Welcome to the REV2013 Conference in Sydney, Australia
6 - 8 February 2013

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REV2013: 10th International Conference on Remote Engineering and Virtual Instrumentation

"Moving from design to innovation and impact"

REV2013 is being held in Sydney, Australia. Sydney is the largest and most dynamic city in Australia. Attending REV2013 will give you an opportunity to experience Sydney's stunning harbour, wonderful climate, friendly people, and numerous other attractions, whilst participating in an exciting conference program.

REV 2013 is the tenth in a series of annual events concerning the area of remote engineering and virtual instrumentation. The REV conferences are the annual conferences of the International Association of Online Engineering (IAOE) (**www.online-engineering.org**). The general objective of this conference is to demonstrate and discuss fundamentals, applications and experiences in the field of remote engineering and virtual instrumentation. With the globalization of education the interest in and need of teleworking, remote services and collaborative working environments now increases rapidly. Another objective of the symposium is to discuss guidelines for education in university level courses for these topics. REV 2013 offers an exciting technical program as well as academic networking opportunities during the social events.

Scope of the conference

Remote Engineering and Virtual Instrumentation are very future trends in engineering and science. Due to:

- the growing complexity of engineering tasks,
- more and more specialized and expensive equipmentas well as software tools and simulators,
- the necessary use of expensive equipment and software tools/simulators in short time projects,
- the application of high tech equipment also in SME's,
- the need of high qualified staff to control recent equipment,
- the demands of globalization and division of labour,

it is increasingly necessary to allow and organize a shared use of equipment, but also specialized software as for example simulators. Organizers especially encourage people from industry to present their experience and applications of remote engineering and virtual instruments.

The general objective of this conference is to discuss fundamentals, applications and experiences in the field of remote engineering and virtual instrumentation. The use of virtual and remote laboratories is one of the future directionsfor advanced teleworking, remote service and e-working environments. Another objective of the symposium is to discuss guidelines for educationin university level courses for this topic.

Links to earlier conferences

Topics of interest include (but are not limited to)

- Virtual and remote laboratories
- Remote process visualization and virtual instrumentation
- Remote control and measurement technologies
- Online engineering
- Networking and grid technologies
- Mixed-reality environments for education and training
- Education and operation interfaces, usability, reusability, accessibility
- Demands in education and training, e-learning, blended learning, m-learning, and ODL
- Open educational resources (OER)
- Teleservice and telediagnosis
- Telerobotics and telepresence
- Support of collaborative work in virtual engineering environments
- Teleworking environments
- Telecommunities and their social impacts
- Present and future trends, including social and educational aspects
- Human computer interfaces, usability, reusability, accessibility
- Innovative organizational and educational concepts for remote engineering
- Standards and standardization proposals
- Products
- Military wireless applications
- Information security
- Telemedicine
- Renewable energy
- Applications and experiences.

Program Summary

The conference will have a core program run over 2 days (6th and 7th February). There will also be a 3rd day for the conference involving a social trip to support networking and following up on the conference discussions in a more relaxed setting. The cost of the trip is included in the conference registration fee. And the Global Online Laboratory Consortium will be hosting two day-long meetings of the Technical and Education sub-committees immediately prior to the conference.

Monday 4th February	Pre-conference Meeting: GOLC Technical Committee
Tuesday 5th February	Pre-Conference Meeting: GOLC Education Committee Pre-Conference Workshop: Introduction to Remote Laboratories
Wednesday 6th February	**REV2013 Day 1 (Remote Engineering Foundations)** **Keynote; Papers Sessions; Best Paper Session**
Thursday 7th February	**REV2013 Day 2 (Remote Engineering Applications)** **Workshops; Paper Sessions; Keynote**
Friday 8th February	REV2013 Day 3 Social Trip to Wildlife Park; Blue Mountains; Harbour Cruise

Other opportunities to participate

Thematic workshops / tutorials / technical sessions, as well as interactive demonstrations and exhibitions, may also be proposed. Prospective organisers of other REV2013 events are encouraged to contact the Conference Chair.

Conference language

English.

Proceedings

The proceedings will be published on CD by the International Association of Online Engineering (IAOE), and they will be indexed by IEEE Xplore.

Interesting papers may be published in the International Journal of Online Engineering (iJOE), **www.online-journals.org/i-joe/** .

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Design, Development and Implementation of Remote Laboratories in Distance Electronics, Control and Computer Subjects

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***Abstract*—Remote laboratories are a good alternative to traditional laboratories in distance learning, due to students can carry out experiment from anywhere and at anytime. This possibility of providing students with online experiment across Internet has done that professors from electrical and computer engineering department of Spanish University for Distance Learning start to design, develop and implement remote laboratories.**

This paper is a description of design, development and implementation of some of the remote laboratories, developed by electrical and computer engineering department, and the educational fields that they cover, such as control, electronic and computer.

***Index Terms*— Distance learning, Remote Laboratories, Online Experiments, Learning Management System.**

I. INTRODUCTION

Spanish university for distance learning (UNED) is founded in 1972 and has as mission the public service of higher education through the modality of distance education. From the last decade until present, Internet and online tools, such as e-mail, web pages and learning management systems have replaced other communication means such as phone or traditional mail. Currently traditional laboratories are being replaced or complemented with online laboratories which allow students to carry out experiments at anywhere and anytime.

As some professor of UNED, The professors of department of electrical and computer provides a set of e-learning tools that allow students to follow their subjects, among them:

- A set of web pages of department where is possible to find the guide of each subject, the timetable of professors, etc.
- A learning management system which allows professor to create a course and provide student with e-learning services, such as forums, file storages, assessments, etc. Nowadays there are a vast range of them, among open sources LMS are SAKAI [1] or Moodle [2].
- An online institutional channel which allow professor to upload videos which can be interesting for students.

Furthermore, these subjects cover several educational fields such as electronic, electrical, control and computer where the acquisition of theoretical knowledge and skills are obliged requirements. For this reason, several remote laboratories have been designed and developed [3]:

- Electronic laboratories. Currently two remote laboratories are accessible for students:
  1. VISIR is a remote laboratory for wiring and measuring electronics circuits on a breadboard remotely. The user designs and constructs his circuit by a PC-mouse on a seamlessly simulated workbench that resembles the real lab elements and components. Once the designed circuit is submitted, it is sent to be verified then to be wired and measured by real instruments, and finally, to be received by the user on his PC-screen in real-time [4-5].
  2. A remote laboratory composed by a data acquisition unit connected to breadboard, and programmed in Labview. The professor can put several circuits in the board. Student through Internet browser can work with the Labview program and study the behavior of those circuits.
- Control laboratory. This laboratory was developed in Labview and allows student to work with a small hydraulic plant (fig 1.) and learn concepts such as *the permanent failure* and *windup effect.*

Figure 1. Remote laboratory of a Hydraulic plant.

- Computer Architecture and microcontrollers. Two remote laboratories are enable for the students:
  1. The Microprocessor Remote Lab allows students to work with a Motorola 68000 microproccessor connected to an I/O board.

2. The PICs Remote Lab allows students to work with a PIC16F88X microcontroller (Fig 2.).
   Both remote laboratories work in a similar way. Students across Internet browser send a program and can see the behavior and results of running that program.

Figure 2. Remote laboratory of PIC.

All these follow the common architecture of a remote laboratory:

- User Interface. It is a virtual end-user workbench that handles all the lab administration process. It is a web site that runs on the user's web browser and usually requires a server-side programming language to retrieve user's data from database such as PHP, ASP, and JSP, along with a Graphical User Interface (GUI), which is built by an animation technology embedded in the HTML code to resemble the real laboratory workbench such as Flash, Java Applets and MS Silverlight. Other scripting languages commonly used are: JavaScript; it adds interactive elements to the web page without relying on the server, and AJAX; it retrieves information from the server in an efficient way and without needing to refresh the web page. The website could be supplanted by a software application written in JAVA, .NET or C/C++ languages which is installed on the user-PC and connected to a database server (application server).
- The web server is a server-PC that hosts the web site and the database files. Apache and Microsoft IIS are the most commonly used servers, while MySQL, Microsoft SQL, and Oracle, are the most commonly used databases. The web server sends the user requests to the lab server in the form of XML messages through TCP/IP model over HTTP layer. Other attempts have been made to use non-HTTP based protocols such as Common Objective Request Broker Architecture (CORBA), Java Remote Method Invocation (RMI), .NET Remoting, and TCP/IP sockets. Some of these technologies, however, are restricted to local networks only [7].
- The lab server is a server-PC that hosts the instrumentation control software (lab server software) and it is connected directly to the instruments and the controller. The instrumentation control software sends commands to the controller regarding the received requests or the programmed code from the user. The instrumentation control software could be built from scratch with a multi-purpose programming language such as C# and C/C++, or with graphical programming environment such as LabVIEW and MATLAB/Simulink. Or else, it could be proprietary software that comes with the controller. The instrumentation control software is connected to the controller and the instruments by Universal Serial Bus (USB), RS-232, Ethernet, General Purpose Interface Bus (GPIB-IEEE-488.2), serial port, parallel port, etc. depending on the controller or the equipment platform. There are several modular types of instrumentation platforms such as PXI (PCI eXtensions for Instrumentation), LXI (LAN eXtensions for Instrumentation), GPIB (General Purpose Interface Bus or IEEE-488), and VXI (VME eXtensions for Instrumentation).

This paper described the design, development and implementation of each laboratory. Furthermore, it shows the necessities of creating e-learning scenarios [6] and the design of services [7], such as scheduling.

II. REMOTE LABS AND DISTANCE LEARNING

Until several decades ago, traditional laboratories were the only possibility that allowed students to carry out experiments and get the needed skills for their future jobs, but, this fact has changed thanks to the improvement in communication networks and programming languages. So, currently, it is possible find a vast number of high schools and universities that design, create, and installed remote laboratories which allow student to acquire skills from home. Some of these developments are:

- LabShare is led by the University of Technology, Sydney, and is a joint initiative of the Australian Technology Network: Curtin University of Technology, Queensland University of Technology, RMIT University, University of South Australia, and the University of Technology, Sydney [9]. This project aims to create a national network of shared remotely accessible Laboratories. This mean a greater number of high-quality laboratory-based educational experiments are available to university and high school students from anywhere in Australia and around the world.
- The WebLab-Deusto project is an open source project providing a web-based, experiment-agnostic, scalable software infrastructure, which permits the University of Deusto to offer several laboratories to its students through the Internet [10].
- The iLab Shared Architecture (ISA) implemented by the MIT to facilitate the rapid development of new web laboratories and to provide a mechanism for students from one university to use the experiments and the hardware instruments of another university [11].
- OCELOT (Open and Collaborative Environment for the Leverage of Online insTrumentation) is an open source and collaborative Online Laboratory framework and middleware. It is based on mixed reality and interactive multimedia. One of its core features is the multimodality of the W3C Widgets-based Graphic User Interface delivered to the

learner. It is currently being implemented by Télécom Saint-Etienne (France) under LGPL [12].

- LiLa (stands for Library of Labs), a European eContentPlus project that promotes a portal of Online labs resources and fosters exchanges on experiments among institutions [13].
- Lab2go project has created a generic model ontology consisting of various properties to add laboratories such as remote laboratories, virtual laboratories, experiments, access URL, status, cost, release date, languages, description, administrator, etc. Likewise, the ontology consists of properties to add experiments such as description, scientific field, documentation duration, etc [14].

All these initiatives are being used in different universities as a complement to the traditional laboratories and classrooms (blended learning). From point of view of Spanish university for distance education (UNED), remote laboratories are a key factor for professors and students. Due to our students of UNED are located at many Spanish regions and abroad of Spain (Fig. 3.).

Figure 3. Students of UNED around the world.

Until several years ago, these students had to go to associated center of UNED to work with traditional laboratories. For this reason, the professors of department of electrical and computer (DIEEC, http://www.ieec.uned.es/) have worked in developing and installing several initiatives, such as weblab Deusto or VISIR project, and new remote laboratories. The next section is going to describe several of these implementations.

III. INITIATIVES AND REMOTE LABS IMPLEMENTED IN THE DIEEC

The DIEEC Professors are involved in a great number of electrical, electronic, control and computer subjects, such as Electronic Design and Technology, Structure and Computer Technology and Microprocessors and Microcontrollers. Some of these subjects must be supported by laboratories. For this reason, several initiatives such as VISIR project have been implemented and remote laboratories have been developed.

A. *VISIR project.*

Virtual Instrument Systems in Reality (VISIR) is a remote laboratory created by Blekinge Institute of technology (BTH) for designing, wiring and measurement of electronic circuits. An identical simulation of the real equipment and instruments appears on the student PC-screen that makes him familiar with the real instrument models and types. The student starts to adjust the instruments and wires his circuit with his PC-mouse. Then, VISIR converts the student's design to a real wired circuit and sends to him, on his PCscreen, the measurement results. Thus, VISIR creates a real electronic lab environment to the student which can be accessed at any time and from anywhere as long as the student have a PC connected to internet [15-16] (Fig. 4.).

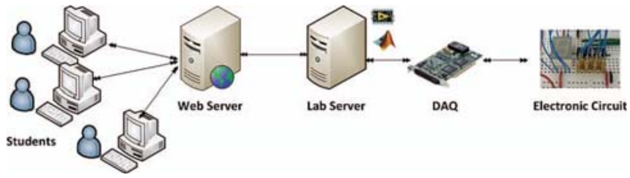

Figure 4. VISIR architecture [16].

This remote lab is being used in subjects, such as electronic fundamentals.

B. *Industrial Automation Remote Laboratory*

This remote laboratory allows students to carry out experiments based on passive electronic networks (Fig. 5.).

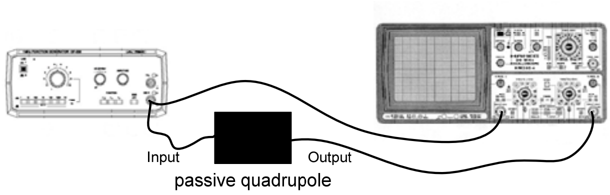

Figure 5. Passive electronic network experiments.

To convert these traditional experiments to remote experiments, the indicated analog equipments have been replaced by digital sampling equipment and data acquisition with digital inputs and outputs. Specifically, we used a Web-connected computer, which is connected to a data acquisition card with at least one analog output and two analog input channels. This card can simultaneously acquire the input and output signals in the system analyze unknown and therefore the system response to certain signals.

Moreover practice to perform on the computer is programmed a virtual instrument (VI) with Labview that integrates a basic function generator and a two-channel oscilloscope with controls typical of this instrument. Also it is included cursors that allow measurements on signals more easily captured. it has been tried to give some semblance realistic VI front panel designed allowing students see the team and the response signals produced by the system under analysis is unknown.

C. *Control Laboratory*

This laboratory allows students to carry out experiment about:

- Permanent failure is a basic concept of self-regulation. Sometimes, this concept can be confused by the students, due to theoretical treatment.

- The Windup effect is about a phenomenon which is rarely considered in this subject. During the theoretical teaching, students work with no saturating actuators.

To do these online experiments, the laboratory is composed by:

- A hydraulic workstation (Fig. 1) [17] composed by:
  - Two analogic actuators (one pump and a proportional valve),
  - Four analogic sensors (flow, temperature, pressure and level),
  - And five digital actuators (four of level and one of flow). These allow choosing among several settings without having to hand the hydraulic plant directly.
- A Labview program (Fig. 6) which allows students to initialize the variables and carry out the experiment based on permanent failure and the Windup effect.

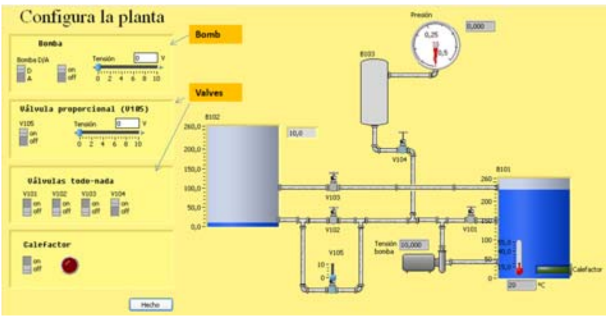

Figure 6. Interface of control laboratory.

D. *Computer Architecture and microcontrollers.*

Two remote laboratories were developed for complement computer subjects, such as Structure and Computer Technology and Microprocessors and Microcontrollers. These laboratories are:

- The Microprocessor Remote Lab allows students to work with a Motorola 68000 microproccessor connected to an I/O board.
- The PICs Remote Lab allows students to work with a PIC16F88X microcontroller.

These remote laboratories were developed to allow student to program microprocessor and microcontroller. To do this, two web programs were developed.

IV. Learning Scenarios

All these laboratories must be complemented with e-learning tools, such as:

- Communication and Collaborative services offer the student the possibility to develop understanding through their own constructs, becoming active learners.
- Assessment service. This software allows teachers to design, configure, and implement, within the online courses, different types of assessments, such as test & quiz. Other important aspect to consider, is the usage of e-learning standards as IMS question and test interoperability (IMS-QTI) specification [18], which describes a data model for the representation of question (assessmentItem) and test (assessment) data and their corresponding results reports. Also, the specification enables the exchange of this item, assessment and results data between authoring tools, learning systems and assessment delivery systems.
- Content services are a set of services which allow teacher and students to create, edit, or delete content resources, such as web pages, links, directories, etc., within their courses.
- Tracking services allow teachers to track the students´ progress during the course. To do this, LMSs provide a set of logs and tables, where is stored the interaction and results of using the different learning activities by students.
- Authentication services. Normally, many LMSs support a great variety of authentication from user and passwords to single sign-on (SSO), such as SAML, Shibboleth, LDAP, etc. These last ones allow students to log in once and gain access to all learning systems, which use that particular SSO.

Therefore, these laboratories are being programmed to be included as an e-learning service into learning management course.

V. Conclusions

This article has shown the remote laboratories implemented in the DIEEC of UNED to teach different electrical, electronic, control and computer subjects.

In the future, the idea is to use these laboratories in different e-learning and social platforms.

VI. Acknowledgele

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