Developing Monitoring and Control Systems with LabVIEW and CompactRIO
We all have a challenge to solve…

- Power Distribution and Control
- Turbine Control
- Industrial Machine Control
- Medical Device Control
- Structural Monitoring
- Process Control
- Oil and Gas Applications
- Power Monitoring and Control

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Graphical System Design

A platform-based approach for measurement and control

The LabVIEW RIO Architecture

Processor
FPGA
I/O
I/O
I/O
I/O
I/O
I/O
I/O
I/O
I/O

Single-Board RIO
4 Slot cRIO
8 Slot cRIO
X86 cRIO

Machine Design
Transportation
Energy/Oil & Gas
Robotics
Life Sciences
The LabVIEW RIO Architecture

- Real-time OS
- Application software
- Networking and peripheral I/O drives
- DMA, interrupt, and bus control drivers

- Application IP
- Control IP
- DSP IP
- Specialized I/O drivers and interface
- DMA controller
NI CompactRIO Demonstration Kit
Exercise 1
Temperature and Strain Monitoring

Filter Param. → Strain Gauge → Filter → Chart

RTD → Mean → Temperature

Limit → Compare → Alarm/DIO
Inputs:

**Slot 6: NI 9219**—24 Bit Universal Analog Input
(4 DIFF · 100 S/s/ch )
Analog Input 0 (AI0 )→ RTD
(3 Wire Pt100-TCR3851)
Analog Input 2 (AI2 )→ Strain Gauge
(Quarter Bridge / 350 Ohms)

Outputs:

**Slot 2: NI 9401**—8 Ch, 5 V/TTL High-Speed
Bidirectional Digital I/O Module
Digital IO 5 (DIO5 )→ LED1
Exercise 2A
FPGA-Based Butterworth Filter

FPGA APPLICATION
- FGEN/Al
- Filter
- FIFO-IN
- Compare
- Alarm/DIO

REAL-TIME APPLICATION
- FIFO-OUT
- Chart
- FFT
- Detected F
- Alarm/HMI
- Limit

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Inputs:

Slot 4: NI 9381 — 0 V to 5 V AI/AO Module With 4 LVTTL DIO Lines
Mod4/Ai7 → Function Generator
Sampling Period → 20 kS/s
Resolution → 12-bit

Outputs:

Slot 2: NI 9401 — 8 Ch, 5 V/TTL High-Speed Bidirectional Digital I/O Module
Digital IO 4 (DIO4) → LED0
Exercise 2B
LED Array Display
Exercise 2B
LED Array Display
Inputs:

Slot 4: NI 9381— 0 V to 5 V AI/AO Module (24bits · 20kS/s)
Mod4/AI7 ➔ Function Generator

Slot 6: NI 9219— 24 Bit Universal Analog Input
(4 DIFF · 100 S/s/ch )
Analog Input 0 (AI0) ➔ RTD (3 Wire Pt100-TCR3851)
Analog Input 2 (AI2) ➔ Strain Gauge
(Quarter Bridge / 350 Ohms)

Outputs:

Slot 2: NI 9401— 8 Ch, 5 V/TTL High-Speed Bidirectional Digital I/O Module
Digital IO 0 (DIO0) ➔ SIN
Digital IO 1 (DIO1) ➔ SCLK
Digital IO 2 (DIO2) ➔ XLAT
Digital IO 3 (DIO3) ➔ BLANK
Exercise 3
Machine Condition Monitoring System

**REAL-TIME APPLICATION**

- **MOTION CONTROL LOOP**
- **DATA ACQUISITION LOOP**
- **ACCELEROMETER**
- **TEMPERATURE CONTROL**
- **VELOCITY CONTROL**
- **SCAN MODE LOOP**
- **EMBEDDED DISPLAY LOOP**
- **DATALOGGING LOOP**

**FPGA APPLICATION**

- **MOTION CONTROL LOOP**
- **DATA ACQUISITION LOOP**
- **ACCELEROMETER**
- **VELOCITY CONTROL**
- **SCAN MODE LOOP**
- **EMBEDDED DISPLAY LOOP**
- **DATALOGGING LOOP**

**HOST PC APPLICATION**

- **HMI LOOP**
Exercise 3
Machine Condition Monitoring System

Inputs:

**Slot 3: NI 9411** — 6-Channel, 500 ns, ±5 to 24 V Digital Input
Mod3/DIO0 → EncoderA
Mod3/DIO1 → EncoderB
Mod3/DIO2 → EncoderZ

**Slot 5: NI 9234** — Dynamic Signal Acquisition Module
Mod5/AI0 → ACCEL X
Mod5/AI1 → ACCEL1
Sampling Period → 102.4 kS/s
Resolution → 24-bit

**Slot 6: NI 9219** — 24 Bit Universal Analog Input
Sampling Period → 100 S/s/ch
Analog Input 1 (AI1) → TC (Type J / Celsius)

Outputs:

**Slot 1: NI 9503** — C Series Stepper Drive with Antiresonance
Axis 1 → Mod1/Direction, Mod1/Step

**Slot 2: NI 9401** — 8 Ch, 5 V/TTL High-Speed Bidirectional Digital I/O Module
Digital Output 7 (PWM7) → FAN
CompactRIO Developer’s Guide

NI LabVIEW for CompactRIO
Developer’s Guide

Recommended LabVIEW Architectures and Development Practices
for Control and Monitoring Applications

http://www.ni.com/compactriodevguide/
NI LabVIEW RIO Evaluation Kit

90-day LabVIEW, LabVIEW FPGA & LabVIEW Real-Time evaluation

Step-by-step tutorials and configuration wizard

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Online Community at ni.com/rioeval/nextstep

$425
Training & Certification

System Installation and Configuration

Getting Started
ni.com/gettingstarted

System Prototyping

LabVIEW Core 1
LabVIEW Core 2
LabVIEW FPGA
(Required if using FPGA Interface mode)

LabVIEW Real-Time 1
LabVIEW Real-Time 2

System Development and Deployment

LabVIEW Core 3
Managing Software Engineering in LabVIEW
Using LabVIEW for Test and Automation in Regulated Markets

NI LabVIEW for CompactRIO Developer’s Guide
ni.com/compactriodevguide

Required Courses and Content
Recommended Courses and Content

1 Since LabVIEW Core 1 and 2 fit into one week, you may choose to take both LabVIEW Core classes prior to LabVIEW FPGA and LabVIEW Real-Time 1.

ni.com/self-paced-training
Thank You

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