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Hardware and Software Reconfigurable Implementation for e- Learning In Engineering Education

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***Abstract*—An effective course in electronics should ideally contain hands-on design and experimental work as well as theory explanation and simulations. In this paper, a hardware and software reconfigurable implementation for e- Learning in engineering electronics courses is presented. The aim of such system is that student can design own electronics circuit and analyze on the LABVIEW [1].Key components of the Distance laboratory are a set of custom-designed hardware and Software tools. The novel hardware tools includes electronics test bed contains semiconductor devices and passive components such as [capacitor, resistor, inductor] and active devices. Novel software tools include a set of virtual instruments used for control, data capture, and data analysis][2].A pulse width modulation (PWM) generator is implemented in a single FPGA chip. As a result, the controller becomes cost effective .The advantages of such platform include flexibility, friendly user interface [3].**

Keywords- Hardware, Software, implementation, e-learning system

I. INTRODUCTION

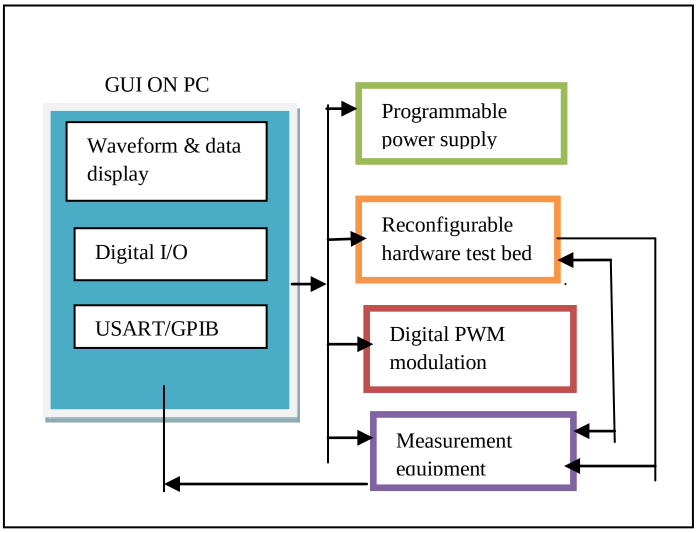
Eelectronics systems are increasingly being used in many applications, including amplifier and pure DC generation, home appliances, and military application. Designing these systems requires significant knowledge in multiple areas of electrical and computer engineering. Thus, an effective analog electronics course should ideally contain hands-on design and experimental work in addition to the study of the theory and simulations [1][2]. Using new media and information technologies in the classroom can not only make studying more attractive to the student but also make teaching much easier. Virtual laboratory has been exploited to offer the students different levels of interaction and understanding of the analog electronics systems. [1][4].The advantages offered by the proposed implementation are the following. 1) The electronics test bed can be configured by the students via a LABVIEW to construct amplifiers, filters etc.. 2) The software accessible distance laboratory system permits the instructors and students to conduct experiments over the software. Software includes customized virtual instruments (VIs) that utilize the commercial package Lab- VIEW [1] for control, data capture, and data analysis. MATLAB [10] is used for time-domain simulations. Reconfigurable test bed can be configured to matrix switch module developed by National Instrument Corporation that is NI PXI2529 matrix module [5].Therefore, such system is flexible, easy to use, and is suitable for analog electronics education.

II. E-LEARNING SYSTEM VIEW

Fig. 1 shows an overview of the e-learning system view. From Fig. 1, the whole system can be divided into four major parts, i.e. software-reconfigurable electronics testbed, reconfigurable hardware test bed, measurement panel, a user interactive e-learning platform.

A. Software-reconfigurable electronics test bed

The e- learning electronics test bed consists of a reconfigurable hardware test bed, a digital pulse width modulation (PWM) generator. This hardware test bed includes a fully software-reconfigurable processing core based on the matrix switch module from National Instruments Corporation and a set of discrete active devices and passive components.



The digital PWM generator is implemented using the MAX II series field-programmable gate array (FPGA) chip from Altera Corporation.

B . Reconfigurable Hardware Test bed

In this paper, the reconfigurable hardware test bed is used to let the students construct their own analog circuit. Based on this concept, a reconfigurable hardware as shown in Fig. 2 is presented. From Fig. 2, this hardware includes a range of discrete semiconductor devices and passive components, which can be used to implement any kind of basic electronics circuit through appropriate wiring of the terminals [1].

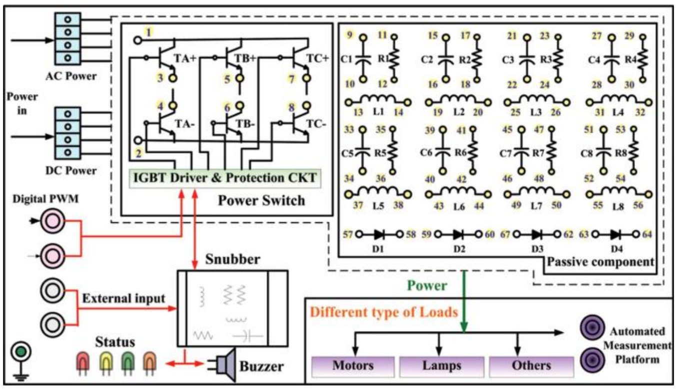


Fig. 2. Reconfigurable hardware test bed.

The only difference between the such test bed and the ones presented in [1], [3], or [4] is that the presented hardware can be configured via software. In this paper, a matrix switch module PXI-2529 from National Instruments Corporation is utilized to deal with this problem. The matrix switch module can be used to connect any input to any output; therefore, the overall system can easily and dynamically change the internal connection path without any external manual intervention.[1][4][11].

C. Measurement panel.

Laboratory contains different types of measurement equipment such as digital storage oscilloscopes (DSOs) and digital multimeters (DMMs). These instruments can be used to measure the voltage and current waveforms of the electronics circuits under test. These apparatus can be remotely operated by a General Purpose Interface Bus (GPIB) or RS-232 interface cards installed on the PC. The interface cards used to configure the hardware test bed and to control distance laboratory instruments, and a graphical waveform display screen. Thus we use these instruments to get output from the hardware and gives to GUI PC to display on waveforms virtually. So that we use LABVIEW software to virtual display of analog output [1][3].

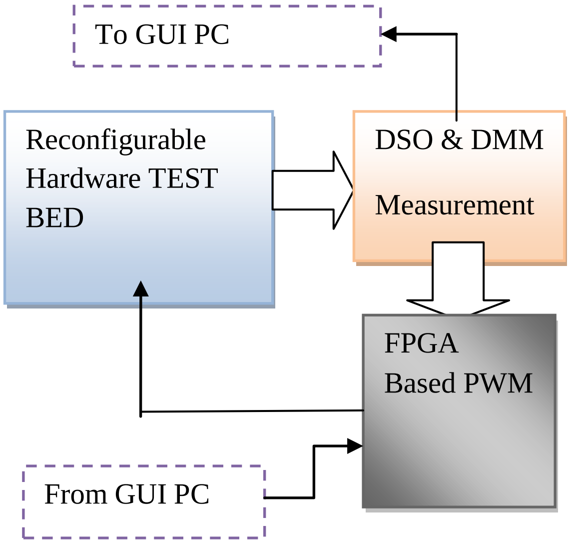


Fig .3. Measurement panel and FPGA

Fig.3. shows that measurement panel and FPGA hardware module for generation of PWM. It is used to generate different width of the pulses from (0% to 100%) when compensation network getting signal from open loop configuration i.e. from directly RS232. Compensation network getting signal from close loop it requires digital controller [1][3][5].

D. Distance Laboratory and e-Learning

Another advantage of e-learning is the independence of the working place and time. Recently, many e-learning educational systems have been developed, targeted to specific environments. The such e-learning platform is composed of Web-based course contents, the interface cards used to configure the hardware test bed and to control distance laboratory instruments, and a graphical waveform display screen. The contents of this e-learning platform contain not only lecture notes and simulations but also an online experiment interface [1][2].

III. DATA ACQUISITION AND MATRIX MODULE

The proposed distance laboratory should be able to measure the currents and voltages of a variety of devices. Thus, the test points will be far more than the input channels of DSO or DMM. Data acquisition is used get signal from various point and given to GUI PC. Because GUI PC get signal in the form of digital hence it is necessary to convert analog signal to digital form we require DAQ [1]. It should be noted that to route a signal from different test point requires matrix module. The matrix switch module is again used to route signals from DSOs and DMMs to various test points on a unit under test. This concept is illustrated in Fig. 4. Matrix module is developed by National Instrument Corporation PXI2529 [11].To route signal this module is used. Configuration specification are 8 X 16, 2 wire matrix module as well as 2 X 32 , 2 wire matrix module.

IV. CONFGURE LABVIEW TO FPGA HARDWARE MODULE

National Instruments' Lab VIEW (Laboratory Virtual Instrument Engineering Workbench)is a graphical programming language that is commonly used throughout academia, industry, and government. Thus some familiarity with this vital tool is important for undergraduate electronics engineering (EE) students [1]. As the perfect combination of measurement and computer technology, virtual instrument is got fast development. In addition, it brings great influence to measurement technology and experimental equipment [6][9].

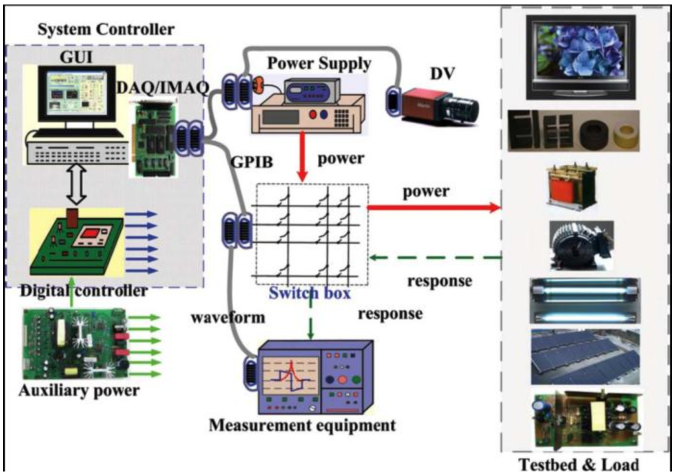


Fig.4. Using matrix switch module in laboratory

A virtual laboratory is defined [3] [9] as an interactive environment for creating and conducting simulated experiments: a playground for experimentation. It consists of domain-dependent simulation programs, experimental units called objects that encompass data files, tools that operate on these objects, and a reference book.

FPGA Hardware module- Field Programmable Gate Array (FPGA) use the high densities in modern process to construct ICs that, as their name suggest are completely programmable even after product is supplied or " in the Field." Here we use FPGA based on SRAM technology is XILINX Spartan series FPGA. These FPGA are implemented with a flexible, regular and programmable architecture of configurable logic blocks(CLBs), interconnect by versatile and also programmable routing channels and surround able by a perimeter of programmable input/output block(IOBs). Digital I/O of FPGA hardware module configure to digital I/O of GUI PC. Hence we can download program into FPGA without any VHDL knowledge [1][8]. As presented in Fig. 5, the basic structure of an FPGA consists of a sea of Logic Blocks (LBs), an interconnection network and configurable I/O blocks. Because of their very high level of integration, the recent FPGA devices also include memory blocks, hardwired DSP blocks, clock manager blocks, and communication blocks. For the same purpose, memory blocks (RAM, ROM, Flash RAM) are also integrated. The integrated clock manager blocks allow the management of the clocking resources. They are commonly based on Phase-Locked-Loops(PLLs).The current FPGA devices also include communication blocks that consist generally ofare Xilinx and Altera families [8].

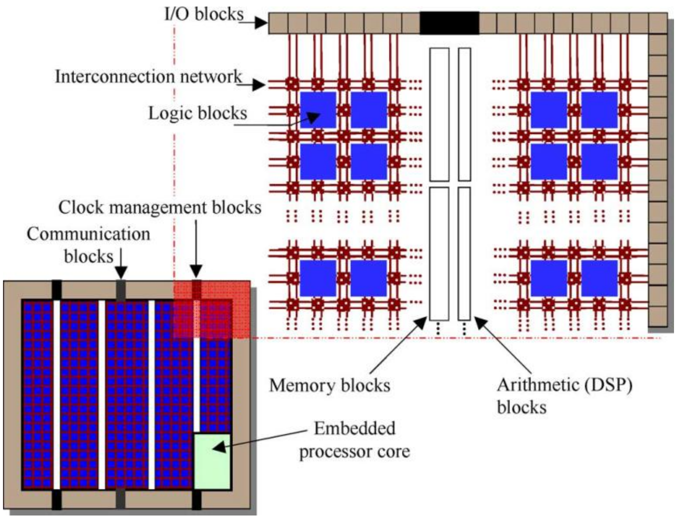


Fig.5. Generic structure of an FPGA

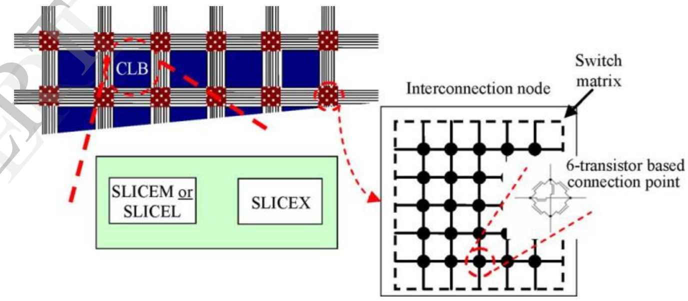


Fig.6.SRAM-based SPARTAN-6 FPGA

V.VIRTUAL LABORATORIES IN ELECTRONICS ENGINEERING

Consider the scientific meaning of simulation as "goal-directed experimentation with dynamic models" [10]. Also, denote a virtual laboratory as being based on the first definition of laboratory presented above, that is, a place providing opportunity for experimentation. Generally, design tools include hardware design and verification tools (VHDL/Verilog editor, synthesizer, place/route and physical implementation tools), vendor libraries in addition to simulation and debugging tools. This design flow consists of two main procedures: the software design flow and the hardware design flow. It offers a user friendly interface that allows the designer to customize the processor for a specific project. After its configuration, the processor core is generated in the form of an HDL file (in the case of Altera and Actel tools) or a netlist file(in the case of Xilinx tool).

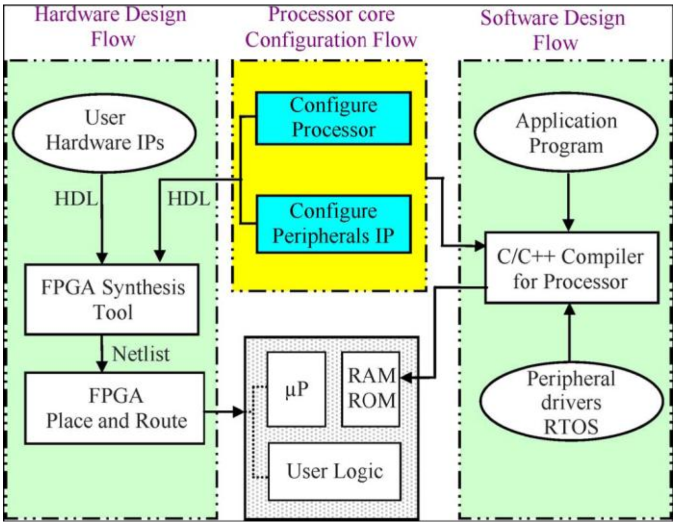


Fig.7.Typical FPGA SoC design flow

Then, this file can be associated to custom user logic and integrated within the hardware design flow to be synthesized, placed and routed. The FPGA can be configured with the resulting bit stream file. Then, the program which will be integrated on the soft processor cores can be compiled with the associated library files and header files. A C/C++ compiler targeted for this processor is also provided for the development system [4][6][8].

VI. IMPLEMENTATION OF REMOTE LABORATORY

In this paper, an Internet-accessible distance laboratory system has been developed. The implementation of the proposed system is shown in Fig. 7. From Fig. 7, the student is located on the client side and accesses the lab simply through an Internet connection using a commercially available browser. A networked PC server is located in the physical lab and is GPIB interfaced to measurement instruments such as DMM and DSO.

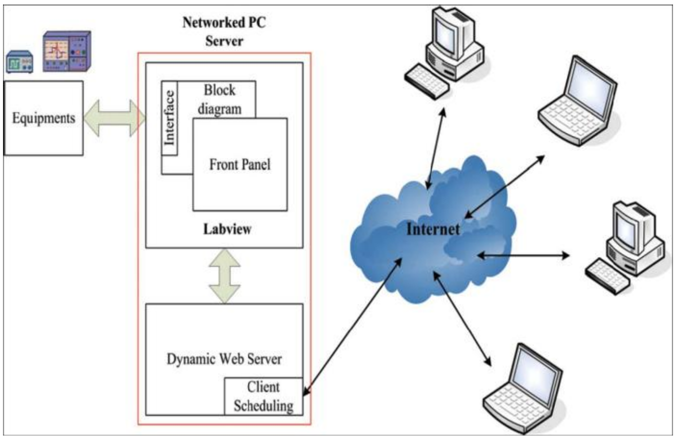


Fig.8. Implementation of Remote laboratory

A dynamic Web page, where a virtual front panel of the instruments is displayed, is also implemented in the server. The students can then read the instruments and operate the equipment using this panel if required. The control and user interface software is developed using LabVIEW software. The main advantage of this Web-based laboratory is that it allows for employing the same equipment used in traditional lab classes [1][3]. The dynamic Web server shown in Fig. 5 makes the front panel available to all clients so that all clients connected to the server can see and operate the front panel. Since the instruments can be used by one student at a time, a schedule is required. A booking system is introduced in the developed distant laboratory.

The remote user can book an experiment for a pre-defined hour, and then, when the reserved time comes, the user gains a valid link to the remote lab Web page [1][3].

VII. CONCLUSION

In this paper, a hardware and software reconfigurable implementation for e-learning in electronics engineering education has been presented. The whole system can be divided into four major parts, i.e. software-reconfigurable electronics test bed, reconfigurable hardware test bed, measurement panel and distance laboratory and e learning .Unlike most related works; the matrix switch module is used in such system to realize a reconfigurable hardware test bed. This test bed, together with an FPGA-based digital PWM generator, forms a electronics test bed that can be configured via software [1]. Further, students appear to be attracted to computer use in this education application, thus taking advantage of the students' expertise in computer software applications [3]. Thus we have conclude that such system is user friendly, easy to use. We use LABVIEW software to reconfigure the electronics hardware test bed. Using matrix module NI PXI2529, we can measure different voltages and currents through GPIB interface bus present on the hardware test bed. Thus we take different test point with the help of Matrix module. To convert analog to digital and again digital to analog we use DAQ (Data acquisition) module developed by National Instrument Corporation. Thus using such system student will feel great experience to interface hardware and software in real time. In this system there may be some limitations while we interfacing any circuit i.e. there may be short circuit problem etc. This problem can be solved in two ways. First, to comply with safety rules, the equipment need to operate from a lower input voltage, and the voltage source should be equip with built-in protection functions.

REFERENCES

1. Malay Trivedi, *Student Member, IEEE*, Erik A. McShane, RamachandranVijayalakshmi, AmitMulay, SiamakAbedinpour, Steve Atkinson, and Krishna Shenai, *Fellow, IEEE "An Improved Approach to Application-Specific Power Electronics Education—Switch Characterization and Modeling"*, IEEE Transaction on Education VOL. 45, NO. 1, FEBRUARY 2002
2. IEEE Transaction on very large scale integration (VLSI) system, VOL. 11, NO. 2, APRIL 2003
3. Joshua M. Williams, Student Member, IEEE, James L. Cale, Member, IEEE, Nicholas D. Benavides, Student Member, IEEE, Jeff D. Wooldridge, Andreas C. Koenig, Student Member, IEEE, Jerry L. Tichenor, Member, IEEE, and Steven D. Pekarek, Member, IEEE "Versatile Hardware and Software Tools forEducating Students in Power Electronics"IEEE Transaction on Education, VOL. 47, NO. 4, NOVEMBER 2004
4. Mihaela M. Albu, *Member, IEEE*, Keith E. Holbert, *Senior Member, IEEE*, Gerald Thomas Heydt, *Fellow, IEEE*, Sorin Dan Grigorescu, and VasileTrus¸cˇa"Embedding Remote Experimentation in Power

Engineering Education",IEEE Transaction on Power System, VOL. 19, NO. 1, FEBRUARY 2004

5.]P. Spanik, L. Hargas, M. Hrianka, and I. Kozehuba, "Application of virtual instrumentation LabVIEW for power electronic system analysis,"in *Proc. 12th Int. Power Electron. Motion Control Conf.*, Aug. 2006,pp. 1699–1702
6. Seul Jung, *Member, IEEE*, and Sung su Kim "Hardware Implementation of a Real-Time Neural Network Controller With a DSP and an FPGA forNonlinear Systems" IEEE Transaction on Industrial Electronics, VOL. 54, NO. 1, FEBRUARY 2007
7.]Shun-Chung Wang and Yi-Hwa Liu" Software-Reconfigurable e-Learning Platform for Power Electronics Courses",IEEE Transaction on Industrial Electronics , VOL. 55, NO. 6, JUNE 2008
8. Eric Monmasson, *Senior Member, IEEE*, LahoucineIdkhajine, *Member, IEEE*, Marcian N. Cirstea, *Senior Member, IEEE*, ImeneBahri, *Student Member, IEEE*, AlinTisan, *Member, IEEE*, andMohamed WissemNaouar, *Member, IEEE "FPGAs in Industrial Control Applications"*IEEE Transaction on Industrial Informatics, VOL. 7, NO. 2, MAY 2011
9.]ZhongbaoJi "Application of Virtual Instrument in Electronic Education"Wenzhou Vocational and Technical College, Wenzhou 325035, China
10. MATLAB: The Language of Technical Computing. Natick, MA: The MathWorks, Inc., 1996.
11. Data sheet "NI PXI 2529 specification" www.ni.com