Measurement experiment, using NI USB-6008 data acquisition

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***Abstract* – Educators and researchers worldwide are using National Instruments products to automate routine tasks, accomplish new objectives, replace outdated and expensive equipment, and demonstrate students the potential of high technology. Engineers have used virtual instrumentation for more than 25 years to bring the power of flexible software and PC technology to test, control, and design applications making accurate analog and digital measurements from DC to 2.7 GHz.**
The goal of this paper is to teach students basic concepts of LabVIEW programming, that can be used to easily integrate hardware and software to acquire, analyze, and present data. The block diagram of your application enables you to define operations to be performed on your data. The front panel allows the user to interact with a program while running.

Keywords: ***LabVIEW, DAQ Assistant, Express VIs, NI USB-6008.***

I. INTRODUCTION

Prior to the 1980s, the oscilloscope and strip-chart recorder represented the most common methods for measurement of time-varying signals. However, with the advent of the personal computer and the introduction of PC-compatible data acquisition cards, PC-based digital data acquisition became standard in most laboratories by the late 1980s. By combining high speed data acquisition cards with graphical software, it is now possible to design complex data acquisition systems with real-time data analysis and plotting features [1].

LabVIEW is a graphical programming language which was first developed in 1986. It combines data acquisition, analysis, and presentation tools into one software program.

The data acquisition hardware used in this paper is NI USB-6008 multifunction I/O device, which interfaces to the PC through a USB connector. It has 8 differential analog voltage inputs, 2 outputs, 12 channels which can be used as either DI or DO (configured individually), and 12-bit resolution. A USB device was chose for simplicity, but it is one of the many different types of data acquisition devices that can be used. Another common interface is a PCI-slot data acquisition card. These cards can be plugged into PCI-slots on the computer's motherboard, much like a sound or Ethernet card.

The National Instruments USB-6008 provides basic data acquisition functionality for applications such as simple data logging, portable measurements, and academic lab experiments. The NI USB-6008 are ideal for students. We are create our measurement application by programming the NI USB-6008 using LabVIEW and NI-DAQmx driver software for Windows [3].

DAQ Assistant is a graphical interface for interactively creating, editing, and running NI-DAQmx virtual channels and tasks. A NI-DAQmx virtual channel consists of a physical channel on a DAQ device and the configuration information for this physical channel, such as input range and custom scaling.

The LabVIEW program, prepares students to develop test and measurement, data acquisition, instrument control, data logging, and measurement analysis applications.

LabVIEW includes a set of VIs that let you configure, acquire data from, and send data to DAQ devices. Often, one device can perform a variety of functions: analog-to-digital (A/D) conversion, digital-to-analog (D/A) conversion, digital I/O, and counter/timer operation [2].

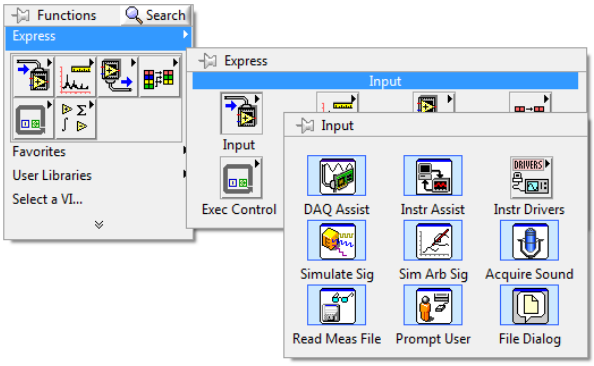

Figure 1. Express VIs

II. CONFIGURING AND INTEGRATION OF HARDWARE INSIDE OF LabVIEW

LabVIEW interacts with many kinds of real world hardware.

1) To see what devices are recognized by the computer, go to **Start » Programs » National Instruments » Measurement & Automation** and then select **My System » Devices and Interfaces.** Under **NI-DAQmx Devices** section we see all of the devices listed, including NI USB-6008.

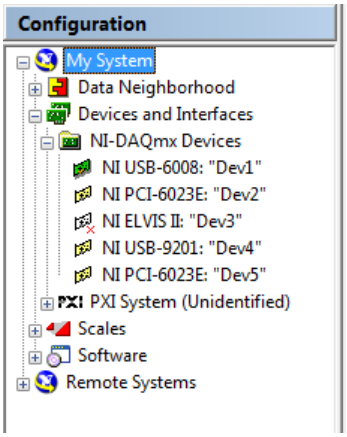

Figure 2. My System Configuration

2) Open a **Blank VI** inside of LabVIEW. **Right-click** on the block diagram and select **Measurement I/O » NI-DAQmx » DAQ Assistant**.

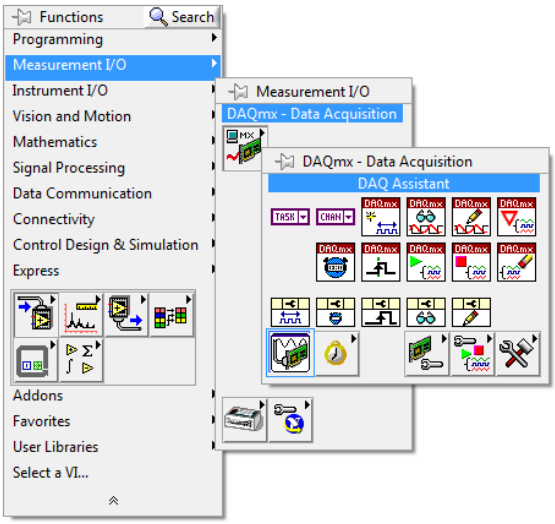

Figure 3. Selecting the DAQ Assistant from the Block Diagram

3) Select **Acquire Signals » Analog Input » Voltage** from the dialog box.

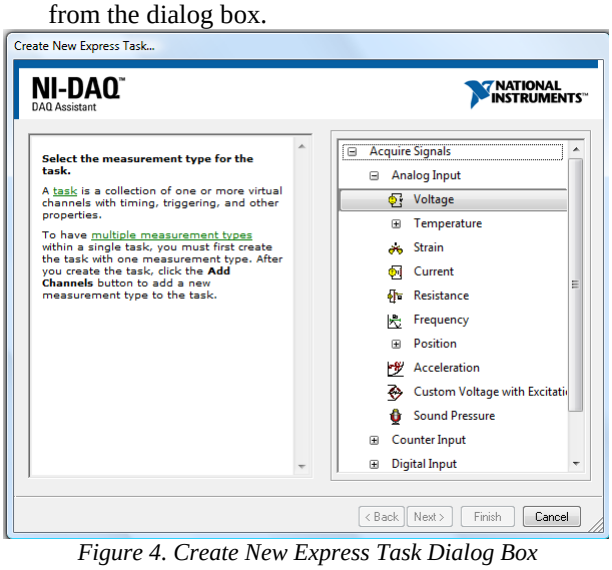

Figure 4. Create New Express Task Dialog Box

4) Select **Dev1 (USB-6008) » ai0** and then click **Finish**.

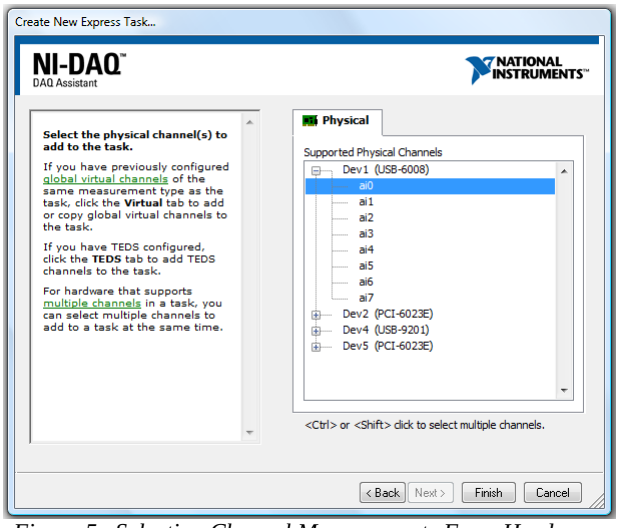

Figure 5. Selecting Channel Measurements From Hardware

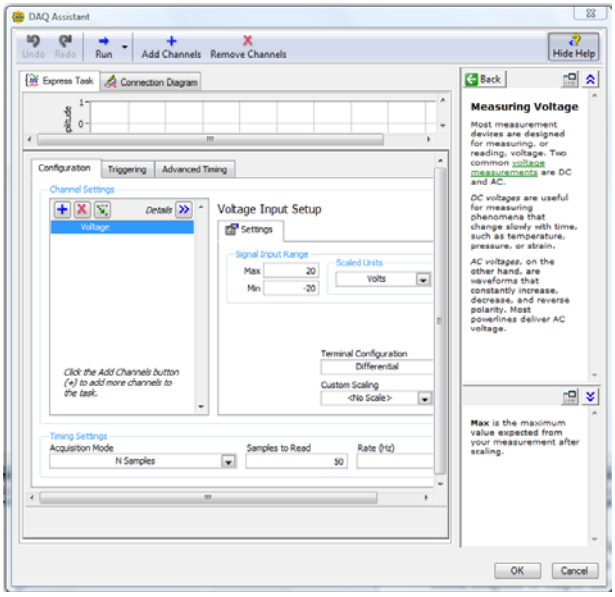

Figure 6. Configuring Task

5) Click **OK** to close the configuration window. Notice that the **DAQ Assistant** is now configured on the block diagram to output the data that we want.

The DAQ Assistant is used to configure the DAQ device and perform data acquisition.

Figure 7. DAQ Assistant Configured

6) **Right-click** the **data** output of the **DAQ Assistant** and select **Create » Graph Indicator**. Notice that a waveform graph appears on the front panel.

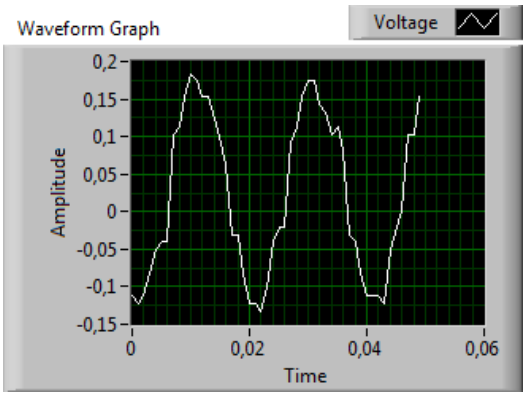

Figure 8. Sample Data from NI USB-6008

III. PERFORMING CALCULATIONS ON HARDWARE DATA

Typically, various calculations and operations will be performed on acquired data. In this section, we will use an Express VI to perform a statistical analysis and spectral measurement on the acquired data.

1) **Right-click** on the block diagram and select **Express » Signal Analysis » Statistics** to put the **Statistics VI** on the block diagram. In the Configure Statistics dialog box that appears, select **Arithmetic Mean, Standard Deviation, Maximum,** and **Minimum.** Click **OK** to close the dialog box.

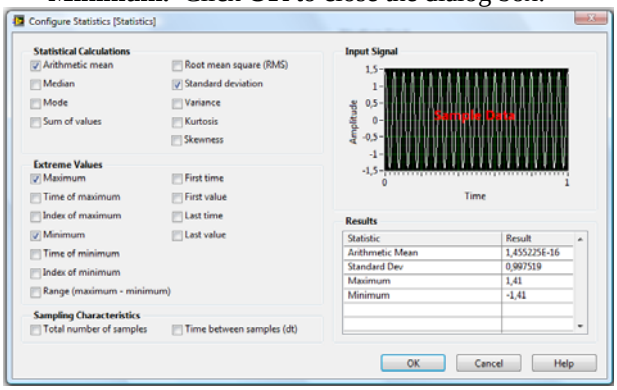

Figure 9. Configuring Statistics to be Calculated

2) **Right-click** on the block diagram and select **Express » Signal Analysis » Spectral Measurements,** to put this VI on the block diagram. In the Configure Spectral Measurements dialog box that appears, select **Power spectrum** and **Linear**.
3) Wire the **data** output from the **DAQ Assistant** to the **Signals** input of the **Statistics VI,** and the **Spectral Measurements VI**. **Right-click** on each output of the **Statistics VI** and select **Create » Numeric Indicator. Right-click** on output of the **Spectral Measurements VI** and select **Create » Graph Indicator**

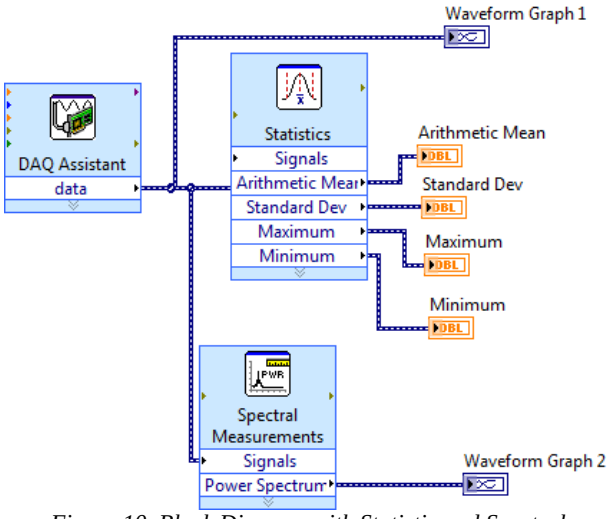

Figure 10. Block Diagram with Statistic and Spectral Measurements

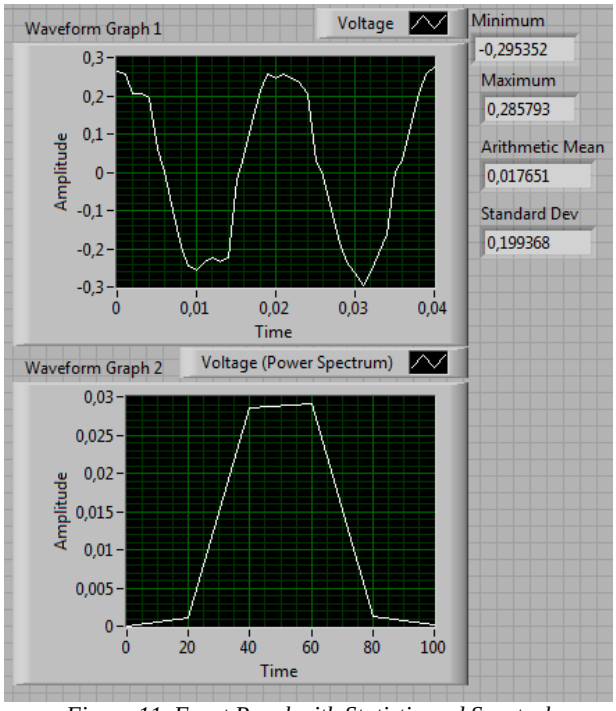

Figure 11. Front Panel with Statistic and Spectral Measurements

III. LOGGING DATA TO FILE

It is often necessary to permanently store data acquired from the DAQ device. LabVIEW contains several built-in functions for saving data to disk. In this step, you will configure the data from the hardware to be written to a file on your computer.

4) **Right-click** on the block diagram and select **Programming » File I/O » Write to Measurement File** to place this Express VI on the block diagram.

The Write LabVIEW Measurement File Express VI, writes signals to a LabVIEW measurement file.

5) Select **Ask user to choose file** in the Configure Write to Measurement File dialog. Click **Ok** to close the dialog box.

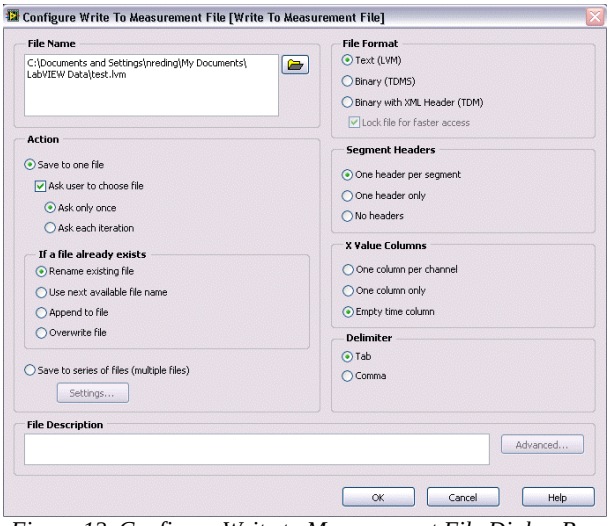

Figure 12. Configure Write to Measurement File Dialog Box

6) Wire the **data** output from the **DAQ Assistant VI** to the **Signals** input of the **Write to Measurement File VI**.

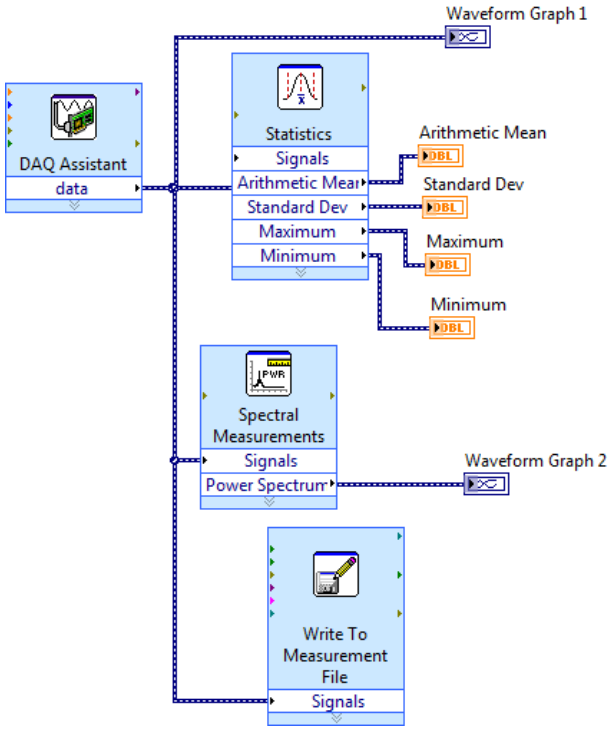

Figure 13. Block Diagram Completely Built

IV. CONCLUSIONS

NI LabVIEW is an open environment designed to make interfacing with any measurement hardware simple. It combines data acquisition, analysis, and presentation tools into one software program. With interactive assistants, code generation, and connectivity to thousands of devices, LabVIEW makes gathering data as simple as possible.

Because LabVIEW provides connectivity to virtually any measurement device, you can easily incorporate new LabVIEW applications into existing systems without losing your hardware investment. Regardless of your hardware requirements, LabVIEW provides an interface to make connecting to your I/O easy.

NI-DAQmx is a programming interface you can use to communicate with data acquisition devices. Measurement & Automation Explorer (MAX) is a tool automatically installed with NI-DAQmx and used to configure National Instruments hardware and software.

Many applications that do not require advanced timing and synchronization can be performed by using the DAQ Assistant Express VI. For programs that require advanced timing and synchronization, use the VIs that come with NI-DAQmx.

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