Work in Progress - Remote Lecture Demonstrations and Experiments for Communication Engineering

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Abstract - This work in progress describes the development of remote lecture demonstrations and experiments for communication engineering. The remote panel feature of LabVIEW is used to allow access to Virtual Instruments (VI’s) through a web browser. The experiments, themselves are located in the laboratory, saving the time and effort off moving all the equipment to the classroom. Full experiments, rather than simulations of the phenomena are used. In the classroom the remote panels are accessed through a wireless internet link. This work-in-progress will conclude with a discussion of several extensions of these ideas.

Index Terms - Communication Engineering, Computer Interfacing, Lecture Demonstrations, Remote Laboratories

INTRODUCTION

The use of demonstrations during a lecture has been universally shown to enhance the students’ comprehension of the materials and as a way to spark student interest. Use of demonstrations is often limited due to the time required for creation, but more often due to the fact that it is difficult to bring all the needed hardware into the classroom and set it up within a reasonable time.

Communications Engineering is one discipline where the material presented often lends itself to appropriate demonstrations. While students have a feeling for many of the topics discussed, seeing and hearing the signals discussed is the lecture reinforces the material in a manner that pure mathematics and description does not.

The limitation on most demonstrations is the lack of time by the faculty and the complexities of bring all the necessary equipment to the classroom. This is further complicated by the simple fact that courses are often not taught in the same building where the laboratory equipment is stored.

Additional constraints include the fact that in many institutions the equipment used is often one of a kind and is part of a research setup that should not be moved. Certain pieces of equipment are sufficiently large that it is impossible to bring them into the classroom. Finally, the research area is not large enough to accommodate the entire class. A final practical constraint is that, unless the instrumentation displays can be viewed by the entire class, some students miss out on the purpose(s) of the demonstration.

REMOTE DEMONSTRATIONS

To alleviate these constraints, remote demonstration experiments for Communication Engineering have been developed. These demonstrations could be created because (1) projection equipment is routinely available in classrooms, (2) wireless networking allows the easy movement of computers, and (3) software has been developed are that allows straightforward control of instruments and transfer of data via the internet.

At the University of Hartford, like at many institutions, a VGA projector has been installed on the ceiling of most classrooms. A professor can connect his/her laptop to the projector and display the computer screen on a projection screen. In addition, the University has installed a wireless network in the United Technologies Hall.

The development of software for remote demonstrations has been practical, although not time-effective for several years. Using system calls and an appropriate web server, a program could be created that would allow the control of instruments and transfer of measured data over a web interface.

LABVIEW REMOTE PANEL SOFTWARE

Rather than creating dedicated software for each experiment, National Instruments LabVIEW was chosen. LabVIEW is a graphical, event-driven programming package optimized for graphical display, data acquisition, and instrument control. Recently, a remote panel feature was introduced for LabVIEW. Using a remote panel any Virtual Instrument (VI) can be controlled over the web by any computer using a web browser. To create a remote panel, one first develops the Virtual Instrument, then uses the WEB Publishing Tool to create the remote panel. Once the remote panel is created, a web server internal to LabVIEW is started and the remote panel may be accessed via any web browser. The server contains a security subsystem requiring, for example, use of a password to access the remote panel. While a single remote panel is included with the standard LabVIEW license, multiple licenses are available from National Instruments.

LabVIEW has many additional features, too numerous to describe in this work-in-progress. For a overview of Labview, see [1] and [2]. A brief summary and tutorial on creating remote panels can be found in [3]. A compendium of

**LABORATORY SETUP**

To use the remote demonstrations, the demonstration hardware must be first set up in a laboratory. As contrasted to the demonstrations described in [4], the work described here includes real experiments, not simulations. The instruments must be controlled and interfaced to a computer capable of running LabVIEW. Almost any recent vintage computer will do. The one used in the laboratory described in this work-in-progress was a Pentium IV class machine, recently retired from an office.

The computer included a National Instruments PC6024E data acquisition card and an IEEE-488 bus interface. The instruments used, including an IFR Service Monitor, Oscilloscope, Spectrum Analyzer, and Power Meter are connected to the computer by one of the above interfaces or a serial port. A laboratory fabricated breakout box was used to connect other signals. For example a relay and several connections were used to switch a transceiver under test to transmit and alter settings.

**CLASSROOM SETUP**

The demonstrations are performed by connecting the computer to the projector and logging onto the LabVIEW server. Both the virtual instrument and the data is displayed on the screen. Various parameters of the instruments may be modified as part of the demonstration. In addition, copies of the demonstration graphics may be saved.

**FUTURE EXTENSIONS**

This work will be extended in several ways. First the demonstration experiments will be modified so that students may perform them remotely. Thus, students not in class for a demonstration will have the opportunity to use the LabVIEW Demonstrations. Second, these demonstrations will be extended to other courses. For example, during an instrumentation course, it might be very useful to exhibit similar demos.

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**REFERENCES**