

Laboratory Stand in Web Browser for Measurements on Distance

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Abstract –The general description of the Internet laboratory stand and its Web application used in laboratory of metrology and technique of experiment has been presented. Some proposed future improvements to this distance learning system has also been discussed at the end of this paper

Keywords – distance learning, ASP.NET, IEEE-488.2 interface.

I. INTRODUCTION

By means of Internet many real experiments could be done by students in the frame of distance e-learning courses. The most convenient way of the measurements would be the use of a web browser to control the devices and to analyse the results. Such statement was a motivation to create a laboratory stand as a tool in teaching Theory of Circuits at Faculty of Electrical Engineering in Bialystok Technical University.

In this paper the measurements performed on a simple DC circuit has been presented. The supplying current and the voltage in one branch of electrical circuit are measured. Students can use a web browser to manipulate three devices by GPIB (IEEE-488.2) interface. The results are observed in the ordinary webcam and can be saved at request.

II. EQUIPMENT, SOFTWARE AND COMMUNICATIONS

A. Equipment and interfaces

The heart of the laboratory stand is a personal computer with IEEE-488.2 interface board for the PCI bus (model KPCI-488A of Keithley).

The board works as a system controller (Fig. 1) and controls three GPIB instruments (Tektronics P2521G DC power supply, Keithley DMM 2000 multimeter and Motech FG-503 function generator). An internet camera is connected by USB interface to the server and the image is seen in a web browser during the measurements.

B. Server's software

The server runs on Windows XP Professional with IIS

(Internet Information Services) version 5.1 installed. IIS application process model consists of *TCP/IP kernel*, *Inetinfo.exe* which runs in-process applications (low isolation) and multiple *DLLhost.exe* processes which run pooled-process or out-of-process applications (medium or high isolation). Security is assured by Windows authentication, SSL, Kerberos and Web Server Certificate Wizard [1].

The prerecorded video from camera is converted into stream by Microsoft Windows Media Encoder 9. This software uses any camera installed on computer and does not require additional drivers or libraries.

C. Communications

The dynamic website has been created with the use of ASP.NET technology [2-4]. The application is installed on server and a client (student) communicates with it using a web browser. The advantage of this solution is that students, before

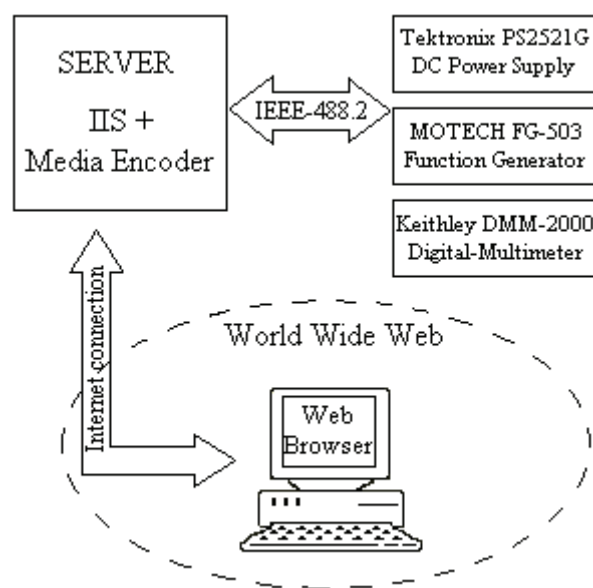


Fig. 1. General outlook on communication.

taking the measurements, do not install any additional software on their own computers which do not have to be modern.

The communications among the devices and the server has been executed by our application, GPIB interface and *ieee_32m.dll* library.

GPIB interface board co-operates with the devices using SCPI (Standard Commands for Programmable Instruments) language. Our application sends and receives simple

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commands and values. As the example of this, to set the voltage 10V on the power supply output, the command "sour:volt 10" is given.

Fig. 2. The panel where the settings of power supply are programmed.

III. USER INTERFACE

The user interface was made with the use of HTML and CSS (Cascading Style Sheets) scripts. The properly created forms like in Fig. 2 serve to input the programming data.

The interface is user friendly. All the settings can be done by choosing a proper point in the list and by filling out any number in the field. Various ways of filling out the numbers are possible, for example the number "10.000.000" can be written as "10000000", "10M", "10000k" or "10⁷".

IV. LABORATORY EXERCISE

The aim of laboratory exercise is to find the DC characteristics of P-N junction diode, any other electronic element or circuits.

The results of continuous measurement of current and voltage are shown in special laboratory window in web browser. Default sampling time (the frequency of voltage and current reading) is 500ms. The results, which help to plot I-U characteristic, are presented in the table and can be saved to the file.

The view of the laboratory stand is presented in Fig. 3.



Fig. 3. The view of laboratory stand.

V. CONCLUSIONS

The ASP.NET and IIS technologies allow us to create the server and user application for establish the distance measurements. The CSS technology enables of build-up the project – create new forms and use another (total 14) measuring instruments with GPIB interface (signal generators, oscilloscopes, etc.)

The user's interface looks the best in Internet Explorer because we have used Windows Media Encoder 9 for video streaming and Java applet and ActiveX control for seeing the picture. In other web browsers the image from camera is not visible. Another disadvantage is that the laboratory exercise can be done by exclusively one student at the same time.

Web-based measurements can probably never replace the real contact with the instruments. But the measurements performed in hazardous environments require remote control of the instruments what motivates to do such experiments in the teaching.

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