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WIRELESS REAL TIME ELECTRONICS LAB

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Abstract : With the integration of Telecommunication Technologies with virtual instrumentation remote laboratories can be developed and accessed in real time, ensuring a richer collaborative experience for the student while avoiding some of the growing limitations of traditional laboratories, such as the lack of enough work area, expensive instrumentation, lack of personnel, time assigned to a laboratory, and their availability in non-working office hours. Units and experiments were built, such as power sources, amplifiers, device characterization circuits, and filters depending on the needs of each circuit, a connection to a function generator and variable voltage sources was provided.

The accelerated pace at which both the computing and Telecommunications worlds are advancing, along with their ever increasing availability are creating a new relationship between the teaching process and the way students are learning, thus revolutionizing the way this process is carried out altogether.

In this paper, an alternative remote lab infrastructure devoted to the study of electronics is presented. Its main characteristics are, from a teacher's perspective, reusability and simplicity of use, and from a students' point of view, an exact replication of the real lab, enabling them to complement or finish at home the work started at class. The remote laboratory is integrated in the Learning Management System in use at the college, and therefore, may be combined with other experiments strategies.

Keyword: Remote lab, Data acquisition,

1. INTRODUCTION

In traditional university laboratories students conduct experiments under the supervision of an instructor. A remotely-operated laboratory for undergraduate education in electronics and communication engineering which emulates a traditional laboratory. The ongoing integration of telecommunications with the learning and collaboration process has enabled many of the engineering projects to take advantage of the remote access to laboratories that it allows. A remote laboratory was developed for measurement, analysis, design, and simulation of electronic circuits. Students are provided with the means to interact instantly with hands-on experimentations while in the classroom undertaking a theoretical electronic circuit's course in order to enhance the quality education. The remote laboratory experiments have improved the teaching and learning efficiency and encouraged students to modify experimental procedures to obtain better results, which mimics research experience but in a class situation. Instructors and students will benefit from this arrangement in courses where they can access remotely located lab equipment during lectures.

The overall experience, together with the fact that the process is being taken from a real circuit, the ease-of-use of the graphical interfaces, the remote access from virtually any place and any time, and, most importantly, that it is all done in real time, give the user a richer experience. To laboratory coordinators, this allows for the elaboration of better practices with a far lower cost than traditional laboratories, the creation of remote laboratories with a minimal space required, and the ability to implement customized instrumentation based in software and low-cost hardware.

2. REMOTE LAB ARCHITECTURE

Remote experiments and virtual laboratories are actively used in various theoretical and applied disciplines. Related training courses have also been explored in Electronics engineering. Other interesting setups are the remote experiments and virtual lab for wind tunnels a virtual laboratory for exploiting circuit, and a learning tool for chip manufacturing. Recently, a solution to implement a remote laboratory for designing and testing Circuits has been proposed.

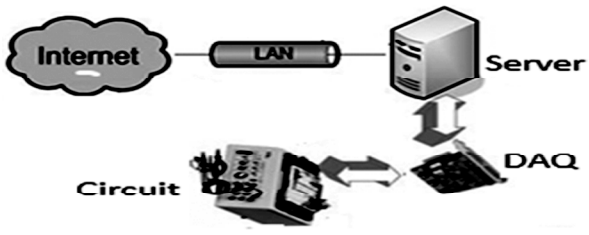

Figure 1: The Remote Lab Architecture

The application allows Electronic Engineering students to access and perform measurements and conduct analogue

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electronics experiments over the internet. Software, running on a Citrix server, is used in the circuit design generating the responses and acquiring data by a data acquisition board (DAQ). This remote analogue electronics lab has been extended to the proposed architecture as shown in Figure 1. The remote experiment can be run from anywhere inside a local area network (LAN) and globally via the internet.

3. HARDWARE AND SOFTWARE DESIGN

The microcontroller block of the experiment is based on the free scale Semiconductor MC9S12NE64 microcontroller/ DEMO9S12NE64 evaluation board is shown in figure 2. This evaluation board was selected for its integrated on die Ethernet controller, fast processing speed and externally available IO pins. However, it contains only 64KB of Flash and 8KB of RAM which must be shared between application and constant web page data. This severely limits the amount of functionality that a given experiment can contain.

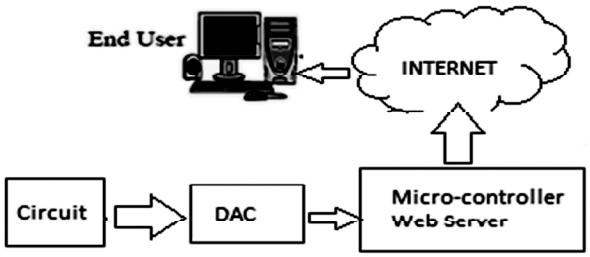

Figure 2: The Overall Experiment Building Blocks

Future versions of the Active Element experiment will utilize some of the expanded IO capabilities of the chip for the addition of external memory where constant web page data may be stored. This would increase the space for application code dramatically. An eight bit IO port is used to adjust the output of the external DAC

4. DEVELOPMENT

The coming of new Information Technologies, an exponential increase in the amount of information and the accumulation that it requires in all courses. A tool that turns out to be extremely useful in this kind of needs is the redesigned courses meant to be taken through a computer, especially, laboratory practices. However, although these kinds of systems has been developed in the past 10 years to replace traditional engineering courses, they have some limitations that have stopped their total immersion in the scholar curriculum, such as complicated structures, use and hardware limitations, and perhaps the most important reason, the cost of implementation. The Internet especially in the educational field, a desire to give access to the information of all courses through the network has been arising, allowing it to be used from virtually anywhere with an Internet-connected machine. A system that allows its users to plan and conduct experiments, as well as obtaining and analyzing data through teleimmersion mechanisms which is shown in figure 3.

In the case of remote laboratories, the access to the physical equipment is made through a computer connected to the Internet and DAQ systems, which have access to analog and digital ports with input and output capabilities, counters, switches, etc. In this kind of laboratory, the user experiments with equipment in a real environment, taking data and experiment status by means of real sensors and transducers, this makes the experience more effective. However, care must be taken not to lead the experiment into extreme conditions to avoid damage to possibly expensive equipment.

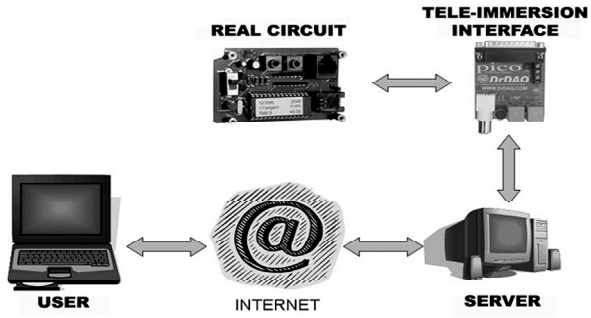

Figure 3: Virtual Laboratory as a Remote Laboratory

5. CONCLUSION AND FUTURE WORK

REL is not to be misunderstood as a replacement for conventional labs or simulation software applications however; REL is an augmentation tool and supplemental modality to help enhance the learning experience, at a distance. RELs have great potentials for expanding distance learning for traditional and nontraditional students, learners, employees, and professionals beyond confined classroom and laboratory environments. A login and scheduling systems were implemented to allow the users to carry out their practices in their own time, without conflicting with other users. A graphical interface was also generated, making it completely user friendly, while also providing enough flexibility for the laboratory administrator so as to make changes in the circuits or projects, minimizing the programming complexity in a structured, complete graphical environment. It became clear that, once the system was made available to students, it provided with a better time flexibility than a traditional laboratory, but retaining the learning benefits of the latter. To make sure the students did learn the proper concepts through the remote practices, a lab practice report is handed in and graded by the instructor. It is also important to note that, although very effective, a remote lab is not meant to replace traditional labs at all, but to enhance the learning process by supplying a remote, flexible laboratory for those basic subjects that lack a traditional one.

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