Title of the Research Project:

Development of a Remote Lab for Electrical Engineering Program (ReLEEP)

Summary of the proposal:

The worldwide spread of the Internet and computing tools has brought new opportunities in distance learning as well as in traditional education. Traditional universities as well as emerging virtual universities are responding to this evolution by proposing and assessing synchronous or asynchronous distance learning curricula [1]. These solutions provide students with more flexibility in both place and time, and reduce campus infrastructure needs. However, the expositive material typically provided on-line is often not sufficient to support a complete learning experience in many disciplines. Practice is often the key to becoming an effective professional and this is particularly true in engineering disciplines. An on-line laboratory enables remote students to participate in hands-on sessions on real equipment located in various geographical locations. Remote laboratory experimentation, and not simply simulation, allows the usage of real worlds in virtual learning environments. The power of this concept is apparent, schools and other organizations [2] may share expensive equipment making it available to more users, in some cases even to students in poorer countries. Usually, the remote users are provided with real-time video views of the equipment. Students carry out a number of instructive and useful non-destructive experiments in the distributed laboratory, and are able to observe in real-time the results of their actions.

This area of research has been of interest for educational purposes since the mid 90’s [3]. According to Aktan et al. [4], the first undergraduate weblab was made fully accessible using networking tools, probably in 1996. This solution contributed to the appearance of the Remote Experimentation concept, defined as a distance learning area that enables the remote control of real experiments using computers connected to the Internet. The widespread use of Internet has resulted in wide interest in this area of didactic research. The importance of the topic of this research may be highlighted by the fact that The IEEE Transactions on Industrial Electronics is dedicating a special issue to "E-LEARNING AND REMOTE LABORATORIES WITHIN ENGINEERING EDUCATION"; this issue has not been published yet [5]. A number of experiences have been reported in literature [6]-[14]. Moreover a number of universities offer...
pilot laboratory courses to be either fully or partially online with dedicated remote laboratories, e.g. in [15]-[24]. Surveys carried out among remote users generally showed good response to such initiatives [9].

The present project aims at developing a Remote Laboratory for Electrical Engineering Program (ReLEEP) at Qatar University. This Remote Laboratory will allow remotely located users whether instructors, full time or vocational students to conduct selected real world experiments in the field of Electrical Engineering over the Internet in an interactive and independent way. This environment should enable the introduction of collaborative learning to engineering students by introducing real experiments that may involve highly priced instruments and/or limited number of available experimental set-ups. An important feature of the ReLEEP environment is the possibility of using a video camera in order to enable remote users to view the real system in the ReLEEP and the results of their commands via the Internet. This is important as it gives the remote user visual and aural sensory perception (feedback) that clearly distinguishes real experimentation from simulation. As a first step, some selected experiments in an analog and digital electronics, and in control will be developed for use online. The ReLEEP will comprise a number of pilot experimental set-ups equipped with all necessary instrumentation, data acquisition, and communication devices needed for remote access, control, data collection and processing. The project will be carried out in steps starting with simple experiments for characterizing electronic devices and circuits, and will be extended to include carefully selected control experiments such as servomotors and inverted pendulums. The didactic environment will be based on a distributed architecture featuring an on-site server and multiple remote clients, as shown in the simplified concept. The on-site server will be a computer located in the real laboratory, and will be equipped with a hardware interface designed to communicate with the sensors that capture measurements from the process, and with the actuators that implement actions on the process. The server software receives commands issued by the client over the Internet, and transmits them to the physical process. The server is also responsible for returning to the client the value of several variables that define the state of the physical process, including a video image. The remote client is a computer equipped with the functionality to observe and to act on the physical process. The control software will likely to be a Virtual Instrument (VI) built using LabVIEW. This software is already available at the University.
References


[22] http://chem.engr.utc.edu/