Informatic system of interactive training for virtual laboratory type aplications

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Abstract- The project proposes accomplishing of a new informatics system architecture, under the form of a high-speed virtual laboratory, with a multitask type access on laboratory work, to remove users' waiting lists and allow reconfiguration of electric assembling in real time. Accomplishing the project was preceded by a thoroughly analysis of didactic requests according to economic problems, so that, the following aspects would be solved: Students will access from the distance real instruments and will accomplish online test montages, in the idea of understanding all the aspects of a real experiment (including possible flaws). Errors detected in prescribing the commands towards the machine will not be corrected automatically, but the student will be warned. The results of the tests will be supplied by the user in the same way the real instrument does.

I. Introduction

The system architecture is composed of multitask server with the role of realizing the interactive communication between users and workstation, having the multitask administration interface as a resident software procedure, workstation with a role in controlled and assisted accomplishment of laboratory work and the reconfigurable platform that represents the physical area of work development and whose equipment chaining structure is commanded by prescription from the users of the assembling scheme accomplishment nodes.

In this project we use NI SCXI-1130 matrix to realise a programmable platform witch permits the configuration by soft of an independent work papers laboratory. This matrix has 256 switches (8 lines by 32 columns). Every switch is commanded true a code sent by matrix and each time must be connected one active source on line or column. Rows will be note $R_0 \div R_7$ and columns whit $C_0 \div C_{31}$.

Interface between PC and Configurable Platform is made by an acquisition and generation data board witch is introduce to the bus system and permits generation of numeric and analogical signals thru soft, acquisition signals and, conversion in numeric format and save the information in the memory PC. In figure 1 we presented the block of the experimental system.
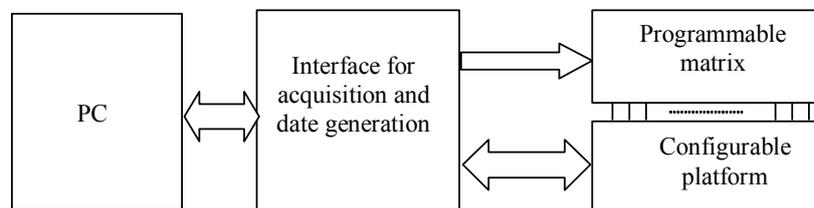

Figure 1. System architecture

The analog to numeric interface connected on the PC bus has several tasks to realise the virtual laboratory:
- Its sends numeric codes to the programmable matrix to command the switches;
- Its sends numeric codes to command the digital to numeric converter from the work platform;
- Its reads the voltages from the measure points of the laboratory papers, it's save them in the pc memory and sends them to the final user;

Work platform was design for the study of the operational amplifier AO and its application in divers' types of signals conditioner. The basic laboratory that can we do whit the reconfigurable platform are: using the AO as inversor and as a voltage follower, current adder, integrator, comparator, offset voltage compensation on operational amplifiers, filtering, Bode diagram (frequency response), R/2R network, numeric to analog converter, numeric to analog converter whit reaction.

This entire configuration will be performed by programming the switches matrix which realise the connection between electronic components on the platform.

A. Analog to numeric interfaces

All laboratory work will be conduct thru analog to numeric interface connected to the numeric PC. These interfaces will provide voltages and references for all the electrical circuits, it will send thru numeric ports commands to the programmable matrix for the specific hardware configuration and it will read thru the analogical acquisition channel the voltages from the specific nodes of the circuit board.

In figure 2 is presented analog to digital acquisition channels. The board can measure 4 differential channels and 8 undifferential channels (voltages to ground). The measure channel is selected by sending the appropriate code to the MUX. So for code 000 is selected channel 0, for code 001 channel 1 is selected and so on. The voltage form the output of the MUX is applied to the input of the AO which is commanded by the 4, 5, 6 bites applied to address (0x120+0x00). There are 8 stapes of amplification and so for code 000 the amplification is 1, for 001-1.25, for 010-2, for 011-5, for 100-10, for 101-20, 110-50, and for 111-amplification is 100.
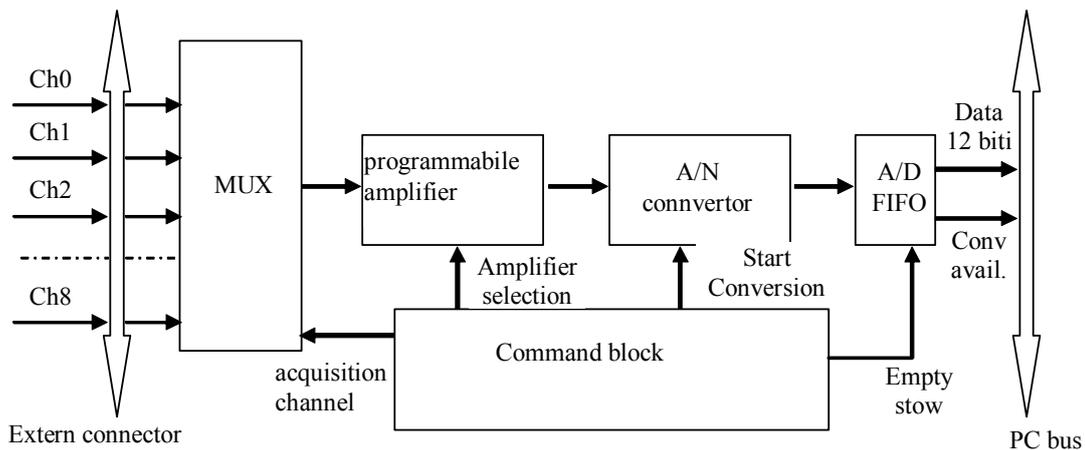

Figure 2. Circuit of the analogical
acquisition channel

B7	B6	B5	B4	B3	B2	B1	B0
0	A2	A1	A0	0	C2	C1	C0

Figure 3. Command octets at address ba+0x00

B. Numeric to analog converter

In a numeric to analog converter we use an R/2R network on 10 bites and every bite will be commanded thru matrix of switches. The numeric to analog converter uses R0 and R1 rows and C0 to C9 columns of the matrix. The network uses $10k\Omega$ and $20k\Omega$ resistances and at input a 10V supply (Figure 4).

In the first 5 nodes of the network the voltages are showed in figure 5.
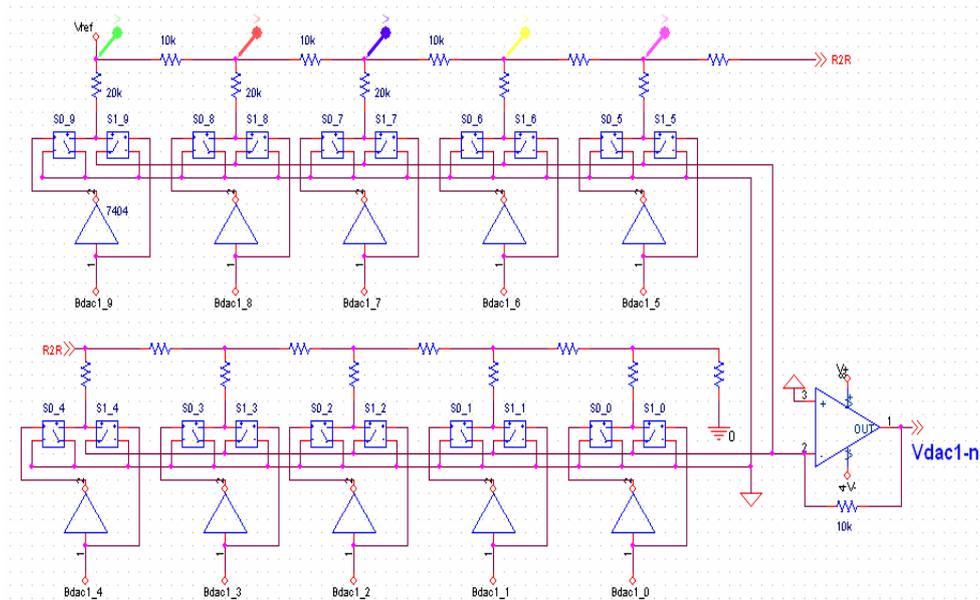
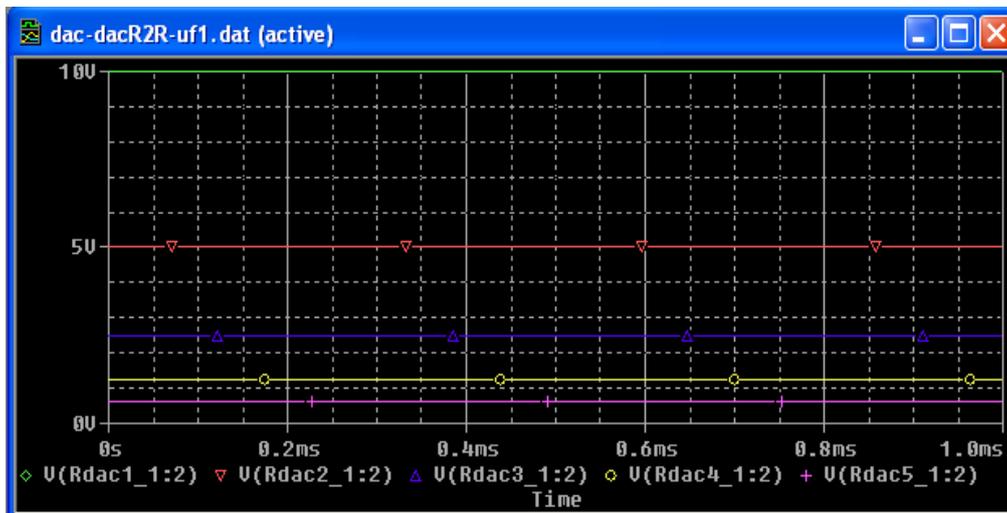Figure.4 R/2R network realised whit matrix switches.

Figure 5. Voltages in the first 5 nodes.

In every nod, the voltage is half than previous. In figure 6 is shown a combination for the R1 row of the input bits of the switching matrix. For V_{ref}=10V and 2R=20k results that the current at the input of the AO is 0.5mA and then V_{out}=-0.5mA*10K = -5V.
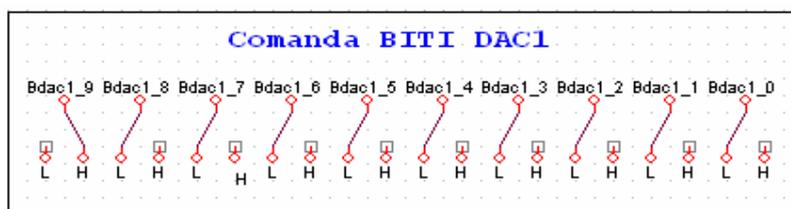

Figure 6. Bites combination.

Another application which can be applied whit the reconfigurable platform is the study of an operational amplifier. We will connect the input of the AO and the reaction thru the switching matrix. There are 2 lines from the switching matrix connected to the operational amplifier Figure 7. R2 whit S10, S11…S15 is connects the source signal to the input of the AO. R2 whit S16, S17, S18 connects the input impedance (resistance, capacitor or capacitor connected to ground) and the R3 line whit

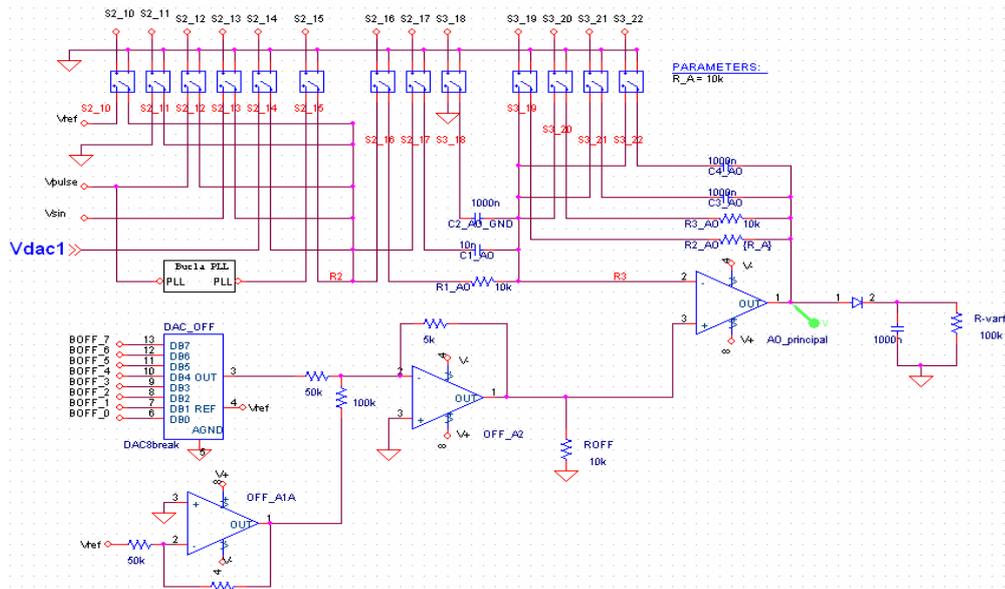C19…C22 establishes the reaction impedance of the AO. To correct the offset we use DAC_OFF, OFF_A1A, OFF_A2.

Figure 7. The circuit used to study the operational amplifier

II. Conclusions

All this circuits and analysis will make part from the lessons which will be implemented in the final e-learning system. The student will cover all the theoretical problems and he will take a test. After this he will program the switching matrix to realise the practical task of the laboratory. The results of the experiments will be text or graphic files and whit this results the student has to establish several parameters of the circuit (frequency, offset, gaining error).

The student will experiment whit the acquisition board as if he is working on the host PC. The major advantage of this system is that more students can work simultaneous to the same acquisition board. The time in which the student builds the program doesn't block the acquisition board and the PC. When the program made by the student is compiled whit success this will be executed in a very short time then the server is free for new compilations.

The proposed project will have as result the creation of a complex and powerful system of virtual laboratory type, with the help of which it will be able to access from the distance resources of real laboratories in education institutions. In private, the system will contain original solutions regarding interfaces with laboratory equipment, user multitask allowance algorithms and an online reconfigurable platform, for creating electronic montages. After an estimative calculation, we reckon a number of over 2000 users/year from the country who could be interested in accessing the system, not considering international users, who could be in an even bigger number after inclusion of the virtual laboratory in the European e-Learning network.

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