Web-based Integrated Environment for Self-learning Electronics: the Analog and Digital Laboratory at Home

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Abstract:

In this work, a Web-based platform for the integrated remote access to the resources of the specialization laboratories of the Engineering Electronics Department at the Telecommunication Engineering School of the UPM will be presented.

The aim is to improve the learning process in electronics courses, by increasing the students autonomous work through the use of self-learning activities.

For that, the system provides a remote and integrated access to several laboratory resources: 1) licensed design and simulation software for microelectronic circuits; and 2) real FPGA prototyping platforms for digital electronics.

Target students are twofold: 1) students from the Electronics specialty are allowed to remotely access the laboratories, getting benefit from an extended timetable; and 2) students from different courses (e.g. theoretical) are enabled to use the resources to perform small exercises, even if they have no access rights to the laboratories.

Additional features of the environment are: 1) security, 2) identity authentication, 3) reduced resources needed at the client side, and 4) automatic collection of statistical information on resource usage to facilitate assessment.

The advantages of the approach are the following: 1) it maximizes the use of limited available resources; 2) it extends accessibility for students, so that distance learning is supported; and 3) it encourages students to perform self-learning.

Currently, the inclusion of autoevaluation capabilities is been addressed.

1 Introduction

Bologna process
Use of information and communication technologies
Remote laboratories
Previous works at the Engineering Electronics Department
2 The Web application

Self-learning
Single Web platform
Additional goals
Students, teachers and administrators
Assessment of the approach
The final assessment of the Web application will be based on data obtained from real experience with students, through:
- Automatic collection of statistical information about resource usage.
- Anonymous opinion polling made among users.

3 Brief system description
Our specialization Laboratory is currently made of four Linux-based computers, each one equipped with Electronic Design Automation (EDA) tools from Cadence® and an FPGA prototyping board.

Each host computer runs a Web server to provide remote access, which makes use of all the available resources through the use of JSP and PHP application code. We use server programming to allow interacting with the prototyping hardware and Cadence® command line utilities by the execution of several custom applications written in C and shell-scripting languages.

Since there are several desks available in the Laboratory, an additional computer has been set up within the same LAN to provide a single interface to the outside world. This is also a Linux-based machine running a Web server, with the following tasks:

− Access control, to restrict the use of the system only to registered students.
− Load distribution, to redirect each student to a free place or reject the request.
− Reverse proxy, to route incoming traffic to the corresponding host computer.

Within this architecture, we have accomplished one of our goals: minimum requirements are demanded on the client side, only a Web browser.

4 Conclusion and future work

In this paper we have introduced a Web-based framework to provide remote access to electronics laboratories with teaching purposes. The emphasis has been made in reducing the resources needed at the client side, so that a Web browser is enough. In this way, the framework will be useful for a great number of students, in different courses and subjects. To achieve these goals the application has been developed using a variety of technologies and development environments (VHDL, JSP, PHP, JavaScript).

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