

WEB BASED SOFTWARE FOR SEMICONDUCTOR DEVICES LAB MEASUREMENT SYSTEM

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The advance of the technologies nowadays allows putting many laboratory measurement instruments in a single desktop box. This desktop box combined with a personal computer and Internet connection, gives a perfect opportunity for a laboratory which is accessible at any time and place. Many companies have created different measurement boxes with different virtual instruments attached to them, but it is still difficult for the trainee to make use of all of them. The article proposes common software architecture, which is suitable for all existing measurement boxes. The proposed software architecture is web based and creates a single view of the virtual instruments, so a trainee could easy use any hardware from single software.

Keywords: software architecture, virtual instruments, web based measurement

1. INTRODUCTION

To achieve the complete level of education it is important to include the experimental work as part of the trainee. Most of the time the experimental work requires well equipped laboratories with “tons” of hardware. The equipment of such laboratories costs a lot, and sometimes the used hardware is quite complicated, and difficult to understand from the learner. To remove these obstacles many companies (for example: Lucas-Nüelle with UniTr@in system [1]; National Instruments with LabView [3]; Visatronic with VT7; Meilhaus with series of USB measurement devices; etc.) have created hardware measurement devices, which collects the whole laboratory hardware in a single desktop box (DAQ – Data Acquisition board, see fig.1).



Fig.1: A typical DAQ board using USB interface to connect to a computer

Each company has its own design of the hardware measurement devices, which makes difficult for the learner to study and use every new device. Moreover the look and feel of the virtual instruments proposed by the companies is different for every company; as well it is far away from the look and feel of the real laboratory instruments. To achieve maximum performance, a laboratory should be available at any time and place for the trainee and this is the place where Internet and the web technologies could help [4].

The article proposes single software architecture making possible:

- single look and feel of the virtual instruments
- virtual instruments with look and feel as real laboratory instruments
- world-wide (through Internet) access to virtual instruments
- easy implementation of new DAQ boards to use created virtual instruments
- operating system independency

By answering the above requirements a web based laboratory could be accomplished and the experimental work of the trainee could be quite improved.

2. COMMON SOFTWARE ARCHITECTURE

The proposed software architecture (see fig.2) makes possible the usage of different hardware measurement devices through single software.

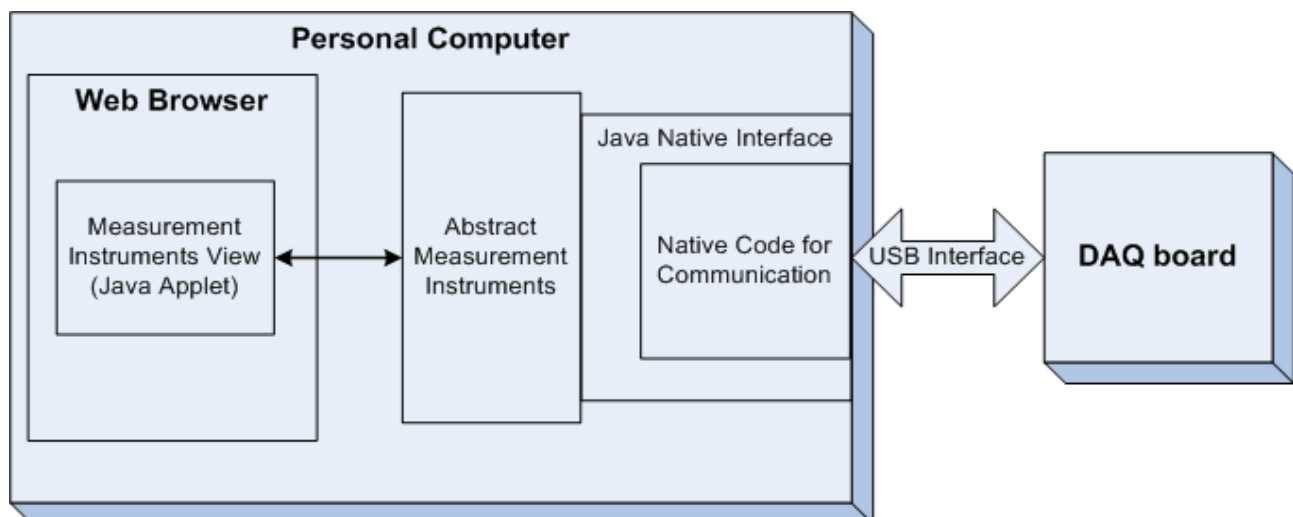


Fig.2: The web-based software architecture for real circuit measurements

The companies creating DAQ boards supply drivers to control them. Through use of JNI [2] (Java Native Interface) those drivers are mapped to “Abstract Measurement Instruments” interface layer. The view of this layer represents the virtual instruments with which the user interacts. Communication between the “Abstract Measurement Instruments” interface layer and the “Measurement Instruments View” interface layer is created through the use of standard Java interfaces. The world-wide access to any virtual instrument is done by using standard web browser and Java Applets technology. The used Java technology allows the proposed software architecture to be created once, and used at any operating system.

2.1. Native code and JNI

To make use of the DAQ boards the providers create drivers and libraries for every specific DAQ board. These drivers and libraries are written in any native programming language (C, C++ and Pascal) [3]. This makes the drivers and libraries different for the different OS (Operating Systems) and PC (Personal Computers). To make the implementation of the proposed software architecture OS independent the use of JNI was implemented. Java technology makes the Java software OS independent and JNI allows connection between Java and native code [5] (the one used in the drivers and libraries supplied with DAQ board). By including the drivers and libraries for all OS and checking the user's OS the appropriate driver can be used.

2.2 Abstract measurement instruments

The “abstract measurement instruments” are the middle tire between the view and the implementation of the virtual measurement instruments. This layer is created by using Java interfaces. The interfaces allow different functionality implementation for one and the same interface [6]. Thus the actual implementation (usage of the DAQ board access library) is separated from the view of the virtual instruments with which the trainee interacts. This separation allows implementation of any DAQ board library in the proposed software architecture, without changing the abstract measurement instruments and the view.

The “abstract measurement instruments” tire allows additional interfaces of measurement instruments to be included. The figure 3 shows the main interfaces included in the tire.

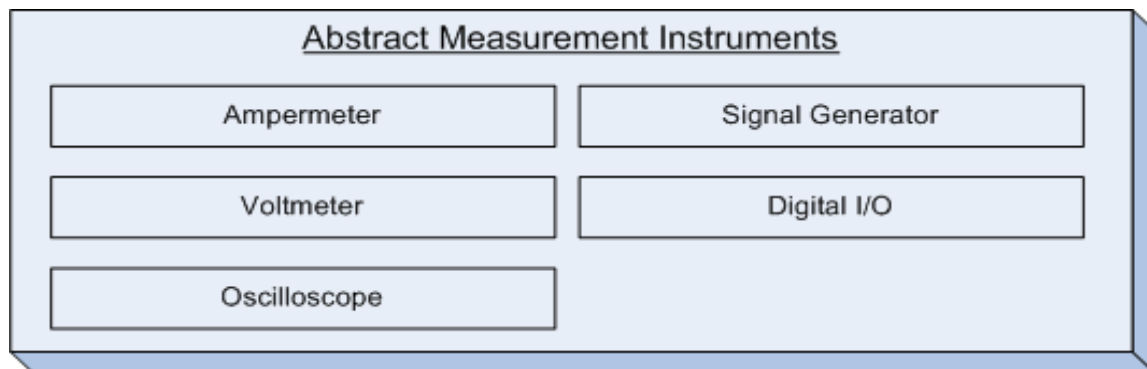


Fig.3: Interfaces of the middle tire – abstract measurement instruments

The methods in any of the interfaces are organized as follows:

- Virtual instruments GUI (Graphic User Interface) adjusters – get/set methods for adjusting the view of the virtual instruments. Since different DAQ boards have different abilities the view should adjust its GUI for the appropriate representation of the used DAQ board.
- A measured value limits adjusters – these methods are used from view to get the real measurement limits of the used DAQ board.
- A measured value queries – methods used for querying DAQ board to make a measure for a specific virtual measurement instrument

- In/Out hardware pins control methods – since some of the DAQ board's I/O pins could be used by more than one virtual instrument, so the reservation of the used I/O pins was implemented.

2.3. MEASUREMENT INSTRUMENTS VIEW

The “measurement instruments view” tire represents the look and feel of the virtual instruments, the ones used by the trainee. This tire is implemented by using Java applets technology which means that the trainee can use the virtual instruments through a simple web browser.

The base set of these instruments includes: Oscilloscope, Ampermeter, Voltmeter, Digital Inputs/Outputs, and a Signal Generator. The trainee can set the parameters of the real measurement instruments of the DAQ board through virtual instruments. They also serve to present in appropriate way the measured values from the real instruments. By using the developed virtual instruments the trainee could observe and set analog and digital signals.

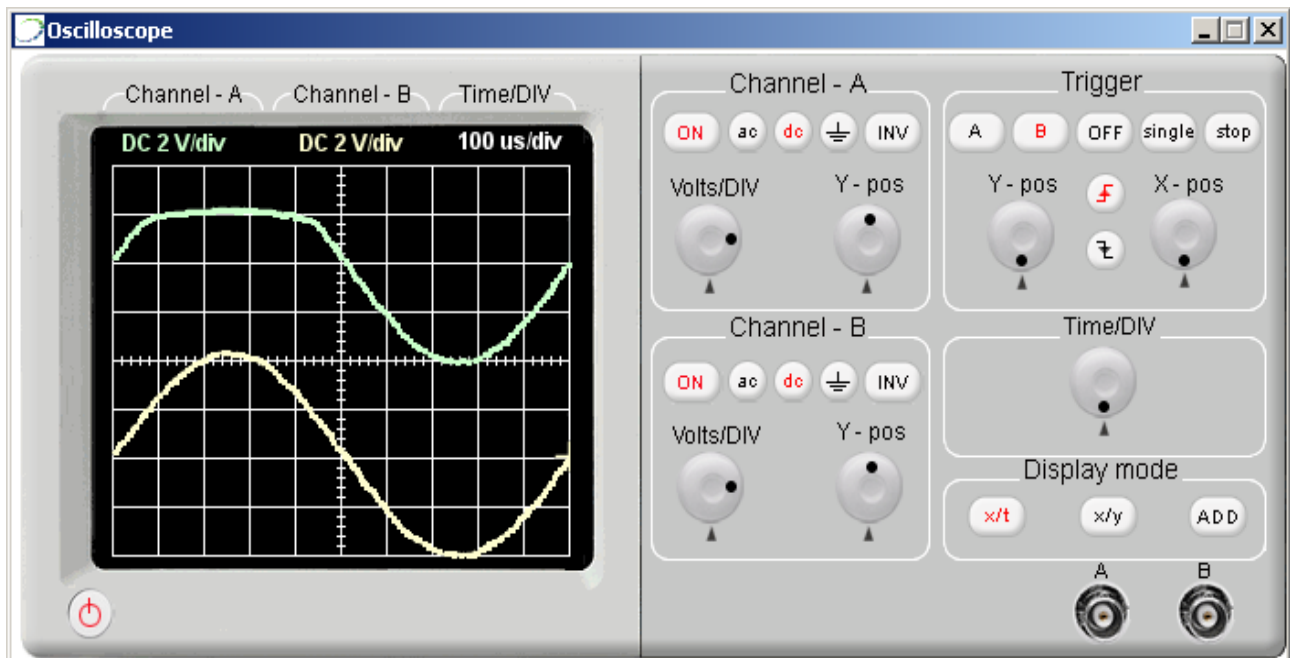


Fig.4: Virtual instrument – Oscilloscope measuring on channel A: the voltage drop across a red light emission diode; and on channel B: the circuit input voltage

The figure 4 shows the view of the oscilloscope virtual measurement instrument, it permits displaying the time characteristics of the measured signals.

The digital input/output virtual instrument, allows the trainee to control 8 digital outputs, and observe 8 digital inputs (see figure 5). The digital inputs are represented as green LEDs (Light Emission Diodes), and the digital outputs are represented as push buttons. The trainee could observe/enter the in/out digital value, in binary (through LEDs and buttons), hex, octal, and decimal (through a display) format. The state of every single output pin could be set (logical '1' or '0'), and the state of every single input pin could be observed.



Fig.5: Virtual instrument – Digital input/output

A great benefit of the virtual instruments is that they can combine the computing power of the PC with the one from the used external hardware. The Current-Voltage analyzer (see fig. 6) virtual instrument uses this benefit. It combines the two analog inputs and the one analog output to measure the current consumed by a circuit, for a given input voltage. Thus the trainee could easily get the current-voltage characteristic of any electronic circuit. The starting and ending voltage could be adjusted for every measurement. The current-voltage analyzer changes the voltage, and measures the current through time. The current is measured according Ohm's law, so an outer shunt resistor (with value 10 or 100 Ohms) should be used.

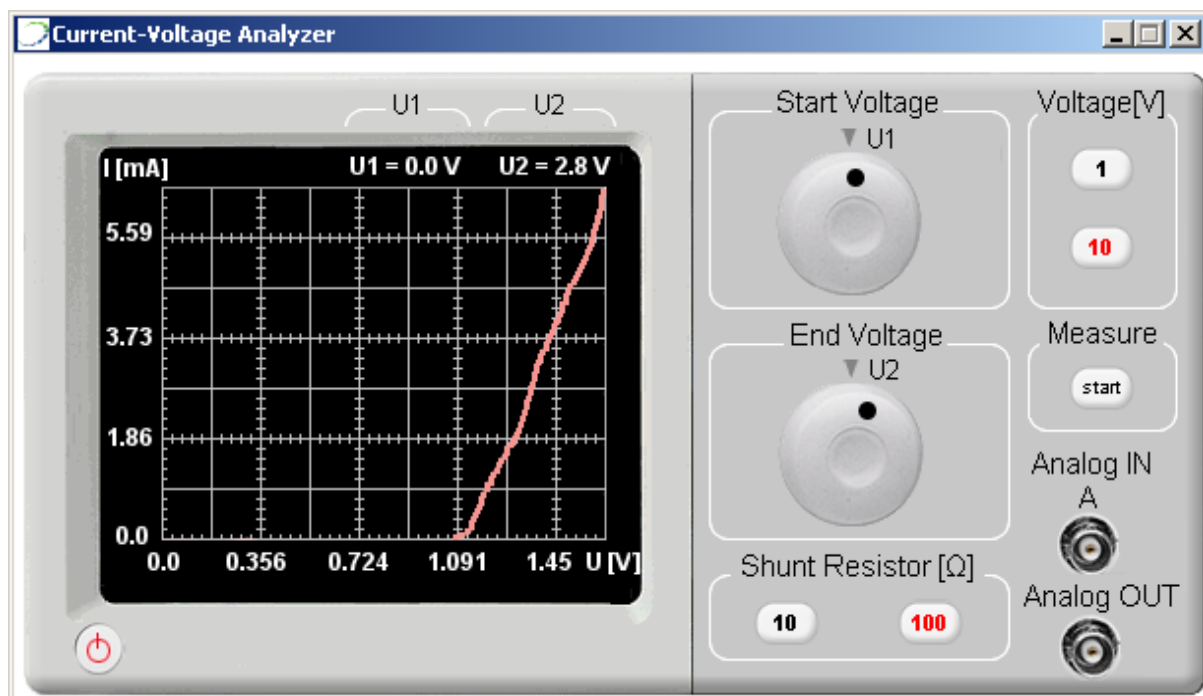


Fig.6: Virtual instrument – Current-Voltage Analyzer which measures the Volt-Ampere characteristic of a red light emission diode

This virtual instrument is an example how powerful, and helpful the virtual instrumentation could be. The trainee can easily do measurements that could spend quite time using common real laboratory instruments.

Any mathematical machine could be implemented on the implementation of a new virtual instrument, so the trainee can observe the results of the measured values immediately, without the need to do the calculations on his/her own. An example of such virtual instrument is the “Fourier Analyzer”. It uses the measured signals by the oscilloscope, and by applying fast Fourier transformation, displays the magnitude, and the phase of the measured signal’s harmonics.

By separating measurement (using DAQ board) from presentation (using PC) a low cost, quite powerful personal measurement instruments could be created.

3. CONCLUSION

Many companies nowadays make DAQ boards with different parameters. The virtual instruments supplied with the DAQ boards have different look and feel from each other, and as a whole their look and feel is far away from the look and feel of the real laboratory measurement instruments. The virtual instruments providers create them for any specific OS, so the installation of the software should appear on every PC on which the trainee will use the DAQ board. All these inconveniences serve as motivation for the development of a standard web based software architecture for real circuit measurements.

As a whole the benefits of the proposed web based software architecture are as follows:

- single look and feel of the virtual instruments
- the virtual instruments have look and feel as real laboratory instruments, which makes easier for the learner to use them
- world-wide (through Internet) access to virtual instruments
- makes possible the usage of different hardware measurement devices through single software
- operating system independency through use of Java technology

The use of a web based laboratory improves the trainee skills, as it is easy accessible from any where, at any time, and has all common laboratory measurement instruments [7].

4. REFERENCES

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