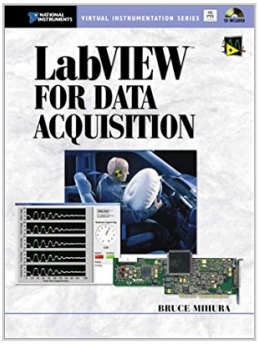

LabVIEW for Data Acquisition

By Bruce Mihura

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The practical, succinct LabVIEW data acquisition tutorial for every professional. No matter how much LabVIEW experience you have, this compact tutorial gives you core skills for producing virtually any data acquisition (DAQ) application-input and output. Designed for every engineer and scientist, LabVIEW for Data Acquisition begins with quick-start primers on both LabVIEW and DAQ, and builds your skills with extensive code examples and visual explanations drawn from Bruce Mihura's extensive experience teaching LabVIEW to professionals.

- Includes extensive coverage of DAQ-specific programming techniques
- Real-world techniques for maximizing accuracy and efficiency
- The 10 most common LabVIEW DAQ development problems-with specific solutions
- Addresses simulation, debugging, real-time issues, and network/distributed systems
- Preventing unauthorized changes to your LabVIEW code
- An overview of transducers for a wide variety of signals
- Non-NI alternatives for hardware and software

LabVIEW for Data Acquisition includes an extensive collection of real-world LabVIEW applications, lists of LabVIEW tips and tricks, coverage of non-NI software and hardware alternatives, and much more. Whatever data acquisition application you need to create, this is the book to start and finish with.
RELATED WEBSITE
The accompanying website includes an evaluation version of LabVIEW and key LabVIEW code covered in the book.

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Editorial Review

About the Author

BRUCE MIHURA is the owner of LC Technology, an NI certified consultancy specializing in writing custom data acquisition, and control software using LabVIEW, LabWindows/CVI, BridgeVIEW, TestStand, Microsoft Visual C++, and Microsoft Visual Basic. He worked for seven years at National Instruments, spending five years as a LabVIEW developer and nearly two years as sole designer of NI's DAQ Designer configuration software for data acquisition systems. Bruce has taught 32 LabVIEW and/or DAQ classes to date.

Preface

I've been interested in gadgets and computers since grade school, particularly gadgets connected to computers. My first real gadget-to-computer project, at age 16, was an alarm for my car made from an Atari computer with 16 Kbytes of RAM and a photoresistor. I caught no car thieves, but I did catch a cat trying to steal a nap on my car! Six years later, I was more than a little happy to get my first job out of college at NI (National Instruments), where I worked for years as a LabVIEW developer, actually getting paid to connect gadgets to computers! I quickly learned that *data acquisition* is the professional term for connecting certain types of gadgets to computers, like the photoresistor in my first car alarm.

If you already have an NI data acquisition board with analog input connected to a computer with LabVIEW 6i, and you are dying to watch it work, skip right ahead to start on Chapter 3, up to and including Section 3.1.5, then come back here.

LabVIEW and Data Acquisition

This book is written for people who intend to use National Instruments' LabVIEW (**Lab**oratory **V**irtual **I**nstrument **E**ngineering **W**orkstation) for data acquisition. LabVIEW has become very popular as the programming language of choice in the context of industrial, scientific, academic, and laboratory environments. LabVIEW is a graphical programming language in which you build the programs with pictures, not words. Data acquisition involves connecting computers to a wide variety of gadgets via electronic signals; the computers then control these gadgets or read data from these gadgets. The term *DAQ* will be used throughout the book instead of data acquisition.

In general, any place that "scientific measurements" must be taken is an appropriate place for LabVIEW. Following are a few examples of LabVIEW applications:

- Measuring pressure, temperature, and vibration in an airplane during the course of its flight
- Monitoring the pH of a chemical solution during processing
- Analyzing sound waves in an acoustics laboratory
- Monitoring and recording flow rates of liquids or gasses

To use LabVIEW for any of these four example applications, you need the following four components:

1. LabVIEW

2. A computer on which LabVIEW can run
3. A *data acquisition* device (changes an electrical signal into something the computer can read)
4. A *transducer* (changes a wide variety of real-world phenomena, like pressure, temperature, pH, sound, etc., into an electrical signal for the data acquisition device)

National Instruments currently makes LabVIEW and a wide variety of data acquisition devices. If you are going to use LabVIEW, I recommend buying your data acquisition device from National Instruments, as it generally simplifies its integration with LabVIEW.

Because LabVIEW is a graphical programming language, it is often quicker to develop than using a text-based language, and its programs are often much more robust.

LabVIEW not only runs on all Microsoft operating systems starting with the word Windows, but it runs on Apple Macintosh O/S, Sun Microsystem's Solaris, and certain Hewlett-Packard workstations as well.

Organization

If you have never written a program before in any computer language, you will likely find this book difficult to follow—if this is the case, consider start-ing with the book *LabVIEW for Everyone*, described in Chapter 1, Section 1.1. Nobody learns how to program for the first time, in any language, without spending much time—usually more time than they expect. Be encouraged to know that LabVIEW, like Microsoft Visual Basic, is one of the least painful languages to learn.

Data acquisition is fundamental to many LabVIEW applications. For this reason, this book is written not quite as a "for dummies" book, but more from the "LabVIEW newcomer" point of view. Many people using LabVIEW for the first time want to do data acquisition—so if you are completely new to LabVIEW, Chapter 1 is designed to teach you just enough LabVIEW to perform some meaningful data acquisition.

Chapter 1: Learning LabVIEW for the First Time. This chapter is designed to teach a LabVIEW newcomer just enough to perform useful data acquisition with LabVIEW. It is meant to be the quickest LabVIEW tutorial ever, but as a result, it's a bit like taking a drink from a fire hose. This chapter is not explicitly DAQ-specific, but it subtly focuses on DAQ-related issues.

Chapter 2: Signals and DAQ. Learn or review the fundamentals of data acquisition that you will find relevant with LabVIEW--or with any pro-gramming language.

Chapter 3: Basic DAQ Programming Using LabVIEW. Combine Lab-VIEW with data acquisition at a very fundamental level. Use real hard-ware and real wires, and manipulate real signals in this chapter.

Chapter 4: Simulation Techniques. Most of your developing can be done without real hardware, right in the comfort of your home or office.

Chapter 5: DAQ Debugging Techniques. This chapter tells you how to track down bugs (with a focus on data acquisition programming), should you ever make a programming mistake.

Chapter 6: Real-World DAQ Programming Techniques. This chapter is a version of Chapter 3. In order to focus on data acquisition issues without being hindered by limitations of your specific device, all hardware is simulated in this chapter. The most common real-world scenarios are covered in detail in this chapter, and these scenarios often require the advanced techniques covered herein.

Chapter 7: Transducers. Exactly what device do you need to convert your temperature (or pressure,

humidity, etc.) into a signal compatible with you data acquisition device? This chapter points you in the right direction.

Chapter 8: Non-NI Hardware Alternatives. Do you already have a data acquisition device that you want to use with LabVIEW? Or do you just want to save some money on your data acquisition device and have time to spare? Read this chapter.

Chapter 9: Real-Time Issues. Suppose you must collect data at a rate of exactly 10 Hz, or 10 times per second--it is unacceptable to wait 0.11 seconds between data samples. Such issues are not at all obvious, but they are covered in this chapter.

Chapter 10: DAQ at a Distance—Networked and Distributed Systems. Suppose your computer must be placed hundreds of feet from the data you're collecting. Or, suppose you have many data sites, widely separated from one another and your computer. This chapter is for you.

Chapter 11: Alternate Software for DAQ. Suppose you want to per-form data acquisition, but you want to use some software other than LabVIEW. For example, maybe you're already very familiar with another programming environment—see this chapter.

Chapter 12: Finalizing Your LabVIEW Software. Your LabVIEW soft-ware now works perfectly, and you don't want *anybody* changing it, not one bit! Here's how to accomplish that.

Appendix A: Fundamentals: Bits, Bytes, Files, and Data. If you have little programming experience or less, this appendix covers programming fundamentals that are needed in *any* programming language. LabVIEW is no exception! It is not enough to know how to draw pretty pictures; you must understand what's going on underneath.

Appendix B: Top Ten DAQ Problems and Their Solutions. You'll find answers to some common problems in this appendix.

Appendix C: Saving LabVIEW's VIs. It is not obvious that you can sometimes cause permanent damage to LabVIEW itself, not just to your application, if you make a common blunder described herein.

Appendix D: Example Applications. Here is a collection of real-world LabVIEW applications I've personally done, presented so that you can be aware of the abilities of which LabVIEW is capable.

Appendix E: LabVIEW/DAQ Tips and Tricks. Review this list at some point while learning LabVIEW—these are time-saving tips and tricks.

Requirements

This book assumes you have version 6i of LabVIEW; you will gain the most from this book if you work through its examples with version 6i. Its most relevant and powerful features will be illustrated in this book. Ideally, you also have one of NI's multifunction DAQ devices. To work perfectly with this book, your DAQ device should have at least two analog inputs, two digital I/O ports, a counter/timer, and an analog output. However, if your DAQ device doesn't have all of these features, then let's hope you won't need them, so you can just skip the parts of the book that use them.

If you're a programmer, but have never programmed in anything but text-based languages, get ready for a surprise. Figure P-1 shows a "simple" example program that ships with LabVIEW 6i, where the user interface is not shown—just the guts of the program.

DAQ, in the context of this book, means monitoring or controlling physical phenomena with a computer via electrical signals. These electrical signals are defined by their voltage or current levels, and are usually attached to some sort of scientific or industrial equipment by means of transducers that can convert physical values like pressure, temperature, position, flow rate, and so on to electricity (or vice versa). Most types of computers can interface to these transducers by means of DAQ devices. Companies like Agilent and Tektronix make a variety of high-quality, often specialized scientific instruments that perform very accurate and precise measurements, often in a laboratory environment. These instruments are generally connected to the computer via a special interface cable (GPIB, RS-232, etc.), but they can run without the computer connection, unlike the DAQ devices discussed in this book. These instruments will not be covered in this boo...

Users Review

From reader reviews:

Stefanie Roach:

This LabVIEW for Data Acquisition book is just not ordinary book, you have after that it the world is in your hands. The benefit you will get by reading this book is actually information inside this guide incredible fresh, you will get facts which is getting deeper you actually read a lot of information you will get. This specific LabVIEW for Data Acquisition without we recognize teach the one who looking at it become critical in pondering and analyzing. Don't become worry LabVIEW for Data Acquisition can bring when you are and not make your bag space or bookshelves' turn into full because you can have it with your lovely laptop even mobile phone. This LabVIEW for Data Acquisition having excellent arrangement in word along with layout, so you will not really feel uninterested in reading.

Numbers Harless:

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