Data Acquisition Software

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DAQ Software

Software is an integral part of all DAQ systems since the systems are implemented on a computer. Today, this means that the software is typically configured to operate under the most recent versions of the Microsoft Windows operating system. However, DAQ software is also available to operate on the Apple Macintosh computer under the Tiger operating system.

The main categories of software are process monitoring, control, data analysis, display, drivers, and programming languages.

Types of DAQ Software

Process monitoring includes the programs that actually control the hardware (multiplexer, ADC, etc.), take the data readings, and store them. The software allows channel selection, gain adjustment, sampling rate, and other characteristics of the system. This software also manages the files.

Control software are the programs that develop the output signals of the system, if any.

Data analysis software are programs that process the digital data by math subroutines, digital signal processing, or other as required by the application.

Display software puts the data on the video screen in tabular form, graphs, charts, flow charts, diagrams, or animated visuals.

Software Drivers and Languages

Drivers are programs that bridge between the hardware and the software described above; they select the multiplexer input, trigger the ADC, initiate PC interrupts, etc.

Programming languages that are used to create custom software for the applications; usually Visual BASIC, C, or C++. Special programs like LabVIEW are also used.

Software Development

In the earliest DAQ systems, engineers had to write their own software tailored to the application. BASIC, Pascal, C, or assembler was used. The creation of the software was typically the most difficult and time consuming part of the system. Programs like Microsoft's Visual BASIC have made it easier not only to do the processing but also to create the output graphics.

Today most vendors of DAQ hardware also supply matching software. It is usually best to use the software developed for the hardware to ensure full compatibility and to minimized development time, learning time, and implementation time.

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Software

Because the most time consuming part of assembling a DAQ system is getting the software to do what you want, you should use the commercially available software instead of creating new programs. Software development is time consuming, costly, and very difficult unless you are an expert.

You should search for relevant software before buying the hardware and buy the hardware that matches the applications software. Most vendors of DAQ boards and chassis sell matching software.

Create your own software only as a last resort.

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LabVIEW: A Software Example

Perhaps the most popular and widely used data acquisition hardware and software comes from National Instruments. This company specializes in DAQ boards, chassis, and offers a huge variety of DAQ modules and accessories. At the heart of their product line is LabVIEW, the software that works with all of the hardware.

LabVIEW stands for Laboratory Virtual Instrument Engineering Workbench. It is essentially a programming language and environment that makes it easy for someone assembling a data acquisition system to make a complete workable system customized to their specific application. LabVIEW works with any Windows PC or Apple Macintosh. Versions are also available for selected engineering workstation computers such as those from Sun and HP.

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LabVIEW Overview

LabVIEW provides a simple way for a user to program the DAQ hardware as well as any processing and display options desired. Instead of the usual text-based programming like BASIC, C, Pascal, or assembler, LabVIEW is a graphical programming language. It is also referred to as the G language and is programmed with graphics. Using clearly defined boxes or icons that each define an operation, process function or display option, you place them on the screen with a click of the mouse. Then you interconnect them as you would in creating a flow diagram.

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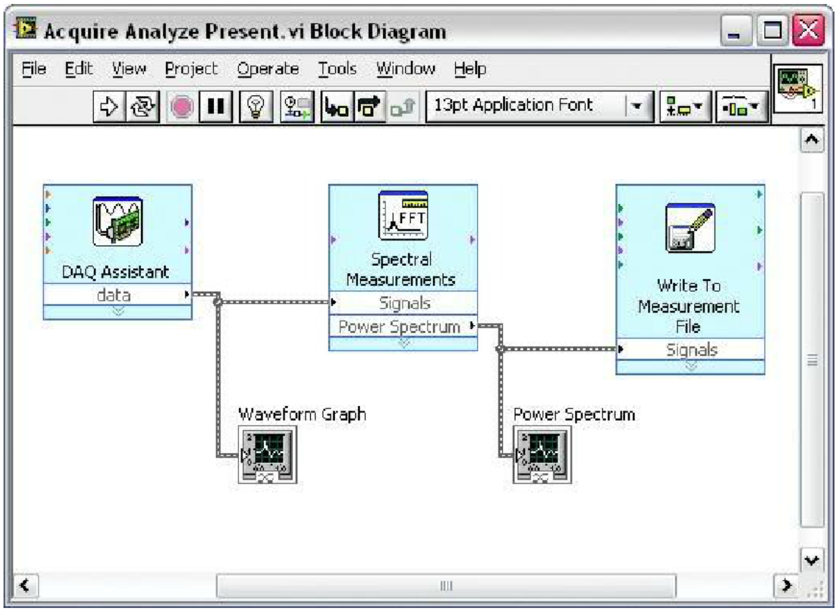
LabVIEW Block Diagram



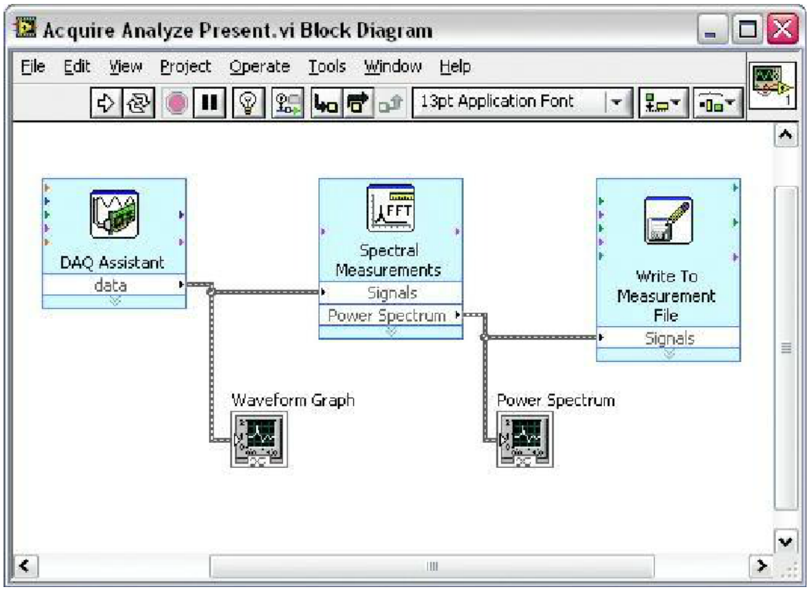
LabVIEW converts your block diagram into the source code that is run on the processor in your computer.

The block designated DAQ Assistant is used to select the desired input channels and sampling rate.

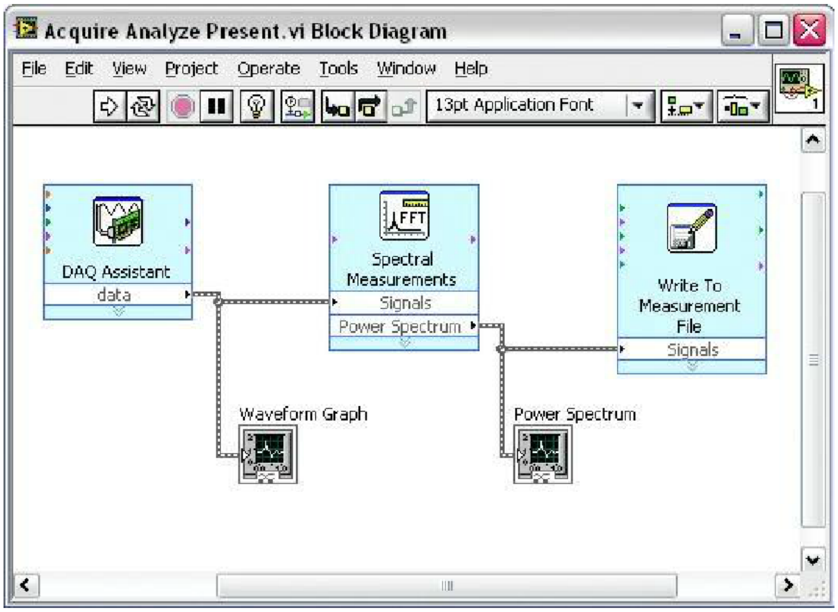
Photo courtesy of National Instruments Inc.

LabVIEW Measurements

The resulting signals are sent to the Spectral Measurements block that performs a FFT analysis producing a frequency domain analysis of the signals. The third block sets up the data for storage to a file. Note the two blocks below which set up waveform displays in the time and frequency domains. Each block simply specifies the operation and tells the software to implement that function with the appropriate code.



LabVIEW Graphical Programming



Graphical programming is fast, easy, and very effective. And you essentially do not have to know anything about standard programming in C or assembler. You define your application by the graphics and the software does all of the conversion to processor native code.

Virtual Instrumentation

Data acquisition systems are actually test and measuring systems. We call equipment made especially for this purpose test instruments or test equipment. Oscilloscopes, digital multimeters, counters, and spectrum analyzers are examples of stand alone test instruments that are used for specific jobs. But with a DAQ system and LabVIEW, you can actually build and program your own virtual instrument (VI). The DAQ hardware combined with the LabVIEW program lets you create and emulate almost any desired instrument.

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Virtual Instrumentation Example

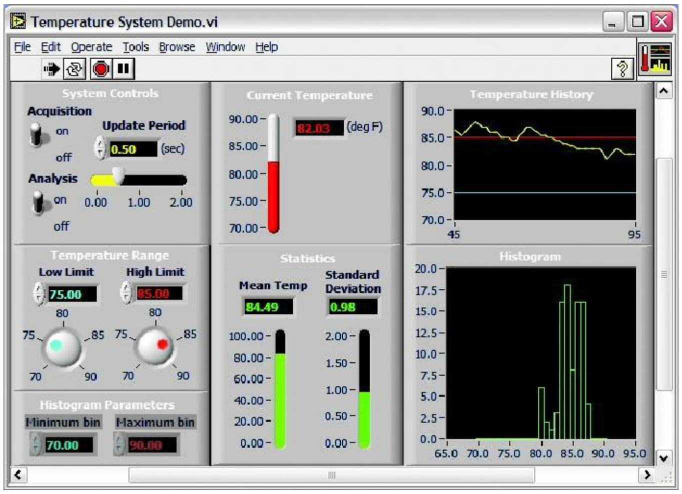
A good example of virtual instrumentation is an oscilloscope. You can actually program your system to be a dual trace oscilloscope. The multiplexer and signal conditioning make the input signal compatible with the ADC which samples any inputs. The computer video screen is programmed to show graphics similar to what you would see on a standard scope. The front panel controls can also be simulated to work just like the real scope functions such as vertical gain, sweep rate, and triggering.

With DAQ hardware and LabVIEW, you can simulate just about any common test instrument within the sampling speed limits of the DAQ ADC. Other commonly simulated instruments are a digital multimeter and a spectrum analyzer with DSP FFT.

Building a VI

Putting together a virtual instrument begins with defining the front panel or display. This is where you tell LabVIEW how you want to display your data. You can use an oscilloscope display of voltage vs. time for a single signal or multiple signal or show outputs on simulated analog meters. You can also create special charts, graphs, or other presentations to creatively show the data you collect in a meaningful way.

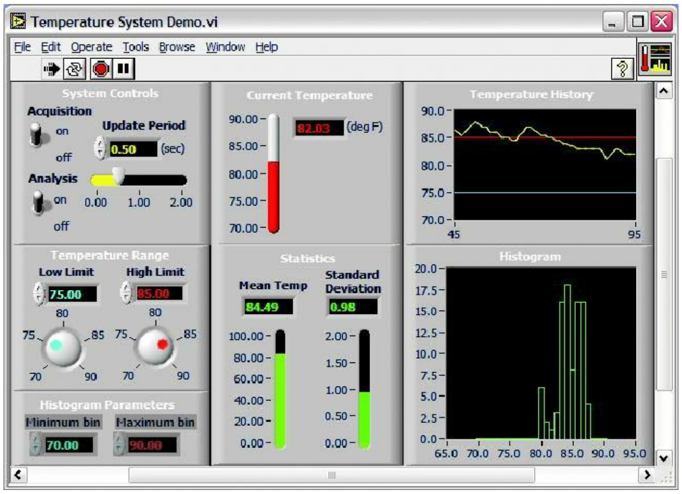
Building a VI Example



The figure above shows a simple system to capture and measure temperature over time and display it as a graphical plot. The recorded temperature is displayed on the time plot on the upper right. Statistical analysis is performed and the resulting mean and standard deviation is recorded on the vertical green meters and displayed as a histogram at the lower right. On the right, controls are provided for turning the system off and on and selecting the upper and lower temperature limits.

Photo courtesy of National Instruments Inc.

Building a VI Example: Create Block Diagram



After creating the front panel or display, you create your block diagram showing exactly what the signal conditioning should be, how often the data is to be sampled, what processing or analysis you desire, and how to send the data to your front panel display.

Finally, you connect all of your icon blocks that define the desired operations with lines.

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Knowledge Probe 3
Data Acquisition Software

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