ABSTRACT

Internet technologies have opened up newer approaches and possibilities in remote access techniques. The competitive enterprise today and especially in near future should be capable of flexible access to the best resources independent of the distance. Developments in computer networking and information technology have provided opportunities to computer aided instruction designers to develop online accessible interactive courseware for web-based learning.

Science and Engineering courses typically involve learners in practical experiments as a part of their knowledge and skill development. Remote laboratories provide a new way of implementing laboratories by allowing experimental equipment to be used by the learners from a distance through Internet. They have the capability to provide the real experimental data by sharing laboratory equipments with a pool of learners. Research has been carried out to investigate the novel web-interface structures for different kinds of remote engineering laboratory experiments.

The thesis describes the design of a web-interface for different domains of engineering experiments consisting of a communication circuit, electrical machines, an embedded board and a process control simulation. The different experimentation environments are chosen with the objective of bringing different kinds of engineering experiments on to the same development platform LabVIEW. The major differences between these implementations are the large variations in power ratings besides programming support required for embedded application.

Remote experiment on an electronic circuit is designed using a precision waveform generator IC to produce frequency modulated output. The experimentation includes the features to control the modulating signal, to display waveforms and to control hardware interconnections through a custom designed circuitry. The remote access and control of low power electronic hardware is designed using LabVIEW and Data Acquisition system NI PCI6251.

The development of remote access solutions to electrical machine requires novel interface methodologies for the control and measurement of experimental parameters.
One such technique is presented to interface an electrical hardware consisting of a 1.5 KW DC motor and a 750 W of DC Generator with the Virtual Instruments. The general web-interface architecture is presented to facilitate control and measurement of experimentation parameters online with complete isolation from the electrical line voltage. The custom built electrical hardware is designed to interface the web server with the experimental resources and to support user friendly interface to access the data online. The safety issues while operating the electrical machines online are addressed through the control logic designed by the graphical code. The designed system exploits the data acquisition and the LabVIEW features to extend the DC Motor and Generator experimentation to online along with the acquired data that is presented in virtual meters as well as in graphical plots.

The NI graphical tool LabVIEW and data acquisition facilities are also used to develop web-based control environment for a stepper motor using microcontroller. The web-based control for microcontroller experiment is implemented by interfacing microcontroller PIC16F877 development board with NI PCI6251. Web-based control architecture for microcontroller application is presented using LabVIEW and Virtual Network Computing (VNC) tools which facilitate the remote experimentation on programmable systems.

Another experimentation environment is the simulation of bioreactor’s process control system, which is developed using *NI LabVIEW control design and simulation module 8.5*. The system is mathematically modeled by considering the real specifications of the physical system to control the parameters such as temperature, pH and agitation speed. The feedback control system is simulated by developing PID control algorithms for the process system. The graphical user interface facilitates to set the system parameters, set PID coefficients and observes the output actuations of the process system.

The different experiments are interfaced with the NI DAQ systems and presented to the web environment along with learning management system tools.

This work was supported in part by research on *Remote Access Labs*, funded by Department of Science and Technology, Ministry of Science and Technology, Vide Number: SR/FST/ETI-033/2005.