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## METHODS OF PUBLICATION IN THE FORM OF INTERACTIVE WEB PAGES OF PRACTICAL APPLICATIONS IN THE ELECTRIC FIELD

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**Abstract.** This paper presents ways to publish a practical application to enable access from remote experimental stands (assemblies) equipped with computerized measurement systems. Concerning these aspects, the paper presents the publication method used by the graphic programming environment, LabVIEW and the publication using the CGI (Common Gateway Interface) script, for the experiment that studies a DC circuit, emphasizing the advantages of using one type of publication instead of another and the disadvantages of using those types of publication.

**Key words:** scripts; Web browser.

### 1. Introduction

In order for the basic lab experiments to be available around the clock and easy to access from home or anywhere else, in order for the users to have access to demonstrations outside of the class and to see an electric/electronic circuit in action and to act on the operating parameters, new technologies are used such as the one offered by National Instruments through the LabVIEW remote panels (National Instruments, 2006).

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With this standard feature in LabVIEW, a user can easily and effortlessly publish the front panel of LabVIEW program to use it in a standard Web browser (Abu-Aisheh, 2010).

Once that it is published, anyone on the Web, with necessary permission, can access and control the experiment on the server. The LabVIEW remote panels turn the application into a remote laboratory without any additional programming or development time.

Thus, after performing the communication between the computer workstations and the Web server, on the latter there will be found the front panel corresponding to the “DC measurements” application. For clients to have access to the panel and control the application, its publication in the form of an interactive Web page is necessary. The control application that will receive data from the sensors through the acquisition board, will process these data, will display them and, according to the settings made by the user on the front panel buttons, will send commands on the digital output of the acquisition board.

The computer on which the application runs will be the server and the computers that will access the future Web page will be the clients. In order to achieve this, the server computer will be connected directly to the Internet (it must have routable IP). This way, any client will have access to the built Web page (Harward, 2008; Buraga, 2001) and will be able to set the type of assembly and the binding way of the two resistances.

## 2. Methods of Publication Specific to the Virtual Instrumentation

The applications in the electric field, including the practical application presented here, can be found on the Web page presented in Fig. 1.



Fig. 1 – The Web page for applications in the electric field.

Each work has a presentation page that contains, besides the theoretical

considerations concerning the paper, the assembling scheme and the requirements, the practical application and an assessment test. So, by clicking on each of the four files, a connection to the corresponding HTML (Hyper Text Markup Language) file is done which will open a .pdf file that will remain open the entire time the application is running. The presentation of Web page for the paper DC Measurements is shown in Fig. 2.

The publication of the virtual instrumentation specific to the presented practical application can be achieved in many ways and here are two of them, namely

1. publication through the LabVIEW Web server;
2. publication through the CGI scripts.



Fig. 2 – Web page of the DC measurements application.

### 2.1. Use of LabVIEW Web Server for Publication

For the publication through the LabVIEW Web server it is necessary that the client computer have at least the LabVIEW Run-Time Engine application (Grimaldi, 2006). In Fig.3 it is shown the corresponding front panel, residing on the server, of the virtual instrument that allows laboratory work: DC measurements. The LabVIEW Web server can be configured in three steps. The first thing to be done is configuring the Web server, the directory where the interactive Web page will be saved (Web Server: Configurations). The users' access to view and control the application is determined by the option: Web Server: Browser Access. To establish a user's accessible virtual instruments and their access time, the option Web Server: Vis is used.

The control of some parameters using LabVIEW, as well as the monitoring can be done either locally or remotely. In this view, the option Web Publishing Tool from the Tools menu that relies on client – the server technology is used.

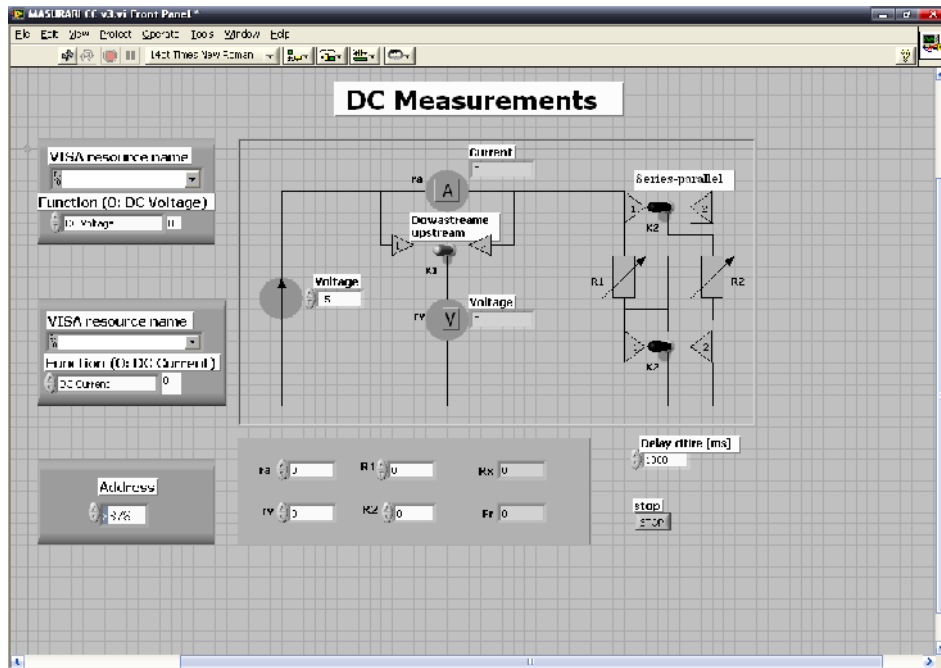


Fig. 3 – The front panel of the virtual instrument corresponding to the lab work: DC measurements.

To achieve control, the local control application must be first built so that, when accessed, it establishes connection with the PC hardware resources within the limits of the built application (Callaghan, 2007). After selecting the Web Publishing Tool option, the Web page implementation procedure begins. At the beginning, the local control application that is going to be published on the Web is selected; in our case, DC Measurement (Fig 4). The Web page is updated at set intervals and will receive new data from the acquisition board through the server. In this way, the measured parameters can be remotely monitored by different simultaneous clients.

The Labview software doesn't have to be installed on the computer that connects to the server in order to see the Web page; it just needs to install software called *LabVIEW Run Time Engine* that can be downloaded for free by accessing the link that will guide the user through the downloading and installation process.

A client can get control of the Web page that in our case will be dynamic, by selecting Request control of VI option from the bottom left in the

front panel of the published application. The client will be able to act on the Web page modifying the published parameters of the application (Harward, 2008).

The monitoring application is limited to acquiring signal not generating it and that is why it can be published on a Web page that can be accessed by anyone.

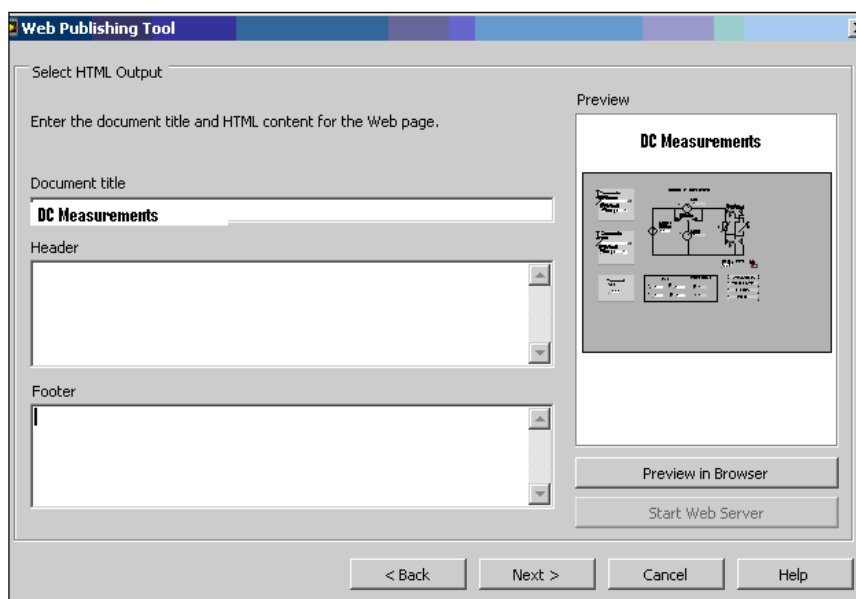


Fig. 4 – Publication of the Interactive Page.

### 2.1. Use of the CGI (Common Gateway Interface) Scripts for Publication

For publishing the front panel of the application in the form of an interactive Web page, one can use both the CGI scripts and also the image maps. (<http://www.cgi-resources.com>)

The CGI scripts are executable programs that decode the commands that are accompanied by the parameters received from the HTML page that make the user interface, send these parameters to the work stations, take the system responses in the form of images and return them to the user in the form of HTML pages generated in the script. The scripts for this work are elaborated as virtual instruments in the LabVIEW 8.6 language using the Internet Toolkit special software package of the National Instruments.

The way in which the information exchange is done between the user and the work station through CGI scripts is presented in Fig. 5.

The client can use any Web browser to remotely access this application but the communication with the resources can only be done through Web pages in HTML language.

This page includes also the tag that sees the front panel of the open instrument and realizes the control of the hardware part of this work. For the user communication with the instrument CGI scripts are used and they decode the command parameters sent by the user through the HTML pages transforming them in actions over the controllers on the front panel as if the client is at the work station. After doing the requested action (*e.g.* changing the type of assembling, upstream or downstream), the CGI scripts transmit the result of the request to the server (*e.g.* there is an updated image on the front panel by changing the electric diagram according to the received command).

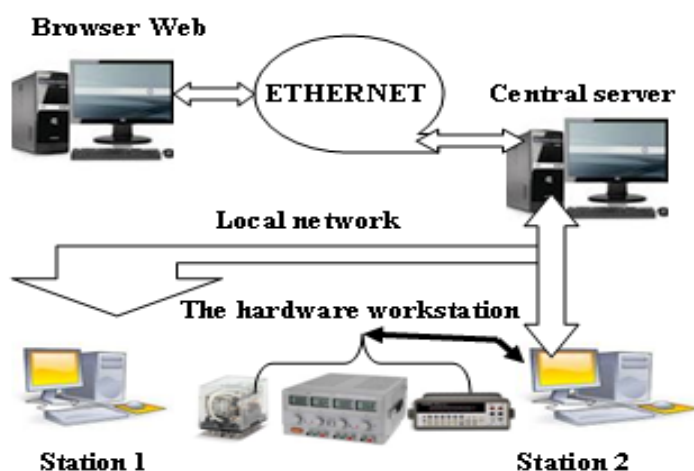


Fig. 5– Information exchange through the CGI scripts.

For the practical application, the command line is more complex and that is why the following are specified: the path and name of the used CGI script, the path and name of the main virtual instrument of the application as well as the parameters that perform the running commands of the virtual instrument and the name of the HTML page on which the respective application is performed. The page through which the user acts on the front panel is presented in Fig.6.

The image of the front panel of the main instrument previously presented must be grafted with the image map which is formed of sensitive areas to the mouse actions corresponding to the controllers through which the instrument is commanded. These sensitive areas access a URL (Uniform Resource Locator) and transmit the CGI parameters through a QUERY STRING, which decodes them and acts on the main instrument.

The way a CGI script works is the following:

a) the browser will request the URL from the server just like any other document;

- b) the server receives the request (sees that the URL specifies a script, after the extension or the position of a certain folder) and then it runs the script;
- c) the script runs the requested operation (interrogation of a database, calculation of a value, calling a program, etc.) based on the data offered by the browser;
- d) the script transforms the result into a format that the Web server understands;
- e) the Web server receives the result of the script and sends it to the browser that formats and displays it.

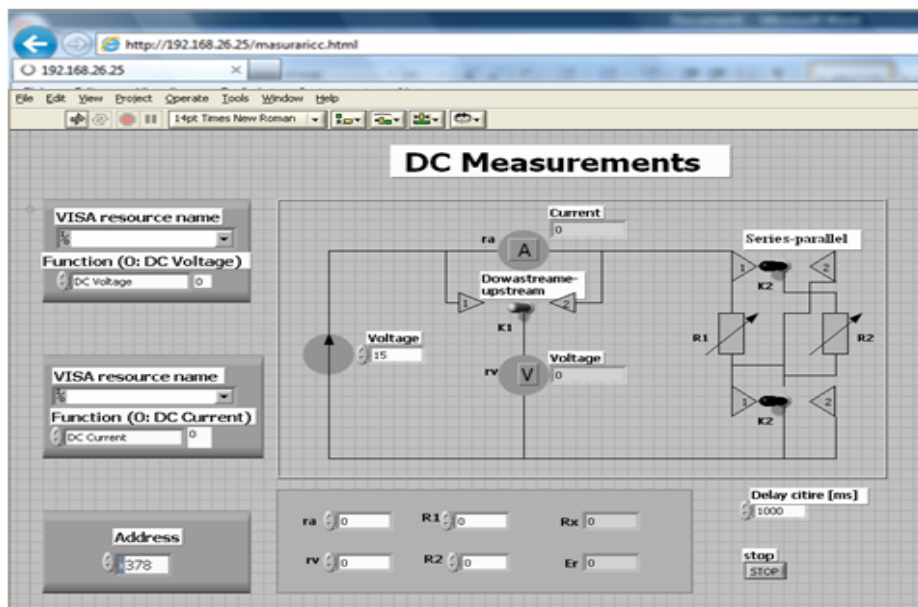


Fig. 6– The Web page of the application: DC Measurements.

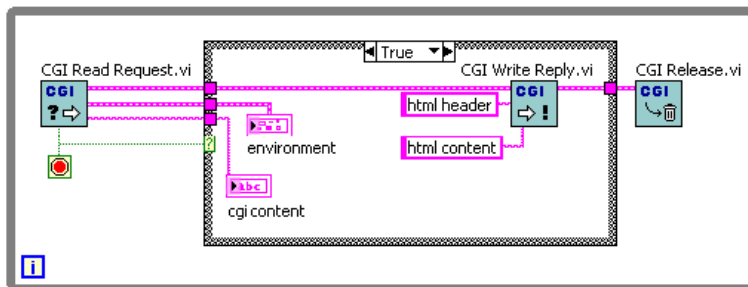


Fig. 7– The way the CGI functions are displayed.

An application that is about to be accessed from a Web page, using CGI scripts (<http://www.cgi-resources.com>) will have to meet three essential functions for the development of the communication and these functions are

found in the Internet Toolkit/CGI VIs/CGI Template VIs menu of the function range. The application will also have to be saved in the cgi-bin sub-directory of the path that is declared the root path of the HTTP (HyperText Transfer Protocol) server. The way the three functions are displayed in the diagram of an application is presented in Fig.7.

### 3. Results

LabVIEW is the software with the most powerful and simplest instrument for acquiring, analysing and presenting real world data, including instruments which help the finalization of the data of more than 400 analysis functions. LabView allows acquiring signals from a variety of equipment. Data can be acquired from GPIB instruments, serials, Ethernet, PXI and VXI, using the included drivers. There is the possibility of communicating with more than 1,400 instruments belonging to 150 producers that use the LabVIEW communication drivers. The software offers high performance and portability.

The control of the physical instruments with LabVIEW is designed with graphic symbols of blocks that can be combined on the screen to build the soft of a virtual instrument (VI). With LabVIEW, the control of the automated instruments is as simple and intuitive as handling physical instrument panels.

The VI contains reusable modules whose front panels can be intuitively used to perform measurements. Furthermore, each VI can be introduced in a simple graphic form (icon) and graphically combined with another icon to build a superior VI.

While running, a CGI application receives certain directives from the request that targeted it in the form of environmental variables and it receives entities from the console (stdin). The application can do whatever it wants respecting the imposed rules of the operating system under which it runs: it can access files, establish Internet connections, etc.

One of the most common restrictions is the fact that they are stored in a separate directory, having a default name set at the configuration of the system of the Web server and this is how the server knows that those files must be run and not sent to the client. At the same time, this directory is usually accessible only to the Webmaster so that a series of security breaches can be prevented.

Every time a browser session sends a request for the URL of a CGI script, the server will run that script and the browser will receive, as response, the script output – what it is written at standsrd output.

A CGI script cannot be run (most of the times) separately at the system prompt. In order to transmit the input data, instead of the command line one can use environmental variables such as: QUERY\_STRING, CONTENT\_LENGTH.

Through CGI scripts, the data from the user is taken, processed, saved into the database and when the information is requested for display, it is searched in the database and it is displayed.

For big applications it is necessary to impose some modules that standardly communicate with one another and each module has a task that can



be done only by it: for instance, a module handles the authentication, another one the information display, another one the database, etc.

Besides the applications that are directly connected to monitoring and controlling the experimental stand, the LabVIEW graphic programming environment provides CGI functions and access functions to the database that allow the transfer of information that concerns different organization aspects of the instruction process in the virtual laboratory.

As regards the method of publication there are advantages and disadvantages in using one of the possibilities. It is important to mention that the publication of a practical application is done according to the requests that are to be solved.

The main difference between a CGI resource and any other resource is that the Web server ensures the running of the CHI resource as a program and, thus, the resource can itself provide directives.

The CGI scripts establish a direct connection between the front panel image and the user and this makes possible the intuition of the notions of controller and indicator.

It also facilitates the command of several simultaneous tasks or the access of a larger number of users on the same work thanks to the parameter exchange through command lines in the HTML file.

After completing the work, these scripts allow closing and deactivating the main programs, thus releasing the resources of the work station computer.

The CGI applications are used when the content that is about to be transmitted is not constant and depends, *e.g.*, on the location from which the application is accessed, on the value of some parameters specified by the user who accessed, on the content of some files (database) on the server computer at the moment of access or even on the state of some real physical systems at the moment of access.

The disadvantage of the CGI programs is that they are slow, especially if they are written in a slowly interpreted language such as Perl, and not in a compiled C code. Some systems launch several copies of the same CGI application consuming system resources. That's why, there were developed server applications such as NSAPI (Netscape API), MSAPI (Microsoft Internet Server API), that can eliminate the CGI disadvantages and the server continues to do the entire work.

#### 4. Conclusions

As regards the publication method used for the data acquisition, transmission and analysis, it is important to mention that the remote lab users use for the application publication the model they consider reliable, fast and easy to use according to the type of data that are to be processed, analysed and transmitted.

That is why for the development of virtual lab applications with different degrees of complexity and user access levels, the LabVIEW Web

server is used because it has the possibility to analyse the request, to transmit it, to process it and to analyse the requested data.

For the users who want the data they transmit when publishing an application to be processed and saved in a database from which they can request anytime the data display in a short period of time, the publication is done with CGI scripts.

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## MODALITĂȚI DE PUBLICARE SUB FORMĂ DE PAGINI INTERACTIVE WEB A APLICAȚIILOR PRACTICE DIN DOMENIUL ELECTRIC

(Rezumat)

Laboratoarele virtuale întâlnite în toate programele științifice și tehnice reprezintă o parte importantă din experiența educațională. Ele nu doar arată concepte și idei de la cursuri dar și pun în practică teoria prezentată la cursuri astfel încat utilizatorii să poată observa cum evenimente și fenomene neașteptate pot afecta măsurătorile reale și cum pot controla algoritmi. Se prezintă modul de publicare a unei aplicații din domeniul electric prin utilizarea mediului de programare grafică LabVIEW. Cu LabVIEW panourile frontale la distanță nu pot fi doar văzute ci și controlate de către

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utilizatori, fie prin mediul LabVIEW fie printr-un browser Web având posibilitatea creșterii nivelului de înțelegere în ceea ce privește principiile generale implicate în experimentele reale simulate. Astfel, utilizatorii au posibilitatea de a observa și modifica parametrii unei aplicații practice fără a fi prezenți în fața unui stand cu aparate reale.