Available online at www.sciencedirect.com

ScienceDirect

Procedia Social and Behavioral Sciences 2 (2010) 5233–5237

Procedia
Social and Behavioral Sciences

WCES-2010

Automatic control simulation environment system (ACSES) designed as a virtual tool for control education

Kenan Savaş[a] *, Hasan Erdal[a]

[a]*Marmara University Technical Education Faculty, Istanbul, Turkey*

Received November 10, 2009; revised December 11, 2009; accepted January 21, 2010

Abstract

This paper shows steps and tools needed to develop and set up a virtual control laboratory for technical and engineering education. It is mainly based on laboratory exercises given at Technical Education Faculty of Marmara University in Istanbul. For this purpose the Automatic Control Simulation Environment System (ACSES) is developed. Students or other users can access this system all around the world through Internet. By doing this, license costs will decrease. Only thing you need is a browser software This system is used to simulate different laboratory tasks, such as modelling and controlling (related to On-Off, PID etc.). The MATLAB and MATLAB Web Server (MWS) is used for modelling and making virtual exercises accessible from the Internet and also Web MWS System is also used to decrease the cost and having virtual simulations web-based.

Keywords: Automatic control laboratory; control education; MATLAB, MATLAB web server (MWS); web MWS system; virtual laboratory; virtual experiment.

1. Introduction

Internet-based a virtual learning lab and a learning lab as well as remote learning environments can be used for the construction of a web based laboratory. A virtual laboratory in which a computer simulates a process allowing continuous access, so any such restriction that you expect users waiting each other or at the same time using only a user interface is not a problem (Johansson et al., 1998). Between traditional and virtual labs, remote labs, allowing for real experiments, do have a structure. However, the virtual laboratory installation costs are lower than remote laboratories.

To learn computer-aided design and cost control will be reduced. Computer-aided control design decisions is given to teach computer and appropriate software from any location (home, university, etc.) must be able to access.

Especially in the field of control education is used as a very popular one of the Matlab software. In order to realize this project, MATLAB was used as the basic tool. MATLAB Web Server (MWS) is a software package developed for MATLAB software by Mathworks that allos developing programs for calculation and displaying results in a Web browser (Valera, 2005; MWS User Manual, 2003). This application according to the MWS application design capabilities using the simulation results MWS'nin graphics, numerical value or a data file can be presented as web users.

* Kenan Savaş. Tel.: +90 5327304408
E-mail address: kenan.savas@marmara.edu.tr

1877-0428 © 2010 Published by Elsevier Ltd.
doi:10.1016/j.sbspro.2010.03.851

2. The design of Automatic Control Simulation Environment System (ACSES)

With the aim of supporting theoretical knowledge of the laboratory courses ACSES takes. At the same time students or laboratory experiments related to web users, and each experiment steps and questions about the experiment will be able to follow through the exercises using ACSES. ACSES is designed to run web-based. Thus, at any time over the Internet, users may have knowledge about laboratory tests and physical environment needs to be done and try to learn the steps related to the simulation will be able to perform. Within the scope of this study with ACSES control training courses and simulation support, this program has a heavy quota of students to support their practical training and experiments before and after the test questions and problems related to the solution is intended to be. Instructional relations, as shown in Figure 1 is considered with the process of ACSES Automatic Control courses within the academic environment provides a contribution.

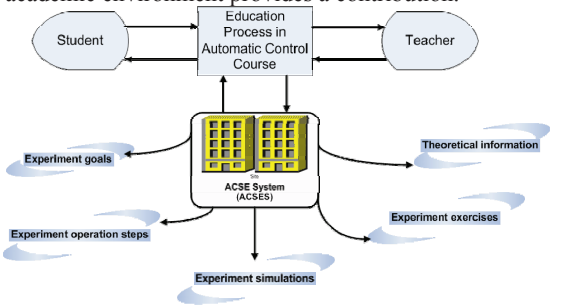

Figure 1. The contribution of ACSES to the education environment

ACSES that has Web-based design, uses web documents and several systems to work together to respond to users via the web. For applications that are included in MATLAB environment ACSES includes mostly web-based design documents, source code and MATLAB Simulink model files. The system is running on a web server environment. In this system, server software, Apache Web Server v.2.2.8 is used. Modeling for the design files in the environment of MATLAB / Simulink v.2006a also are included in this design. Thus, a laboratory experiment for each model over ACSES using MWS simulations of the experiments are presented to web users. Each of the model experiments performed with the support of Web MWS System allowing allow web-based design uses MATLAB / Simulink environment (Retrieved November 16, 2009, from http://www.controlworld.tk/web_mws/). ACSES'nin architecture in Figure 2 is shown in.

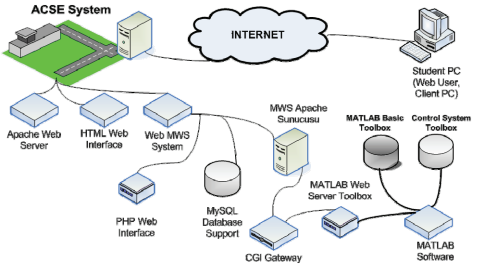

Figure 2. The architecture of ACSES

2.1. Apache Web Server 2.2.8

A server computer needs a server software to publish html structured documents over the web. ACSES is a web-based system so this system uses a web server computer and Apache Web Server runs on this computer.

2.2. MATLAB/Simulink 2006a

MATLAB is a software environment that enables numerical computation and provides physical systems to run within the integrated environment, Simulink. Especially in the field of control this software is widely used in theoretical courses related to modeling and control contents in the various universities as a popular tool (Uran & Jezernik, 2008).

2.3. Web MWS System v.5.0.030909.0

This system is designed to allow developing and running applications which use MATLAB/Simulink environment. It is possible to develop and run a web-based MATLAB applications using Web MWS System and this system provides an easy way doing this. This system uses PHP-based web documents which are installed on a server computer in which at the same time MATLAB software installed (Retrieved November 16, 2009, from http://www. Controlworld.tk/web_mws/). Thus, a dynamic web page within the support system is used. This system can be accessed at any time via the Internet. Web users can add any application, there are existing applications can list or you can view the source code of applications. MWS System previously installed any of the Web application can run with ease. In addition, the results obtained as a result of MATLAB work may be download to own computers by web users.

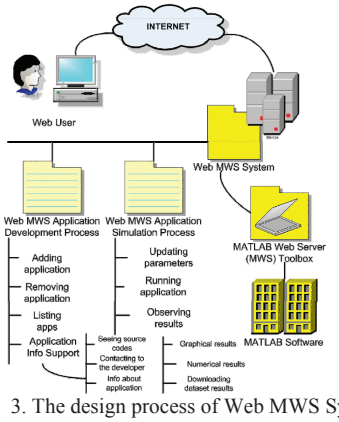

Figure 3. The design process of Web MWS System

2.3.1. The Architecture of Web MWS System

MATLAB users to benefit their own algorithms and can prepare them as a part of the MATLAB libraries become possible. Is easy to make programming with MATLAB (Hercog et al., 2007). Therefore, Web users easily through the Web MWS System develop MATLAB applications. MATLAB software uses an integrated MATLAB Web Server tool box. It can be seen that how Web MWS system works in Figure 4b, It can also be seen that how MWS toolbox can operates MATLAB applications.

2.4. MATLAB Web Server (MWS) Toolbox

MATLAB Web Server is the well-known software package for the MATLAB as a toolbox developed by Mathworks. This tool provides a web front MATLAB interface to establish connections between a client and a server. Thus the client to be viewed from a computer and a server that can start an application on the computer installed MATLAB on simulations will be possible to design (Diez et al., 2002). Outputs of the simulations are HTML documents. The relationship between the client application and MATLAB Figure 5 'te is shown.

MATLAB Web Server (MWS) and simulations can be done online. These are many technical courses and in particular virtual lab environment is required. Moreover, they are also useful laboratories for mathematics courses. Simulation of the input interface and output of numeric, alphanumeric, or may be graphical. However, there are some disadvantages of using this tool. For example, users can change input values only. Another disadvantage is that high-performance CPU and simulation to shorten the time taken into account that requires much RAM capacity. In addition, MWS development of applications for registration application is required and that application development time increases because of registry of applications. This study, to find solutions to these problems uses a system of Web MWS (Retrieved November 16, 2009, from http://www.controlworld.tk/ web_mws/).

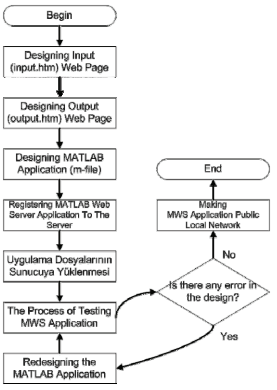

Figure 4a. The steps developing MWS applications

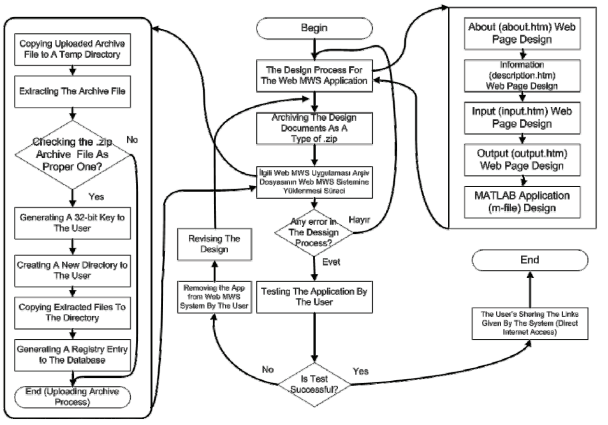

Figure 4b. The steps developing applications in the support of Web MWS System

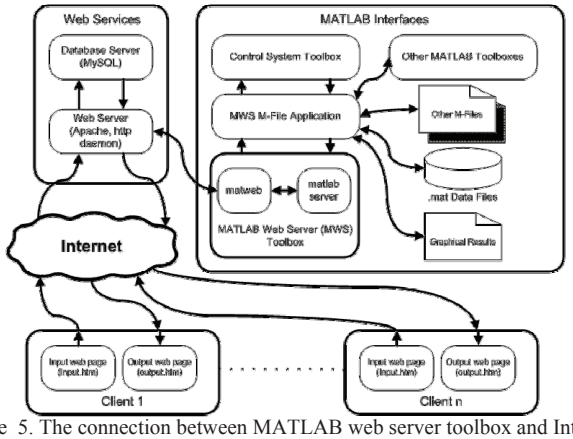

Figure 5. The connection between MATLAB web server toolbox and Internet

3. ACSES Environment and Simulation Interface

Students or web users via ACSES can reach all kinds of information related to the experiments in Automatic Control laboratory. However, these tools are developed not in real time, here, simulated models as a system are operated. Therefore, many users will have the opportunity to be online simultaneously in the system. ACSESuser interface in Figure 6 also shown. Users use any page to access the simulation experiments with each experiment offered "Test Application" fields. This fields can be changed from the user as the parameters of the experiment.

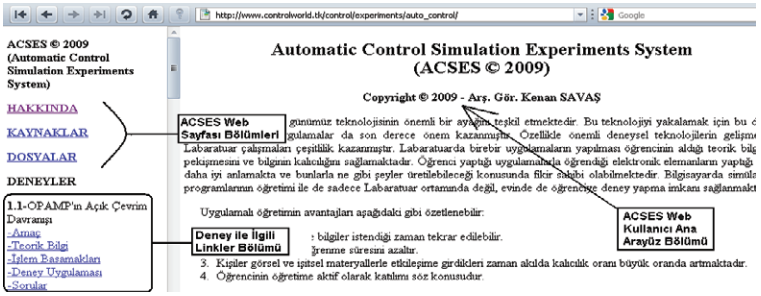

Figure 6. The user interface of ACSES

After students enter values to change the parameters to the experiment, to send the form information they will click on the Send button. Then on the web page in a separate window users can see results graphically and numerically. This is illustrated in Fig. 7a. and Figure 7b.

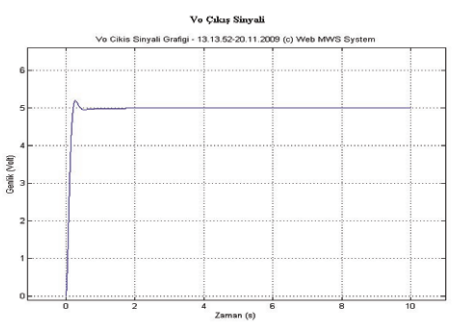

Figure 7a. A graphical result ınterface for The experiment in ACSES

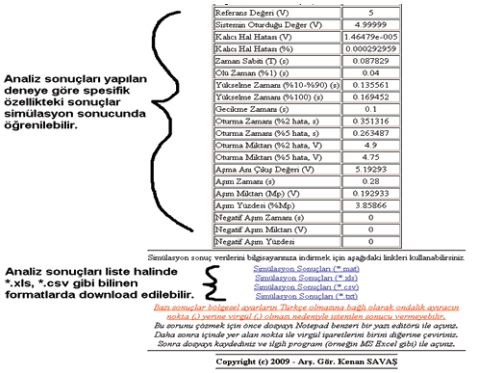

Figure 7b. Facilities in ACSES, a simulation result interface with easyness and simplicity, downloadable data list files that provide users to use data in another tool

Also, the simulation values generated by MATLAB users to their local computer may download and use in any 3rd part software (Figure 7b.).

4. Conclusion

In this study, Automatic Control Simulations Environment System (ACSES) has been designed. This platform will offer users of basic services to the students about laboratory tests at any time and from anywhere via the Internet (Chinchilla & Nurre, 1994). This study is based on the undergraduate program for Automatic Control laboratory courses at the Department of Electronics and Computer Education in Technical Education Faculty, Marmara University (Retrieved November 16, 2009, from http://posta.marmara.edu.tr/ ~ kenan.savas/categories/ders_notlari/deney_foyleri/oto_kontrol_1_deney_foyu.pdf). In the work presebted here, we emphasize that any student accountable in the field of Automatic Control course will have a virtual laboratory facilities and to their own computers without having to install the MATLAB, simulation software developed in ACSES will be able to perform work. The only requirement, is connected to the internet with a PC and a web browser. Especially among university students and the sharing of MATLAB and the license conditions are considered activities (Uran & Jezernik, 2008) with ACSES costs will be significantly reduced.

Refererences

Chinchilla R. & Nurre J. H., Design of an Industrial Controls Laboratory, Proceedings of the 26th Southeastern Symposium on System Theory, IEEE (pp. 618-622), 1994.

Díez J. L., Vallés M. & Valera A., “A global approach for the remote process simulation and control,” in Proc. 15th IFAC World Congress Automatic Control, Barcelona, 2002, pp. 76–81.

Erdal H., Otomatik Kontrol Dersi Deney Kitabı, İstanbul, 2004, http://posta.marmara.edu.tr/~kenan.savas/categories/ders_notlari/deney_foyleri/oto_kontrol_1_deney_foyu.pdf (16nd Nov, 2009).

Hercog D., Gergic B., Uran S. & K. Jezernik, ,A DSP-Based Remote Control Laboratory, IEEE Transactıons On Industrıal Electronıcs,Vol.54,No.6,December 2007.

Johansson M., Gäfvert M. & Aström K. J., “Interactive tools for education in automatic control,”IEEE Contr. Syst. Mag., vol. 18, no. 3,pp. 33–40, 1998.

The MathWorks Inc., MATLAB Web Server User’s Guide., 2003, http://www.mathworks.com/access/helpdesk/help/toolbox/webserver/webserver.html.

Uran S. & Jezernik K., Virtual Laboratory For Creative Control Design Experiments, IEEE Transactıons On Education,Vol.51,No.1,Feb 2008.

Web MWS System User Manual, 2009, http://www.controlworld.tk/web_mws/ (16th Nov, 2009)

Valera A., Díez J. L., M. Vallés, & P. Albertos, Virtual and Remote Control Laboratory Development, IEEE Control Systems Magazine (pp. 35-39), 2005.

Yang S. H., Chen X., & Alty J. L., “Design issues and implementation of Internet-based process control systems,” Contr. Eng. Practice, vol. 11, pp. 709–720, 2003.