Web based simulation tools for virtual Labs

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Abstract:

The paper describes a web based virtual online lab using simulation tools. The used simulation tools can be included using existent web front ends or the technique of an application server. The paper shows the advantages of using virtual labs in educational environments. To simplify the work of virtual lab developers, an XML-technology for online Labs is introduced.

Introduction

The Carinthia Tech Institute (CTI) offers an evening study program for working students, setting an increasing demand for computer-based and internet-based training courses. The system concept of telelearning at the CTI is shown in the following schematic.

![Figure 1 System concept of telelearning at the CTI](image-url)
The central part is a Hyperwave Information Server [1], which fulfils the functions of user administration and dynamical design of documents. The server furthermore works together with other specialized servers [2].

Typical fields of use of online labs are:

- Telelearning, eLearning
- Demonstrations in lecture halls (classrooms)
- “Broadcast“ of experiments to groups of students/learners
- Industry, research institutes

### Online Labs

A key application of modern educational technology is elearning/telelearning with a Web-based approach. Lab work is becoming increasingly important in Web-based educational systems not only for engineering studies.

This contribution answers the question: How does one effectively set up a virtual online laboratory environment?

Let us start with a brief introduction to the basic concepts and ideas of online labs.

Simulation software becomes increasingly capable, because of this more and more experiments can carried out virtually. Thus, we have the following situation:

The experiment can be carried out real (i.e. at real hardware) or virtual (simulation). The experimenter can be local or he can execute the experiment from a remote location. This means: In a virtual lab, each experiment is simulated by using software (e.g. LabVIEW, MATLAB, ORCAD). The remote lab is designed to provide real-time experiments to students via the internet. In both cases experiment and experimenter are at different locations. Exactly there are the possibilities, shown in Figure 2.

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Experimenter</th>
</tr>
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<tbody>
<tr>
<td>real</td>
<td>local</td>
</tr>
<tr>
<td></td>
<td>Traditional Lab</td>
</tr>
<tr>
<td>virtual</td>
<td>Local simulation</td>
</tr>
</tbody>
</table>

**Figure 2:** Relation between experiment and experimenter

Remote labs and virtual labs are defined as online labs [3]. If parts of labs or experiments are in different locations, then one calls it distributed labs. Online labs have the following benefits:

- The user can login and carry out experiments from any place of the world at any time.
• Online labs provide extended access to expensive and/or highly specialized hard- and software. Labs give users the opportunity to work in the remote mode, which will become more and more important in engineering jobs.
• With online labs it becomes possible to share also experiences between different institutions and all over the Web.

Virtual Lab Project VELO

CTI implements the project VELO (Virtual Electronic Laboratory) with other partners. The binding of various tools for simulation is made by Web interfaces. Some simulators (for example MATLAB) have already a Web interface. So it is easy to use it in the lab configuration.

For others, like ORCAD, with the help of the Citrix Application Server [4] an appropriate solution was compiled. This solution is for all Windows based simulators and programs applicable (see Figure 4).

In VELO the tools MATLAB, ORCAD and PAC-Designer are supported at present.

All experiment descriptions, tasks, and background materials are presented as HTML sides. Thus, on the client side, (student, user) only a standard web browser is needed.

Part of the virtual lab is furthermore a new Web-based evaluation tool. It supports both the tutor’s preparation and the implementation of the evaluation with the students with the help of Web forms. The following queries are possible: multiple choice, value, and keywords. To give the possibility to use the tool also in other applications, user interface, data storage and Web page design are strictly separated. The system supports different tracking functions.

![Figure 3: Binding of the simulators in the project VELO](image)

The great advantage for the student with the use of the online laboratory is that he can use it independent from place and time. Such courses are distributed via the Internet or CD (Web-based leaning, Computer-based learning).
XML-Templates for Virtual Lab Environments

The problem for the lecturers is, that they now are authors of eLearning material. But the design and develop of so-called eLearning courses is a very complicated process. Furthermore, different document formats are needed, the eLearning material is interactive (simulations) and special knowledge for example, in html programming is necessary. So it is a hard job for a lecturer to design his lab work as an electronic one. In this context, it is a good idea to use XML (Extensible Markup Language). XML is a meta-markup language for text documents. Data is included in XML documents as strings of text, and the data is surrounded by text markup that describes the data. That means: data and design of a document are saved in different files. So, contents are raw data with so-called tags for structuring. This makes it possible to generate different document formats from the same XML document.

For example
- html for the presentation of course contend in the Internet
- pdf for printed issue of scripts
- audio files
- wml for PDA’s.

So, if the contend changes, only the data file (xml) has to be edited. Carinthia Tech Institute, Villach and AdVIS GmbH [5], Dresden developed full functional XML templates and the necessary style sheets (xsl, css) for use in online labs and eLearning. Furthermore there is a very helpful XML editor for this style sheets. So an author can do his work very easy and comfortably. Because “Learning by Doing” is an important part of modern education, the XML templates give the possibility to add simulations with any software tool. All necessary calls and links the editor automatically generates. To give the possibility to use the templates also in other applications, environment, content and simulations are strictly separated. On the client side only a standard Web browser is needed.

References:

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