Network of Instruments Shared over the Internet

by
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Category:
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Products Used:
LabVIEW™ 5.1.1
PCI-GPIB card

The Challenge: To develop a mechanism for upgrading local measurements, via remote control, in a simple-to-use and cost-effective way. The aim is to enable remote users to perform measurements and laboratory exercises from their distant locations. Moreover, the ultimate goal is to have as many simultaneous multiple user connections as possible.

The Solution: Utilize LabVIEW, for local process control, AppletVIEW for Web publishing, and a remote user interface, to allow remote users to connect and run experiments via their Web browsers. The solution provides simplicity in connecting multiple users and allows for collaboration among them during the measurement process.

Abstract
The paper presents an efficient way for the remote control of instruments and simulations over the Internet. The interaction between a LabVIEW-operated application and a remote Web browser is obtained. No additional software is required for the remote clients regardless of their location or platform. Client-server communication is attained by Java-script-based graphical user interface. Moreover, all data transfer is accomplished, simultaneously, on all remote computers connected to the same session. The concept encompasses the interactive power of computers and networks, but in a very simple and versatile way. This approach is applicable to both industry and education.

Introduction
Due to practical software tools such as LabVIEW, users have enhanced computer-based measurements, by combining good data acquisition properties of instruments, signal processing, data analysis, and the storage capabilities of today’s computers. In here, the aim is to enhance the capability of performing measurements controllable from a remote location. One of the main goals, of course, was to employ the power of the Internet. That way, one can increase the level of comfort and operability of long-distance measurements and reduce the costs by sharing expensive equipment worldwide. For academic needs, both lecture and laboratory practice can be improved and offered on the Web for students residing in remote locations.

The main problem, however, has been the difficulty to represent the real instrument as a virtual one, in a Web browser, without the need of any other sophisticated software. The approach presented here is practical, simple, and very versatile. Some other solutions require all potential remote users to have specific software installed on their platforms or to own complementary replicas of the application being run on the server. Moreover, users need to be fairly coordinated with the host platform as well. These problems have limited the number of users that can access the same instrument simultaneously. Our solution loosens up these constraints and provides a simple and cost-effective way of increasing the number of simultaneous remote users that can share the same experiment.

Performance
The basic step was to control an instrument, locally, through a computer. In our case, a network analyzer was placed under computer control using LabVIEW and a GPIB card, as shown in figure 1. A graphical user interface (GUI) panel, or virtual instrument, was also developed for communication with the network analyzer.
After getting this done, the aim was to bring up, somehow, the measurement process on the Web, in a way that it is accessible from a distant location. Furthermore, it was important to reduce the requirements for the computers used by the remote user. This was achieved by using the AppletVIEW to create GUIs and manage data transfer. The connection to a remote process, whether it is a simulation or an instrument, including all data transfer, is based on the scheme shown in figure 2. Here, two examples of remote control are presented, based on this model. One is amplitude modulation (AM) simulation, and the other is controlling a network analyzer (NA).

The AM simulation, in figure 3, is a paradigm for any simulation that can be run, on-line, for mere calculations or simply practicing. Students, using these on-line simulations can get a better feeling and experience of how certain parameters affect the overall process. They can change any parameter and instantly track changes on waveforms and other related effects.
In both cases, in AM simulation and NA control, the access to the process was meant to be simple. Users can browse the Web page that introduces a desired process, and connect to it by clicking on the designated button, as shown in figure 4. This action virtually brings the distant instrument to the student’s computer browser and the control of the instrument lies in his hands via the virtual panel.

Figure 5 shows the operation of a NA under remote control from a laptop computer. The laptop computer was wirelessly networked so that it can be used from any location. The GUI built here allows the user to set and adjust various types of S-parameter measurements, by simply choosing an option from a user-friendly menu.
Gains
First, a student or other users can run a measurement or a simulation process by making use of understandable GUIs appearing in their browsers as virtual replicas of front panels of real instrumentation. Second, all the relative complexity of the system is placed on the host side. Remote users do not need anything but a Web browser on their computer in order to connect and run the measurement. Consequently, it avoids issues on software compatibility between host and distant clients.

Furthermore, multiple user concurrent connections are possible. In this case, all users being in the session get instant updates of any parameter changes, as shown in figure 6. If any user changes any value on his screen, it immediately takes effect on the host side, and it is also broadcasted to all the other users to update their GUIs. In addition, sessions can be organized so that either every user has the same rights during the session, or we can assign ‘read-only’ and ‘read-write’ authorization levels to different users. All users, although connected from various parts of the globe, can collaborate during the session through a chat window that is placed on the GUI, as shown in figures 3 and 6.
We can normally connect up to fifteen instruments to just a single computer slot. By creating their corresponding virtual instruments, and putting them on the Web, we can truly make an entire laboratory be available on the Internet. If one reproduces such a configuration on other places where specialized measurement equipment exist, as shown in Figure 7, an amazing network of laboratories shared worldwide over the Internet can be obtained.

**Conclusions**

As it was shown, the concept can be used to improve the quality of presentations in the classroom, as well as, experimentation in the laboratory. It provides students with the opportunity to run or observe experiments from distant locations at convenient times and in a more comfortable surrounding. Laboratory groups and sessions can be arranged in a more flexible way for both students and instructors. If the trend of long distance education will keep developing, the model described above can be successfully employed to offer online courses that include laboratory experiments. Due to the generality, flexibility, and versatility of the model, it can be used for commercial purposes as well. Sharing instrumentation in the depicted manner, offers tremendous savings and it allows a large number of students or researchers to share equipment worldwide.