DESIGN AND IMPLEMENTATION OF VIRTUAL LABORATORY USING LabVIEW & myDAQ

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ABSTRACT

In engineering education system, the laboratories play a key role because that is the place where the theory is practically applied and verified. But, laboratories at the engineering colleges are not available to the students all the time. In the case of Electrical and electronics stream, although there is some simulation software like NI Multisim, Spice etc., they cannot give the practical values or cannot show up the minor changes due to the atmospheric effect like temperature, humidity and so on. We cannot easily access that software from our home all the time. To overcome this problem, we came up with the concept of virtual labs using the LabVIEW tool & NI myDAQ. This paper details about the implementation of virtual laboratory which is aimed at making the students be able to access their regular laboratory experiments from a remote area and still avail the practical values (i.e. output) of the experiments being conducted.

Keywords: Data Acquisition; LabVIEW; myDAQ; Web Servers; Virtual Laboratory; Web Publishing tool.


1. INTRODUCTION

Today, in the era where the education and the technology are becoming inseparable aspects, the technology for delivering the education still needs to be enhanced. The experiments which the students take up in their laboratories are needed to be made accessible at any point of time from anywhere so that the students can spend more time getting hands on. This can be possibly accomplished by using the technology.

The technology that has to be used should be able to create an interface so that the students can control the controllable factors of any system and can access the experiments over internet.

The system should provide a Data acquisition Device where all the data (input and output data) can be logged.
It should give the practical values of that particular experiment which is being executed at any time.

One way of accomplishing this is to use the ‘LabVIEW tool’ as a platform for interfacing and publishing using the ‘Web Publishing Tool’ the same over internet so that everyone can access it. And the Data acquisition can be done using a device named National Instruments (NI) – ‘myDAQ’. Now, let us go with a complete procedure of implementation process. This process mainly compromises of two parts. One is the software part and the other is the hardware part. In the software part, we will look how the VI (Virtual Instrument) is created and also the web publishing part. In the hardware part we will see how to configure the myDAQ and connect it to an experiment (circuit connected on bread board) so that it can be controlled remotely.

There have been many earlier attempts made to provide remote access to labs using many software’s and computer based applications such as Internet-Based Remote Experimentation which includes that the user is able to trigger a real-experiment on a real piece of hardware and the output of the experiment which is conducted remotely is communicated back to the student over the Internet [1], using 3-layer client/server (c/s) model based on www.dynamic web page and web database which is using LabVIEW to acquire data accurately from physical instruments [2].

The paper is organized as follows. In Section II, we have provided the complete procedure of the building the setup, in which the sub section A describes the procedure of generation of a signal using myDAQ. In sub section B, we have described how to connect a test experiment (we considered to be a Diode clipping circuit) to the myDAQ. It can be replaced by any of the experiment as per the user needs. In Section III, we have described how to make this experiment be able to accessible to any student from any remote area over Internet using the Web Publishing Tool. Finally the Section IV gives the conclusion. Figure 1 shows the overview of the complete work.

2. IMPLEMENTATION

2.1. Generation of Signal
Firstly, connect myDAQ device to your PC. Connect analog output (AO0 pin) to analog input (AI0) of myDAQ. Now, create a new VI in LabVIEW.

![Flow Chart of the Implementation of Virtual Labs](image)

Open LabVIEW and then go to file > new VI. Front panel and block diagram will appear on the screen. Now, in block diagram, Right click>Express>Output>DAQ Assistant. Place the DAQ assistant on block diagram panel [3]. Generate Signals>Analog Output>Voltage. Select
Dev1 (or the name of your device if not Dev1) and Select AO0. Right-click the block diagram and select Express>Input>Simulate Signal. Choose sine wave for the Signal Type. Click OK to configure the Express VI. Now, wire the sine output to the Signals input of the DAQ Assistant in block diagram.

Create the stop condition to include when the Stop button is pressed or an error is detected. Remove the Conditional Terminal from the Stopped output terminal of the analog output DAQ Assistant. Right-click on block diagram and select Programming>Boolean>OR. Wire the output from the Stop button control to the bottom input of the OR Boolean function.

Right-click on the block diagram and choose Programming>Cluster, Class & Variant>Unbundle by Name and place this to the right of the analog output DAQ Assistant. Wire the Error Out output terminal of the analog output DAQ Assistant to the input of the Unbundle by Name function and check Status is unbundled [4].

Wire the output of the Unbundle using Name function to the top input of the OR function.

Connect the output of the OR function to the input of the Conditional Terminal. Run the VI to observe the signal being output on the waveform graph.

2.2. Diode Clipping Experiment
Connect your circuit on bread board. In analog input, AGND pin and AI0^- pin are grounded. (On bread board) In analog output, AO0 pin is connected to input of circuit. In analog input, AI0^+ pin is connected to output of circuit.

Place a DAQ Assistant on the block diagram.

Right-click on the block diagram and select Express »Input »DAQ Assistant

Place the DAQ Assistant on the block diagram by left-clicking. Configure DAQ Assistant type Select Acquire Signals> Analog Input Select Voltage> Dev1 (or the name of your device if not Dev1). Select AI0 Configure acquisition settings. Select 1000 for Number of Samples, 10k for Sample Rate. Select Run to test your settings and OK to finish the DAQ Assistant. Put the amplitude and frequency indicators to observe in front panels. Create the graph indicator to view data.

Right-click on the Data output terminal of the DAQ Assistant. Now Create>Graph Indicator. Run the VI by pressing the Run button and visualize the results. Adjust Graph indicator, desired Change acquisition mode to Continuous. Double-click on DAQ Assistant. Change Acquisition Mode from N Samples to Continuous. Click OK to finish the DAQ Assistant.

![Figure 2 Connections on the Block Diagram Panel of the VI](http://www.iaeme.com/IJMET/index.asp)
Select yes to auto place the While Loop around the DAQ Assistant which creates the stop condition when the Stop button is pressed and an error is also detected. Now, Unwire the Conditional Terminal from the Stopped output terminal of the analog input DAQ Assistant. Right-click the block diagram and follow Programming »Boolean »Or Wire the output from the Stop button control to the bottom input of the Or Boolean function Right-click the block diagram, select Programming »Cluster, Class, & Variant »Unbundle by Name, and place this to the right of the analog input DAQ Assistant Wire the Error Our terminal of the analog input DAQ Assistant to the input of the Unbundle by Name function and ensure Status is unbundled. Wire the output of the Unbundle by Name function to the top input of the OR function [5].

Wire the output of the OR function to the input of the Conditional Terminal. Now, for output DAQ assistant follow the above generation procedure.

Run the VI to visualize on front panel.

The Fig. 2. illustrates the above methodology [6].

3. PUBLISHING THE EXPERIMENT
Click on tools > web publishing tool > select the check box to monitor or control the changes, copy the link generated there and click ok. Now, open that link in Internet explorer to observe your experiment from remote panel [7].

Link generated for our experiment: http://103.15.62.237:8000/sig_gen.html

The VI generated is published using the “WEB PUBLISHING TOOL” that generates an http URL enabling it for browser access. The LabVIEW web publishing tool generates the html code required for the VI output to appear in the browser when the generated http URL is given as the address for the browser. This URL also consists of the system IP information hence making it local on the Local Area Network [LAN]. This browser page that displays the front panel of the running VI is compatible only on the same device [being a local file] in which the VI is created and saved or the devices on the same LAN. The LabVIEW software and the extensions are mandatory for the file to run. To enable the VI to be remotely accessed and control, the Computer is given a public IP turning it into a server that can be accessed on any device either local or non-local. As mentioned earlier, there are a few supporting software/plug-ins that are needed for the VI to be remotely accessed through the Internet [using the http URL] and for browser compatibility as per the browser platform used by the user like the LabVIEW Run-Time Engine [RTE].

![Output of Diode Clipping Circuit obtained using Virtual Labs](image)
4. CONCLUSION

The LabVIEW based Virtual labs using myDAQ has the following advantages and improvements:

- More accurate values: As the circuit is connected practically all the external conditions are taken into considerations and output obtained is accurate.
- Remote accessibility: Users at remote areas can conduct their experiments with practical values.
- Multiple users: We can provide time slots for the end users and many users can perform their experiment without disturbing other users.
- Flexibility: As the Web server was developed based on HTML link obtained, only a web browser with LabVIEW Run time Engine is required by the user to access the experiment.

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