

Low-cost electronic board improves electronics laboratory efficiency

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Abstract – A low-cost electronic board (Laborplatine) connected to a PC can be used to simulate the facilities of a digital oscilloscope, function generator, voltmeter etc. Using this board in order to achieve real signals from electronic circuits, one can organize frontal and/or guided experiments which improve efficiency of electronics laboratory. This can be important in the context of a reduced teaching program for disciplines like "Electric Circuits" or "Fundamentals of Electronics".

Keywords: electronic board, electronics laboratory, frontal experiments

I. INTRODUCTION

The basic idea in developing the electronic board presented in this paper was to offer a cheap solution, so that students interested in electric and electronic circuits can do their own experiments at home, as individual study [1]. However, a future

reduced program according to the Bologna process determines an imperative efficiency improvement of all teaching activities, including practical training. In this paper the utilization of the electronic board in teaching electric and electronic circuits through frontal experiments is suggested.

II. THE ELECTRONIC BOARD

The electronic board presented in fig.1 was developed at the University of Applied Sciences Karlsruhe, Germany [1], [2]. The size of the board is 160mm x 100mm and it can be connected for data transmission to the serial port of the PC. The minimal requirements for the computer are: CPU frequency greater than 200MHz, free memory more than 20MB, 17" CRT monitor or 15" Notebook with 1024 x 768 pixels, Windows 95, 98, XP or NT.

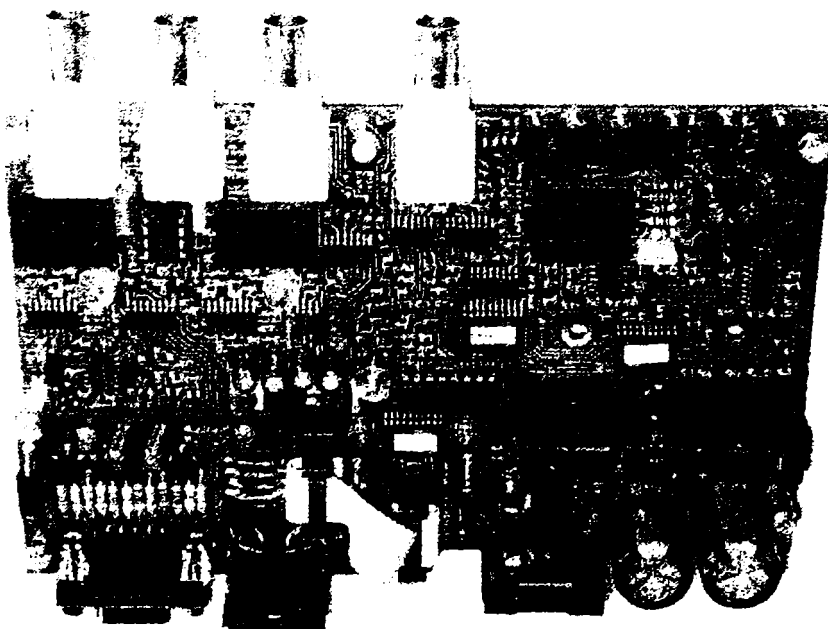


Fig. 1 The electronic board (Laborplatine)

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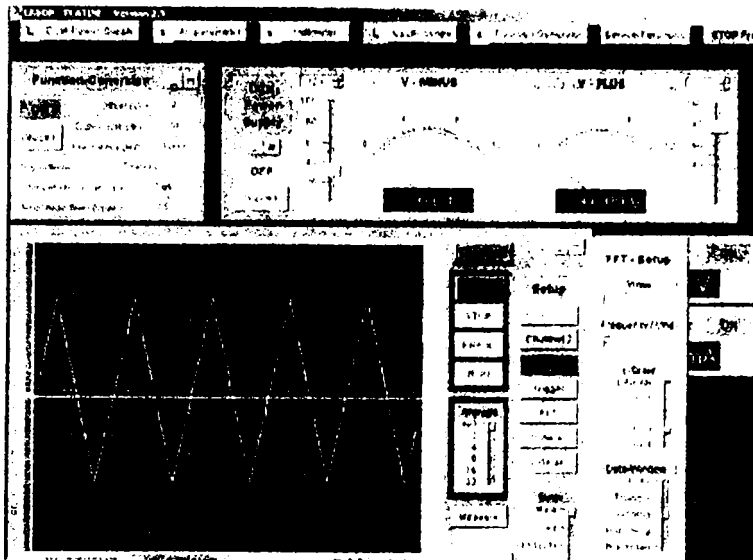


Fig. 2 A representation of the electronic board on the PC monitor

The reduced price (100€) of the electronic board implies certain constraints. For example, the sampling frequency of the two input signals is only 2 MHz. This is, however, more than enough for experiments on basic electric and electronic circuits. The supply voltages for the electronic board are +12V (150mA) and -12V (60mA). The software for the PC (written in the HP-VEE language) as well as the latest update can be downloaded from internet [2].

III THE IMPLEMENTED DEVICES

The electronic board itself can deliver a dual supply voltage for the circuit under experimentation: (0 to 12) V and (-0 to -12) V.

A DC-voltmeter can measure constant voltages in ranges from 2V to 20V. A DC-ammeter is also implemented for constant currents in ranges from 60µA to 200mA.

The implemented function generator (quartz controlled PLL synthesizer) delivers, via BNC, usual signals (sinus, rectangle, triangle and positive or negative sawtooth) as well as customized waveforms (programmable function).

Certainly, the most important instrument implemented on the electronic board is the digital oscilloscope. The impedance of the two Y1, Y2 inputs (via BNC) is 1MΩ/13pF and the bandwidth for each channel is 2MHz (-3dB). Both inputs have DC, GND and AC (time constant 0.1 sec) facilities. One can choose the sensitivity in the following steps: 10, 20, 50, 100, 200, 500mV/Unit and 1, 2, 5V/Unit. Important functions like external triggering (BNC output), FFT and signal averaging are also provided. Fig. 2 shows a representation of the electronic board on the PC monitor.

IV FRONTAL AND GUIDED EXPERIMENTS

Frontal experiments can be easily carried on if the computers in laboratory are connected in a local

area network. Combining problem solving (specific seminary activity) with PSpice simulation and frontal experiments using the electronic board, one can assure better understanding of theoretic and practical issues regarding electric and electronic circuits. This approach can accelerate the learning and save time. Groups of two or three students guided by the laboratory assistant in their work with the electronic board will also realize the importance of cooperation and teamwork. The feedback from the students is also important, since they can raise interesting problems. Our experience shows that students are better motivated to do simulations and experiments using the PC as main tool, than working with several different measuring instruments. Certainly, the frontal and guided experiments under the control of the laboratory assistant must be continued with individual assessments and hands-on exercises developed by the students in their own free time.

V CONCLUSIONS

The presented electronic board is a cheap and suitable solution for experiment-based teaching and learning of electric and electronic circuits. It can be utilized not only for individual study, but also in organized laboratory and classroom activities. Especially, frontal and guided experiments based on this electronic board can improve teaching efficiency, in comparison with classical laboratory training utilizing expensive measuring instruments.

REFERENCE

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A web-based teaching tool for laboratory classes

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Abstract – The paper presents a solution that the authors have used for implementing a virtual laboratory to allow students to conduct an experiment from a remote PC, as part of an e-learning process.

Keywords: web-based teaching tool, e-learning, virtual laboratory.

I. INTRODUCTION

With the rapid growth of Internet and number of PC users, web-based tools for teaching purposes become more and more present in teaching activities [1], [2], [3]. The paper presents an application that can be run from a remote PC by a student such as to conduct an experiment from a remote location, without the need of a physical presence in the classroom. The application is intended to allow each student of a group of students to individually conduct the experiment, as part of the implementation of an e-learning process.

II. DESCRIPTION OF THE APPLICATION

One important part of an e-learning system is the one that plans the execution of the experiment by the student(s). A reliable system is therefore needed. This system should also be able to monitor the execution such as no interference or overlapping between several users occur. The application that has been developed consists of two parts: the practical experiment and the planning and handling part. The experiment chosen to be conducted is the automatic calibration of a d.g.m.l voltmeter [4]. The system that has been developed for this goal consists of a PC, a programmable power supply, the DVM to be calibrated and a high accuracy voltmeter (fig. 1).

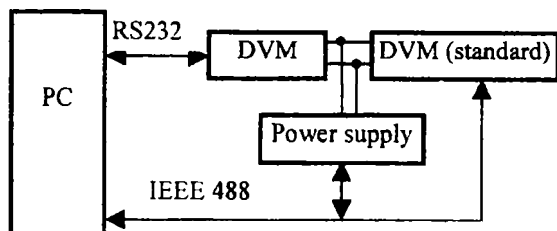


Fig.1. System architecture.

The power supply and the high accuracy voltmeter are connected to the PC via the IEEE 488 parallel interface. For the DVM to be calibrated a 4^{1/2} digit Voltcraft 4650 CR with built-in RS 232 serial interface was considered. An application (or virtual instrument - VI) has been developed in order to control all the devices and to accomplish the required tasks. The inputs of this VI are: the voltage range of the DVM to be calibrated, its number of digits, the formula given in its specification for calculating the maximum permissible error, the number of points (voltage values) and the number of times the measurements should be repeated at each point in order to obtain an averaged result. The tasks to be accomplished by the system are described in the following:

Step 1 – The VI calculates the first voltage value and sends it to the programmable power supply.

Step 2 – After a convenient delay the readings of the two voltmeters are sent to the PC. Step 2 is repeated the required number of times, and the readings are averaged. The averaged results are output in a table, and the error is calculated and compared to the maximum permissible error. Steps 1 and 2 are repeated for the required number of points. In the end, the operator sees a table with the averaged readings of the two voltmeters, the actual error and the maximum permissible error. Additionally, an array of LEDs indicates whether and at which point the error exceeds the limit. The front panel of the VI is shown in fig. 2.

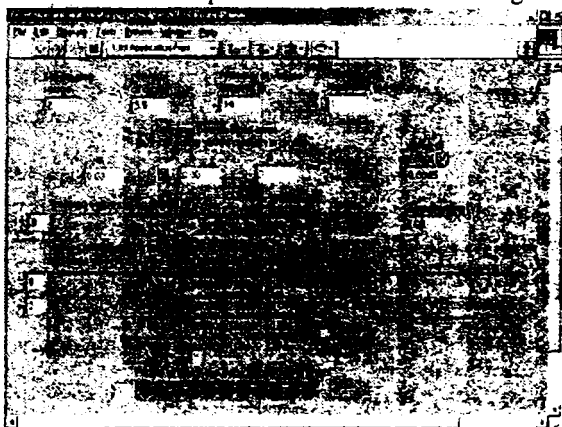


Fig. 2. Front panel of the VI.

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The planning and handling part of the application has been developed in HTML and PHP, and the data base for the data about the users has been implemented in MySQL. When the user accesses the e-learning site, a window appears and asks the user for identification (fig. 3).

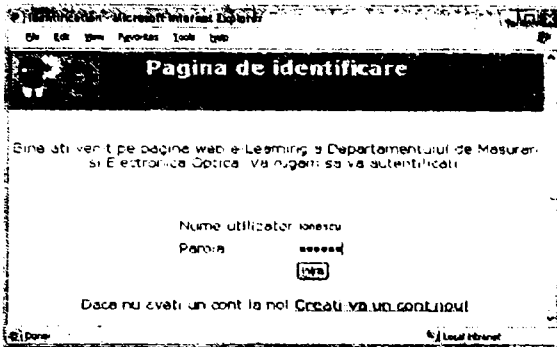


Fig. 3. Identification page.

If the user is not yet in the data base he or she can create a personal account. The following data must be filled in: the name of the user, a name for the new account, and a password that has to be reentered (fig. 4).

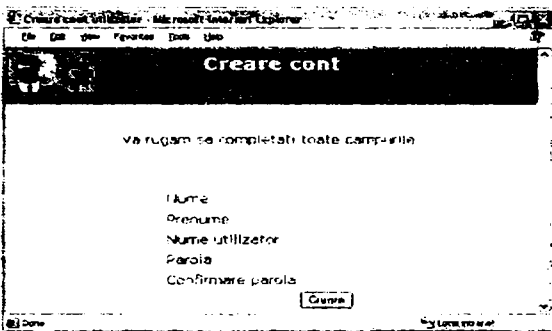


Fig. 4. Page for creating a new account.

The program checks the data and provides a dialog with the user (user name too short, improper password or non identical passwords). Once the account created, the user is redirected to the identification page. After being identified, the user is shown a page where he or she can choose a time frame for running the experiment (fig. 5). The time required for the experiment does not normally exceed 20 minutes. Therefore, in the application, 30-minute time slots have been provided.

In the selected time frame the user can access the e-learning site where the page in fig. 6 will be displayed. The user can choose to be connected to the virtual laboratory, where the front panel of the VI shown in fig. 2 will be displayed.

The user can remotely launch the application and after running it the front panel of the VI on the remote PC changes its appearance and provides the user the results of the experiment. The user can easily print a report with these results. He or she can also submit to

the professor, by e-mail, a complete report concerning the experiment carried out.

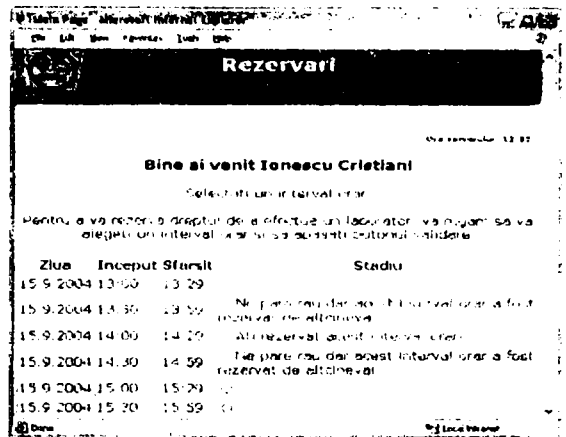


Fig. 5. Time frame reservation page.

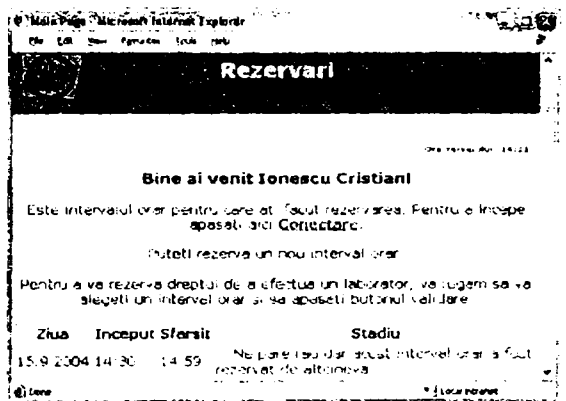


Fig. 6. Page for connecting to the virtual laboratory.

III. CONCLUSION

The paper illustrates a way in which the Internet is used to implement an e-learning procedure. It offers the advantage of a relative flexibility by offering the students a wide choice of time frames for conducting the experiment. The drawback, as for all virtual reality issues, is the loss of practical feeling (the students do not have a touch and feel of the real instruments and of the experimental setup).

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