

Distance-Learning using LabVIEW

M. V. Păuleț¹, Oana Maria Neacșu², M. Crețu³, A. Salceanu⁴

¹ Technical University “Gh. Asachi” of Iasi, Faculty of Electrical Engineering, Bd. D Mangeron 53, mpaulet@ee.tuiasi.ro

² Technical University “Gh. Asachi” of Iasi, Faculty of Electrical Engineering, Bd. D Mangeron 53, oneacsu@ee.tuiasi.ro

³ Technical University “Gh. Asachi” of Iasi, Faculty of Electrical Engineering, Bd. D Mangeron 53, mcretu@ee.tuiasi.ro

⁴ Technical University “Gh. Asachi” of Iasi, Faculty of Electrical Engineering, Bd. D Mangeron 53, asalcean@ee.tuiasi.ro

Abstract-Laboratories, which are found in all engineering and science programs, are an essential part of the education experience. Perhaps the simplest solution is to use a USB webcam to broadcast a picture to a remote third-party image-hosting location and access that picture through a separate browser window. However, this solution would depend on the remote image-hosting site for connection speeds, and the picture would not appear in the same window as the LabVIEW program.

I. Distance-Learning using LabVIEW

Laboratories, which are found in all engineering and science programs, are an essential part of the education experience. Not only do laboratories demonstrate course concepts and ideas, but they also bring the course theory alive so students can see how unexpected events and natural phenomena affect real-world measurements and control algorithms. However, equipping a laboratory is a major expense and its maintenance can be difficult. Teaching assistants are required to set up the laboratory, instruct in the laboratory, and grade laboratory reports. These time-consuming and costly tasks result in relatively low laboratory equipment usage, especially considering that laboratories are available only when equipment and teaching assistants are both available.

A. Distance-Learning Remote Laboratories

In engineering education written exercises are necessary for a student to master mathematical tools while virtual experimentation done by simulation serves to reinforce the understanding of the subject. Real experiments are indispensable for developing skills to deal with instrumentation and physical processes. Practical projects provide the framework for a group of students to learn to cope with real world problems. There is no doubt that nothing will replace synchronous learning through face to face interaction but it is not always feasible for students to attend conventional classes. Models for using information technology to enhance learning experience for conventional on-campus students, as well as for students asynchronous in time or space have been presented [1], [2]. Interesting proposals for the use of the Internet for various educational purposes including virtual laboratory web sites have been advanced [3], [4].

In this paper a virtual laboratory measurements temperature and measurements voltage theory and practical is described. In a typical Web-enabled experiment, students might connect physical apparatus, such as a coupled DAQ, multimeter or other apparatus, to a controller such as FieldPoint or a PC running LabVIEW application to support a TCP/IP function. To share laboratory resources and reduce development time, the OnlineLab framework provides the uniform and standard platform for hosting a variety of experiments. We use TCP sockets to connect the controller to the OnlineLab framework in a plug-and-play manner [5].

A remote laboratory is defined as a computer-controlled laboratory that can be accessed and controlled externally over some communication medium. For this discussion, a remote laboratory is an experiment, demonstration, or process running locally on a LabVIEW platform but with the ability to be monitored and controlled over the Internet from within a Web browser. In the simplest case, the remote laboratory server can be an experiment connected to a computer through a standard interface (DAQ, GPIB, serial, parallel, etc) and with the host computer connected to the Internet. The client can be any computer connected to the Internet running a simple browser. Once connected, the client will

see the same front panel as the local host and also have the same program functionality. General structure virtual laboratory is in figure 1.

To simplify system development, we have separated the implementation of Web-enabled experiments into two parts controller and user interface (UI). Students can use the controller, which resides on either DAQ or a PC running LabVIEW, to perform the actual real-time control tasks. The UI, which resides on the online server machine, serves as the control panel for remote users. The reasons of separating these functions include:

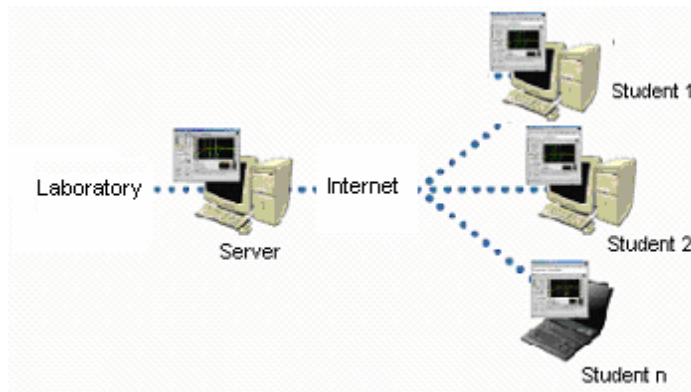


Figure 1. Internet Control of a Remote Laboratory

B. Human interface

Frontal Panel for virtual laboratory is presenting in figure 2.

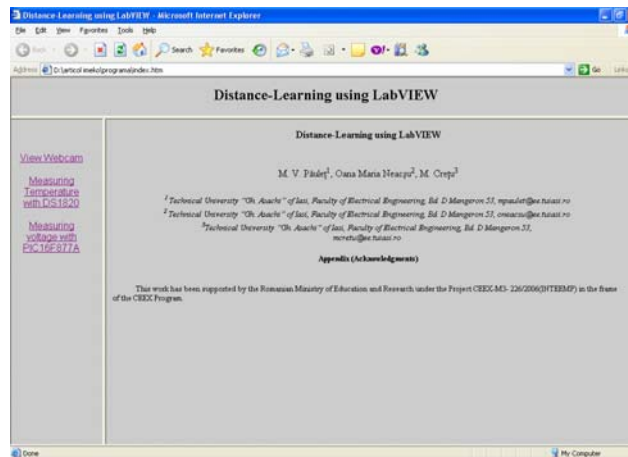


Figure 2 Frontal Panel for virtual laboratory

Students can select one experiment from left list:

1. View Webcam
2. Measuring temperature with DS 1820 (and PIC16F877A)
3. Measuring voltage with PIC16F877A

1. First option student can see: all instruments (DAQ, sensors, etc), and he can have a chat with teacher.

Program for transmission image and sound it is built up with LabVIEW. Frontal Panel and Diagram for acquisition image and sound is presenting in figure 3.

Image can be setting for different frames per seconds, size of image, deep of the colors by way button "Video". For connection with low speed Internet is indicate parameters of image will be settings minimum. Is caned used and the sound for chat between student and teacher.

If is to else many webcams instalate on computer is caned select a certain room ab whereat is taken over the image. The sound is taking over of the microphone included in webcam through the USB port. The sound is stereophonic with sample rate 44.1 KS/s and 16 bits on sample.

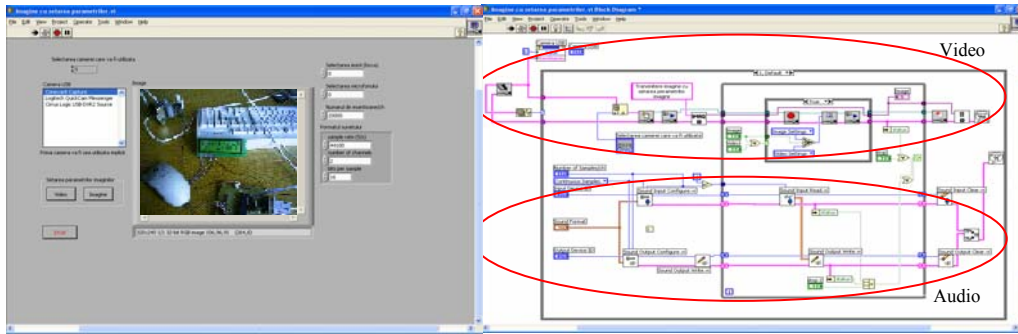


Figure 3 Frontal Panel and Diagram Bloc for acquisition image and sound

2. For second option from virtual laboratory students can learn fundamental measuring temperature with sensor DS1820 product of MAXIM. The DS1820 Digital thermometer provides 9-bit centigrade temperature measurements and has an alarm function with nonvolatile user-programmable upper and lower trigger points. The DS1820 communicates over a 1-Wire bus that by definition requires only one data line (and ground) for communication with a central microprocessor. It has an operating temperature range of -55°C to $+125^{\circ}\text{C}$ and is accurate to $\pm 0.5^{\circ}\text{C}$ over the range of -10°C to $+85^{\circ}\text{C}$. Each DS1820 has a unique 64-bit serial code, which allows multiple DS1820s to function on the same 1-Wire bus; thus, it is simple to use one microprocessor to control many DS1820s distributed over a large area.[6]

Sensor is connect to the computer through data acquisition board built up with PIC 16F877A [7] at pin RE2 of microcontroller. Program for communication between PC and data acquisition board it is built up with LabVIEW. Frontal Panel and Bloc Diagram for acquisition and display of temperature is presenting in figure 4

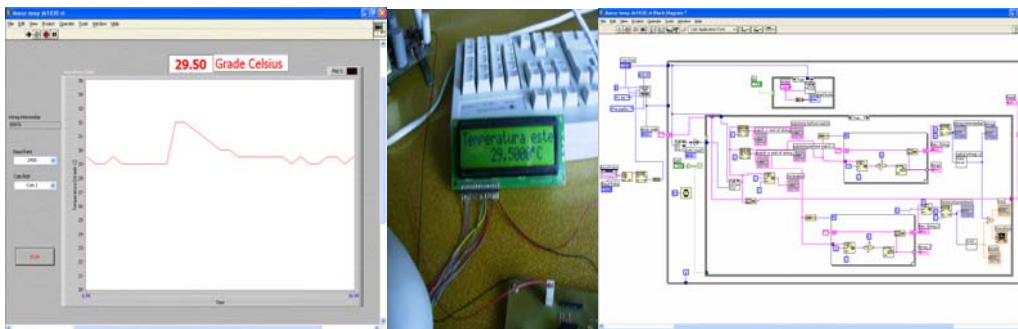


Figure 4 Frontal Panel and Diagram Bloc for temperature measurements

Program for microcontroller is written in C language with MikroC [8]. After conversion date from sensor DS1820 are send to serial port of PC by way MAX 232 in string format. After initiate serial port from PC date in string format is read. At each rolling of while loop string is initiate with string null therefore result is not affected by measurements previous measurements. Results from microcontroller is sent strings made of seven characters and afterwards are extract three characters, two characters for result the whole part and one character for result the decimal part because accurate is to $\pm 0.5^{\circ}\text{C}$. After extract, characters are converting in integer format for integer part and convert in double format for decimal part. Decimal point is obtained through multiplication with constant (0.1). Afterwards draw together integer part with decimal part.

3. For three options from virtual laboratory students can learn fundamental measuring voltage with data acquisition board built up microcontroller PIC16F877A. Program for microcontroller [9] is written in C language with MikroC. Are utilization converter analog digital with resolution of 10 bits included in microcontroller. Frontal Panel and Bloc Diagram for mesurement volatge DC is presenting in figure 5

These data acquisition boards can measurements voltage DC between limit 0-5V. Result is displays on LCD and sent to serial port of PC in string format. After the initialization ports serial of computer (baud rate, parity, etc) from data in string format is extracted the whole part results (one digit) and the decimal part results (three digits). After extraction whole part and decimal part from serial ports, date is converting in the numeric characters. By way case loop commanded the channel from that is done the mensuration. Developmental board with microcontroller has setat carry as the input analogic port A (5 inputs).

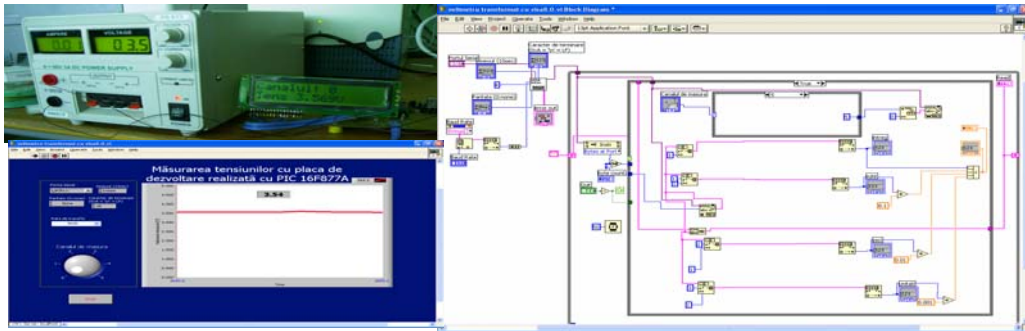


Figure 5 Frontal Panel and Diagram Bloc for voltage DC measurements

The entrance selected is displayed on lcd at first line. On second line is displayed value measurement. Finally, a dedicated web server, communicating with the client general web browser, is more flexible. Additionally, leaving only a web browser to run on the client provides a portable and low cost solution for the student.

II. Conclusions

Using LabVIEW[10] as the platform of choice is one of the easiest, fastest ways to get your instrumentation system on the Internet. A variety of technologies, using the Web as a primary interface medium, are currently compatible with LabVIEW.

Typical laboratories have relatively low usage, and remote laboratories can eliminate some of the barriers found in traditional laboratories[11]. Remote laboratories can remove the need to have a teaching assistant on hand, reduce the cost associated with a traditional laboratory, and can also be made available 24 hours a day, seven days a week.

The solution for the described system was adopted after testing and comparing more possible variants such as running the code at the client.

Appendix (Acknowledgments)

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