some remarks about the future use of Web-based technologies in school environments.

INTRODUCTION

The evolution of the Internet has changed the education landscape drastically (Bourne et al. 2005, Rosen 2007). What was once considered distance education is now called online education. In other words, the method of teaching and learning is based on the use of the Internet to complete educational activities. A specific example of this new teaching model is the Spanish University for Distance Education (UNED). Compared to other Spanish universities, this institution has the largest number of students because distance education allows students to obtain a degree or improve

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their professional skills without having to change their lifestyles. UNED is not a unique institution; there are many universities around the world with an online presence, such as the Open University in Colombia, Open Universities in Australia, the Open University in UK, the Open University in Catalonian, Fern Universität in Germany, and many more. The existence of these institutions confirms the viability and importance of computer-assisted teaching and learning through the Internet.

The implementation of a distance learning model is not an easy task in engineering and sciences studies (Williams 2007). In addition to textual/multimedia information and other resources required to demonstrate theoretical aspects in an online course, hands-on laboratories should also be included. This requirement is particularly necessary for control engineering, which is an inherently interdisciplinary field in which progress is achieved through a mix of mathematics, modeling, computation, and experimentation (Astrom 2006). In this context, students should be able to

- Understand the underlying scientific model of the phenomenon that was studied.
- Become acquainted with the limits of the model (i.e., how does the model accurately reflects real behavior and to what extent it remains a basic approximation).
- Learn how to manipulate the parameters of the model in order to fine-tune the behavior of the real system. (Dormido 2004)

To achieve these goals, the implementation of an effective Web-based educational environment for any engineering topic should cover three aspects of the technical education: concept, interpretation, and operation. The student should be provided with an opportunity to become an active player in the learning process (Dormido et al. 2005). In this context, the potential for Web-based experimental applications such as virtual laboratories (Valera et al. 2005), remote laboratories (Casini et al. 2004, Brito et al. 2009) and games (Eikaas et al. 2006) as pedagogical support tools in the learning/teaching of control engineering has been presented in many works. In fact, in the last decade, several academic institutions have explored the World Wide Web (WWW) to develop their courses and experimental activities in a distributed context. However, most of these developments have focused only on the technical issues related to building Web-enabled applications for performing practical activities through the Internet (e.g., how to start up remote monitoring of a real device or how to build sophisticated virtual interfaces). At most, these implementations may include a set of Web pages with a list of activities that need to be carried out by the users. Some examples of these implementations are provided in the additional reading section at the end of the chapter. In general, these developments do not take into account the social context of the interactions and the collaboration that is typically generated in traditional hands-on laboratories (Nguyen 2007). Indeed, direct contact with teachers and interactions with classmates are valuable resources that may be reduced or even disappear when hands-on experimental sessions are conducted via Web-based laboratories.

New trends in the use of Web-based resources for teaching and learning in the engineering disciplines include the use of Web 2.0 technologies such as social software in building virtual representations of face-to-face (f2f for short) laboratories in a networked, distributed environment (Gillet et al., 2009). This objective was grounded in the idea that educational institutions and many workplaces are equipped with a type of tool that connects people, contents and learning activities and can thus transfer information and knowledge. *Learning to learn* is the new challenge for the new generation of students. In other words, they have to learn to use Web resources to improve their teaching and learning.

Commonly, a mix of Web-based technologies and software agents (Salzmann & Gillet 2008) is used to develop remote experimentation systems

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