WebLab-Deusto-CPLD: A Practical Experience

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Abstract— **The paper shows the experience of the University of Deusto with the WebLab-Deusto-CPLD at the "Programmable Logic" subject of the Faculty of Engineering in the field of Digital Electronics. Presented herein is a technical overview of the laboratory, and its characteristics.**

Keywords-component; Engineering education, Students experiments, remote laboratories

I. WebLab-Deusto Platform

A remote laboratory is a tool, which provides to students an access to real experiments through Internet.

At this moment in the classroom WebLab-Deusto is used with different experiments: WebLab-Deusto-CPLD, WebLab-Deusto-FPGA, WebLab-Deusto-PIC, WebLab-Deusto-GPIB, WebLab-Deusto-Logic, WebLab-DEUSTO-Microbot, VISIR, and LXI-VISIR. Furthermore the platform already supports new schemas based on Virtual Machines that will be used in the near future at the University. Fig. 1 shows the weblab.deusto.es page which includes demos, mobile lab, Facebook integration, and different options offered to students by WebLab-Deusto. The exhibition described in this work is centered in VHDL, FPGA and CPLD of Xilinx.
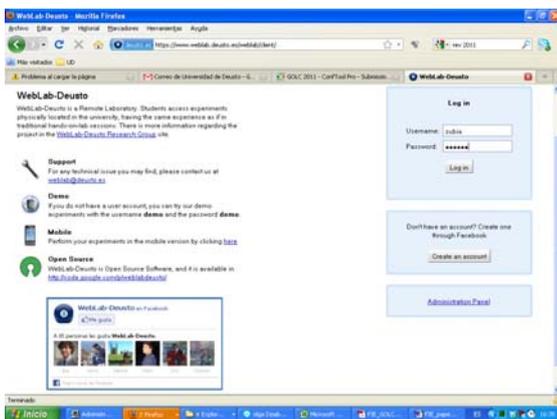

Figure 1. WebLab-DEUSTO main page and experiments

The WebLab-Deusto is an Open Source platform. It can be easily deployed to offer different remote experiments. It is important to distinguish between the platform that manages a number of remote experiments (rigs) and the domain-dependent remote experiments (i.e. "electronics remote laboratory"). MIT iLabs, LabShare Sahara [1] and WebLab-Deusto [http://www.weblab.deusto.es] are good examples of the rigs while VISIR [2] is a good example of the domain-dependent remote experiments.

Since February 2005, WebLab-Deusto is being used in production through different versions in the University of Deusto. Until September 2007, WebLab-Deusto was a domain-dependent experiment platform: WebLab-Deusto 1, and AJAX and web service based WebLab-Deusto 2. WebLab-Deusto 3.0 [3] manages different remote experiments, focusing on the software challenges and providing libraries for a wide range of development frameworks to make the development easy.

Todays WebLab-Deusto 4.0M1 is a robust platform that uses web standards suitable for mainstream web browsers, and adapts to mobile devices. It can be downloaded and deployed to serve new remote experiments in different environments and operating systems. The effort has been put to provide a secure and scalable design, using SSl in the communication and untrusting experiment developers in the management layers, and to track of the use of the system and the messages sent by students.

The system also supports different authentication schemes such as a regular database, LDAP, supported external students OpenID. It is extensible enough to be integrated in a number of platforms such as, Graaasp, Facebook, .LRN and Moodle, and to integrate external experiments such as VISIR.

In order to support a usage of hundreds of students, administration tools have been developed, which come out of the box with the available packages of WebLab-Deusto.

II. Subject and Remote Experiment

The University of Deusto is using the experiment WebLab-Deusto-CPLD for the subject "Programmable Logic". This subject is offered for the third-year students of Electronics and Control Engineering Degree.

The course includes VHDL –VHSIC hardware description language– which is used in electronic design automation to describe digital and mixed-signal systems such as field-programmable gate arrays and integrated circuits, and CPLD – complex programmable logic device. The course is based on the Project Based Learning (PBL) approach offering to the students the labs assignments and projects as main activities.

The students learn to program in VHDL, and to develop, implement and test the designs in an educational board in traditional laboratory. Weekly student´s assignment is to program, and to implement a design. Student decides how and on which equipment –remote or traditional labs– will execute the assignment uploading a video with the design running in the remote lab or in the classical lab. The remote laboratory is not a replacement rather a complement of the traditional lab to promote the autonomous and significant learning, and to support students.

In order to accomplish the assignment student writes the VHDL code (Fig. 2), simulates it (Fig. 3) and obtains a binary file.

```
53  process(inicio, clk)
54  begin
55  if inicio='1' then
56      cont_base<="1000000000";--"0000000000";
57  elsif clk='1' and clk'event then
58      if cont_base=999 then
59          cont_base<="1000000000";--"0000000000";
60      else
61          cont_base<=cont_base+1;
62      end if;
63  end if;
64  end process;
65
```
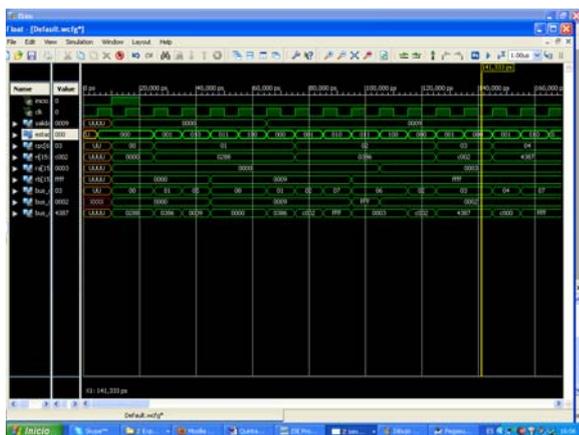
Figure 2. VHDL Code for designing

Figure 3. Simulation of a VHDL Code

Student accesses the WebLab-Deusto -a demo is available- using the university authorization validated through LDAP. Once logged-in she uploads the generated binary file. From this moment student has a control of the board during 200 seconds. The board is based in Xilinx CPLD XC9572 and its interface consists of 10 switches, 4 buttons, 1 clock, 6 LEDs, and 4 seven-segments. Then she tests the design using these inputs and sees an evolution of the system through the WebCam (see Fig. 4).

If the program is running properly, student records the results on video. Finally student uploads the program and the video into Moodle - LMS system of the University of Deusto. The use of WebLab-Deusto is an optional tool to complete the assignment.

Figure 4. WebLab-DEUSTO-PLD interface

Administration of the access to the WebLab occurs based on a priority queue. The platform automatically shows to the student availability and position in the queue, and gives the control of the experiment when student´s turn arrives.

III. CONCLUSIONS

The presentation of this work will be based in a real demonstration of WebLab-DEUSTO-CPLD during the conference. The experiment purposed is offered through the WebLab-DEUSTO architecture and it will be accessed with any web browser in any type of device (PC, lap-top, mobile phone or tablet) under any operating system without security problems with open ports and firewalls. These characteristics promote the deployment of this remote laboratory in other universities and institutions.

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