17th Symposium IMEKO TC4, 3rd Symposium IMEKO TC19 and 15th IWADC Workshop
Instrumentation for the ICT Era
Sept. 8-10, 2010, Kosice, Slovakia

E-multitask server in virtual laboratory applications

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A b s t r a c t – This research project aims to minimize the time of accomplishing of a set of laboratory work using real measurement instruments with a virtual laboratory. Virtual laboratory users, usually students, will access the actual distance measurement system through a web interactive interface without expecting the system release when multiple users access at the same time measuring system. Using web application, information about each user is stored in a database which will contain also measurement results obtained by each work in laboratory. This project improves the system of e-learning and help students to perform laboratory work necessary in the measurements field. To limit access time working at the stand during the experiment, measurement system uses a new server type E-multitask to take over the implementation phases of laboratory activity that does not require exclusive access to hardware resources of working stand.

I. Introduction

In higher education especially, the increasing tendency is to create a Virtual Learning Environment (VLE) in which all aspects of a course are handled through a consistent user interface standard throughout the institution. Virtual education is a term describing online education using the Internet. A virtual program (or a virtual course of studies) is a study program in which all courses or at least a significant portion of the courses are virtual courses. Many virtual study programs are mainly text based, using HTML, PowerPoint, or PDF documents. Most virtual study programs use an e-learning platform (Learning Management System – LMS) to administer students and courses and to provide learning content. Among them are Blackboard, WebCT, Moodle, JoomlaLMS, SharePointLMS, Tadaros and many others. The Virtual Laboratory may be a software platform that simulates the operation of measurement instruments but can be a software platform that brings in the web environment the results of actual measurements in real time.

A. Web interface

Web interface is the connection between the user and the actual measurement system.
The users access a remote measurement system and the web interface will help to understand its functioning. Web interface should be attractive, should have a small response time and must be understandable to all users. This interface involves a number of web pages, each page addressing one specific task. Web interface runs on a web server that will call an application server and the tasks can be summarized in the following:

- create new user accounts;
- opening work at the request of a certificate user;
- possibility of selecting a set of specific tasks experiment;
- facilities have to download various files regarding the laboratory work: laboratory presentations, explanatory videos, links to other sources;
- open a dialogue between server and user that he should be able to set their work schedule by programming matrix switches;

- implementation of the queue for accessing the hardware resources;
- dialogue with the server to initiate experimental work;
- taking experimental data from the work server;
- sending results back to the user.

Being a web server, it allows simultaneous connection of several users, each of them working with its own testing scheme and their settings for the reconfigurable platform. Until it completes the entire dialogue between user and web server, it does not deal with anything from hardware resources of application server leaving him free to carry out other works which have passed the stage of dialogue and programming.
Thus essentially reduce access time to hardware resources in the conduct of laboratory work, enabling many more users to perform various experiments in unit time.
Web application can be accessed by 3 categories of users: the administrator who has access to all system resources, teachers, who can insert and modify teaching materials or student status and students, who can download educational materials, can check their online catalog notes and can perform their laboratory work.
The administrator creates special user accounts to run virtual laboratories. In this way, limited access of the experimental stands, only users who have created works in the special account can run the virtual laboratory. In the opening page for a new work session the user is prompted to enter his username and password given by the administrator. The purpose logging software is downloaded from the ASP.NET library and it includes all the features of saving and checking accounts in an internal database (ASPNETDB.MDF). After the successful introduction of the password, the user has access to the page with laboratory work that can be performed on-line. In the left frame is presented the list of works, selecting a work from the list will automatically in the main frame the work.

Figure 1. Opening work session

Students read the laboratory documents and then follow the link “Make a laboratory work”. At this point the laboratory work is added to the waiting list for accessing the work server. Queue is implemented as a file on the hard disk. When launched a new laboratory work, the web server takes up the file list of all works and attached to the tail end the new planned work. Web server supplies to the queue file the new planned works, while the work server deletes from queue the works which had been executed. Thus, the system implements a list of FIFO (First In First Out) type which is fueled by the web server, with new laboratory work selected from various work sessions and server applications empties the list of works by execution of the work of the tail head. Access to file is made by automatic, if one server open the file, it can not be accessed by other server until its closure by the server owner. So, it avoids situations that can lead to blockage by simultaneous access from several points on the same hardware resource.
After the addition of laboratory work in the queue, the web server must wait for that session until the work will be executed by other server and will be available the results obtained by the experiment. After execution of the work and reading the results of various working points of the scheme, application server saves these results as graphics or text files. Web server reads files and displays the results on this page session.

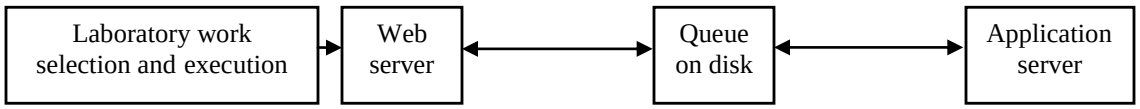

Figure 2. E-multitask server operation

B. Actual measurement system

The actual measurement system is responsible for the accuracy of measurement results and is suitable architecture laboratory works to be carried out. Used in this sense is a configurable board that will operate in accordance with the configuration chosen by the user. Configuration programming is done with a programmable matrix with 256 switches (8 lines by 32 columns). Every switch is commanded by a code sent to the matrix and each time must be connected one active source on line or column.
An acquisition and generation data board is used for generating digital or analogic signals for platform configuration and also for the signal acquisition representing the measurement results which are saved into database. Laboratory work is performed by two servers so that they can work simultaneously with different users and different configurations of work stand. The first server (web server) provides the interface between the user and bench work and the second is responsible for setup and execution of works.

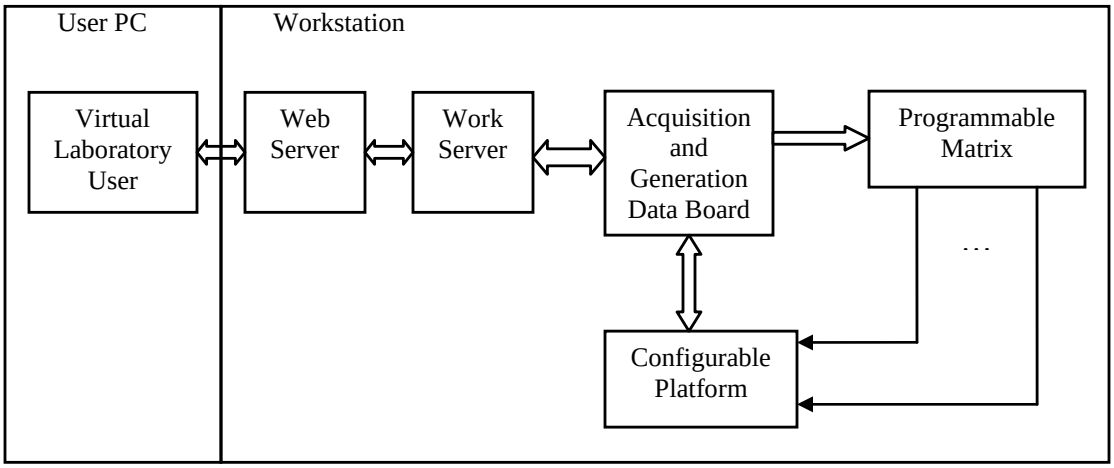

Figure 3. Actual measurement system

C. Exemplifying the workstation work

When a new laboratory experiment is started, the data acquisition board sends numerical codes using digital lines (12 digital lines) to the switches of programmable matrix, which change the electrical connections inside the configurable platform according with the new planned experiment. So, programmable matrix connect measuring signal source to the tested circuit.
After the experiment completes, the data acquisition board reads resulting voltages from the platform through the eight analog inputs. These results are processed by the work server and then saved to the local disk. The web server reads the files and sends the measurement results to users using the web interface. The configurable platform is structured to be able to perform laboratory work using different structures with operational amplifiers.
One of configurable platform modules is the integrator. As an example, in the follow is described the experiment which uses the operational amplifier as an integrator (Figure 4).
For working as integrator, the AO should have in the back loop a circuit having the time constant much higher than the time constant of the input signal:

$$\tau = R1*C1 \gg T$$

We choose for the input signal (V4) a pulse with 1 ms period having the falling and rising time much lower to not disturb the experimental results. This source V4 will be connected to the tested module by the user through proper programming the programmable matrix.
Figure 4 is displaying the electrical diagram for AO circuit used as integrator and the figure 5 shows the output voltage obtained by simulation.

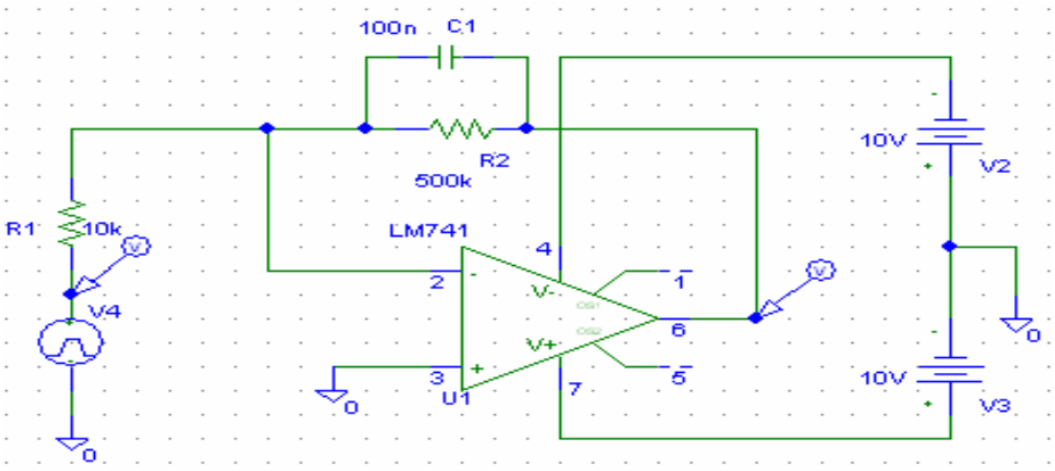

Figure 4. AO working as integrator

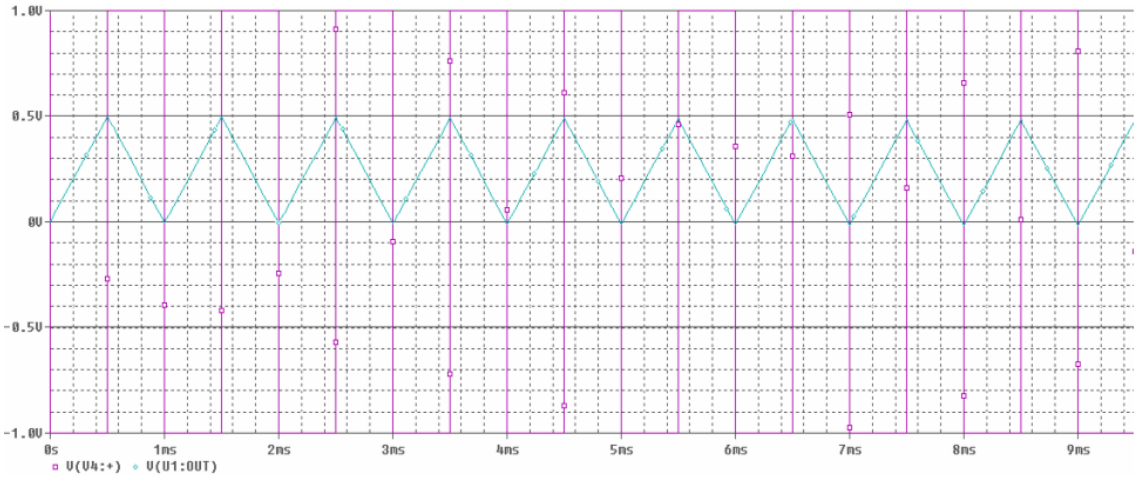

Figure 5. OrCAD simulation of the integrator

II. Conclusions

Virtual laboratory users will perform laboratory work in a very short time but at the first, they have to go through all the theoretical concepts provided by the web interface and not before successfully passing the assessment test. They must build the electrical circuit assembly for laboratory work by programming the programmable matrix. Measurement itself takes very little time freeing measuring system and so users found in the queue will not get bored waiting for the system release. So, more users can work simultaneously using the same measurement system and then each user will get the desired results as graphics or text. Each user can present conclusions and can make their own interpretations.

References

[1] Lawenda, M., Meyer N., Stroinski, M., Rajtar, T., Okon, M., Stoklosa, D., Kaliszan, D, Effective job management in the virtual laboratory European Grid Conference 2005, LNCS 3470, pp. 414-423, Science Park Amsterdam, the Netherlands, February 14-16, 2005

[2] M. Bertocco, S. Cappellazzo, A. Carullo, M. Parvis, A. Vallan, Virtual environment for fast development of distributed measurement applications, Proc. of IEEE International Workshop on Virtual and Intelligent Measurement Systems, VIMS 2001, Budapest, Hungary, May 2001, pp. 57-60

[3] Andrew Troelsen, Pro C# 2008 and the .NET 3.5 Platform, Fourth Edition, Apress, Springer-Verlag New York, 2007