

Development of a system based on open source technology for DC resistor calibration

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Abstract: This work present the development of a new system, based on open source technology, for the automation of DC resistor calibration. The new system is web-based, stores the measurement registers on a structured database and has new features that can increase the productivity of the laboratory. Some proposes of future development are presented, also.

Keywords: resistance calibration, automation, software development.

1. INTRODUCTION

The Electrical Standardization Metrology Laboratory (Lampe), among its tasks, is responsible for providing traceability in DC resistance to all other laboratories and industries in Brazil. To accomplish this, the laboratory has automatic resistance bridges that cover a large range of resistance values, at different voltage and current levels.

The treatment of the results obtained by the resistance bridges, including the uncertainty calculation, was carried out by a simple software written in Visual Basic 6, and the registers was stored in simple text files. Due to the difficulty in the maintenance of that software and the incompatibility with newer versions of the Operating System (Microsoft Windows XP), it was decided to develop a new system.

The new system is multi-platform, stores the registers in a structured way, using an Open Source Data Base Management System (DBMS), and has new features that can increase the productivity of the laboratory. A comparison

between the old system and the new system is summarized in Table 1.

Table 1. New system versus old system.

Features	New System	Old System
Operating System	Multi-platform	Windows 98 / XP
Register storing	Open Source DBMS	Simple text-files
Read bridge report files	Yes	No
Modular Structure	Yes	No

The purpose of this paper is to present the progress obtained in the development of the new system, compare its features with the previous system and propose new improvements for future works.

2. SYSTEM DESCRIPTION

2.1. System Architecture

The new system uses client-server architecture, illustrated in figure 1.

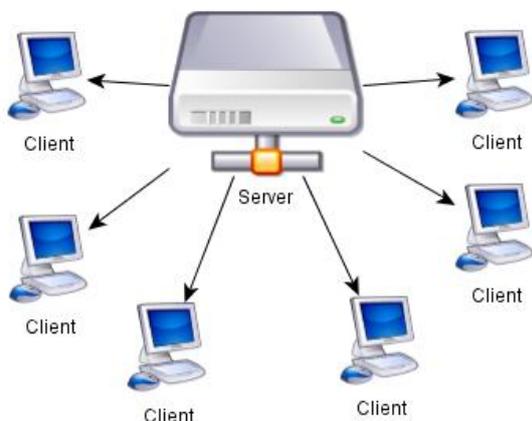


Figure 1. System model.

The clients can access the system using a Web Browser, and all the calculations are carried out in the server, in a centralized way. The server is based on a typical LAPP (Linux, Apache, PHP and PostgreSQL) stack, using Scilab for mathematical calculations, and runs on an Oracle VirtualBox virtual machine. As the system runs on a virtual machine, it is very easy to make backups of the full system and install it on other machines, if needed. This is very useful to create a production environment separated from the development environment, for example.

PHP is a programming language originally created for the implementation of dynamic contents in Web pages [1]. The language is provided with many extensions to interact with other applications, especially Web servers and databases (Apache and PostgreSQL, in our case).

Scilab is free and open source software for numerical computation [2]. It has a high level programming language and includes hundreds of mathematical functions, allowing faster development of scientific applications.

The concept of combine the efficient mathematical processing provided by Scilab with a web interface using PHP was already discussed [3]. The basic idea is to join the versatility of server-side scripting languages like PHP, Python

and Ruby with the robustness of languages aimed at scientific computing, like Scilab, R and Matlab. This can be achieved in PHP using the function *exec()*, that permits the execution of a external program and capture its output. PHP can be used to control instruments via GPIB, also [4].

The following open source software packages are employed in this system: Oracle VirtualBox (virtual machine), Debian Linux (operating system), Apache (web server), PHP 5 (scripting language), PostgreSQL (DBMS), Scilab (scientific computation), Gnuplot (generation of graphics), ImageMagick (image manipulation) and Git (version control).

2.2. System modules

The system was built with independent modules (figure 2), in order to make the maintenance and addition of new features easier. All the mathematical processing is done in a small Scilab program. The interface between this program and the PostgreSQL database is managed by PHP scripts. In a similar way, the user interface is presented in HTML, with dynamic code generated by PHP.

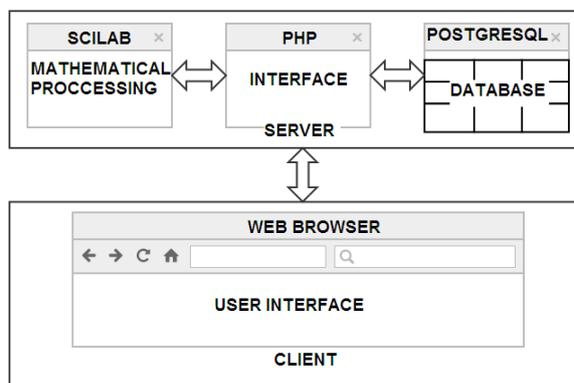


Figure 2. Integration of the system modules.

2.3. System features

All the old system features were retained in the new system. Those features include the corrections of the resistance value due to environmental conditions, calculation of the drift of the standard and uncertainty calculations. All

the calibration information of the instruments used for environmental conditions measurements and of the standard resistors was stored in text files in the old system. A tool was written to translate that data to the format of the new database.

Figure 3. Client user interface.

One of the most useful new features included in this system is the ability to read the measurement reports generated by the automation system of the resistance bridges. Up to now, this feature is compatible with the bridge Guildline 6675A and with the bridges 6000A, 6000B, 6010B and 6010D from Measurement International Limited (MIL). This feature not only speeds up the calibration process, avoiding the need to manually enter the values, but also stores in the database all the information provided by the measurement report, and not just the ratio R_x/R_s , as in the old system. Another useful feature is the possibility to store in the database observations and even pictures of the measurement setup. All this info can be easily retrieved later, when needed.

Storing all the calibration results in a structured database makes easy to plot the historical behavior of the calibrated resistors, for example. In order to add this feature to the system, it is being studied an efficient way to insert all the old calibration data into the database. 8th Brazilian Congress on Metrology, Bento Gonçalves/RS, 2015

The user interface for the client computers is a dynamic web page, and can be accessed from a web browser. That interface is shown on figure 3.

3. FUTURE WORK

The next planned features to be added to the system include automatic generation of history plots and automatic generation of calibration certificates. For the history plots, the biggest challenge is to import all the old data of resistor calibration. This data is stored in different formats (in some cases, only in printed paper). For the automatic generation of calibration certificates, it is being studied an approach to use PHP functions that permit to interact directly with Microsoft Word files (the format used by the institution certificate templates).

4. CONCLUSIONS

The new system of automation of DC resistor calibration was presented. The system's new features can speed up the analysis of the results given by the resistance bridges, improving the productivity of the laboratory. Some other features have to be implemented yet, moving to an almost full automated process.

5. REFERENCES

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