
NATIONAL
INSTRUMENTS™

Sviluppa Sistemi embedded con Labview

Design Real Systems, Fast

Ambra Buccarelli

Academic Account Manager

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Agenda

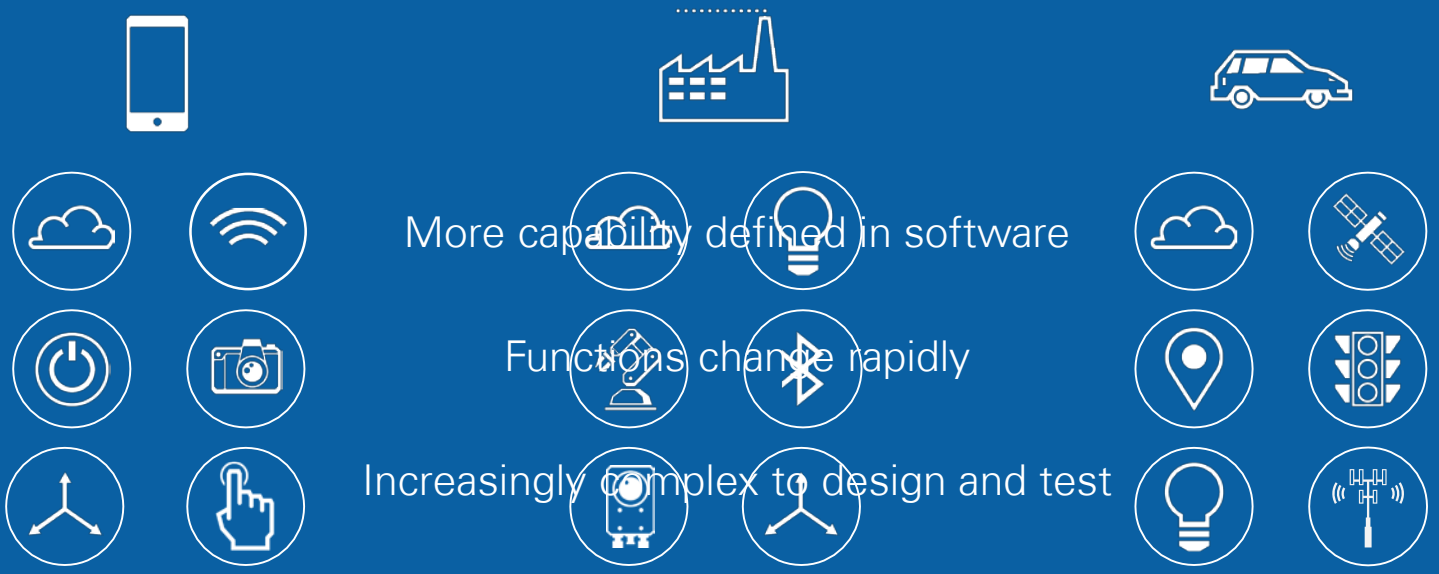
- Introduction to NI
- Introduction to LabVIEW
- Introduction to NI myRIO

- Introduction to LabVIEW Real-Time

- A simple control system with Labview and myRIO

Introduction to NI

The World of Converged Devices



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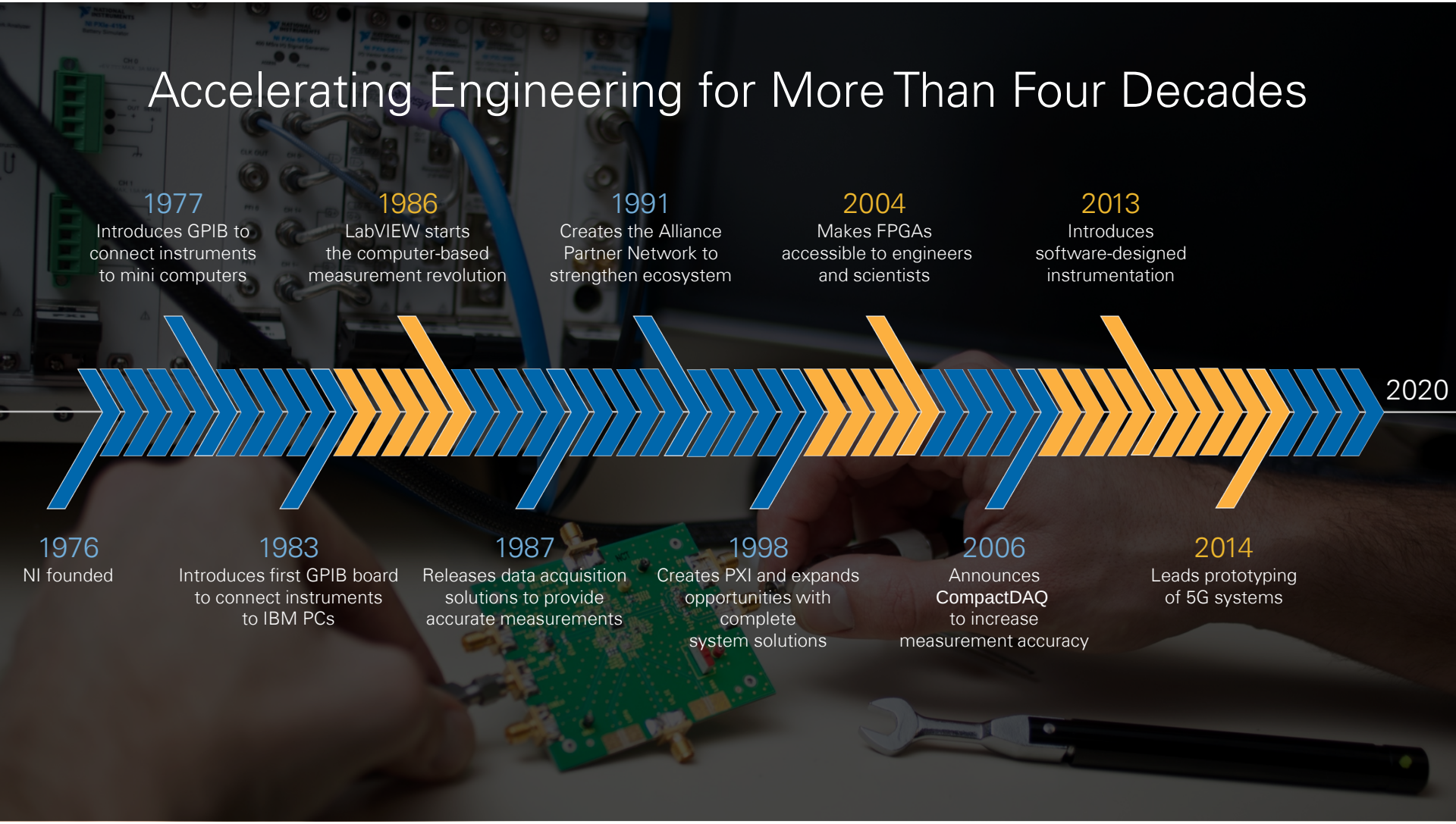
NI Mission

NI equips engineers and scientists with systems that accelerate productivity, innovation, and discovery.



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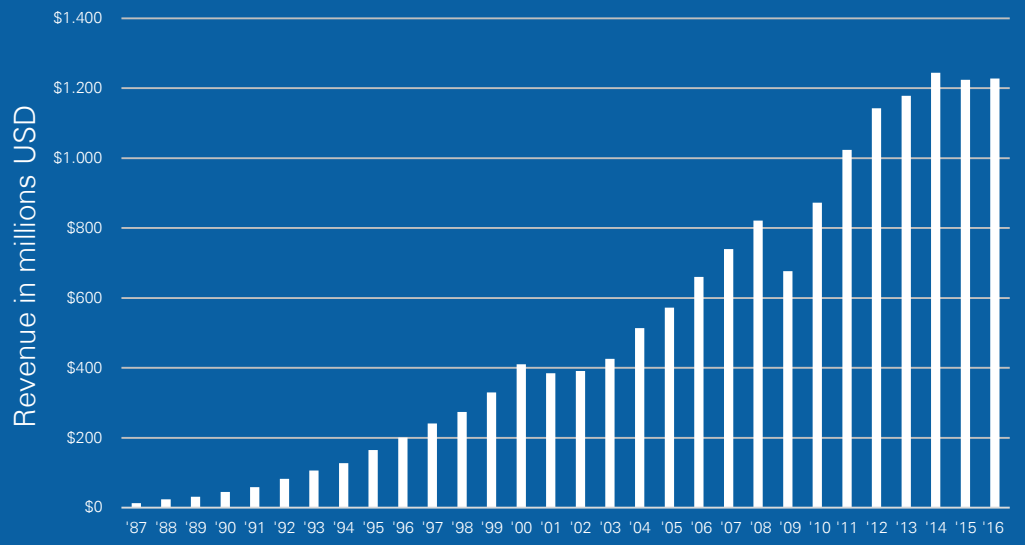
Long-Term Track Record of Growth



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Everyday Engineering Challenges

Do more with less

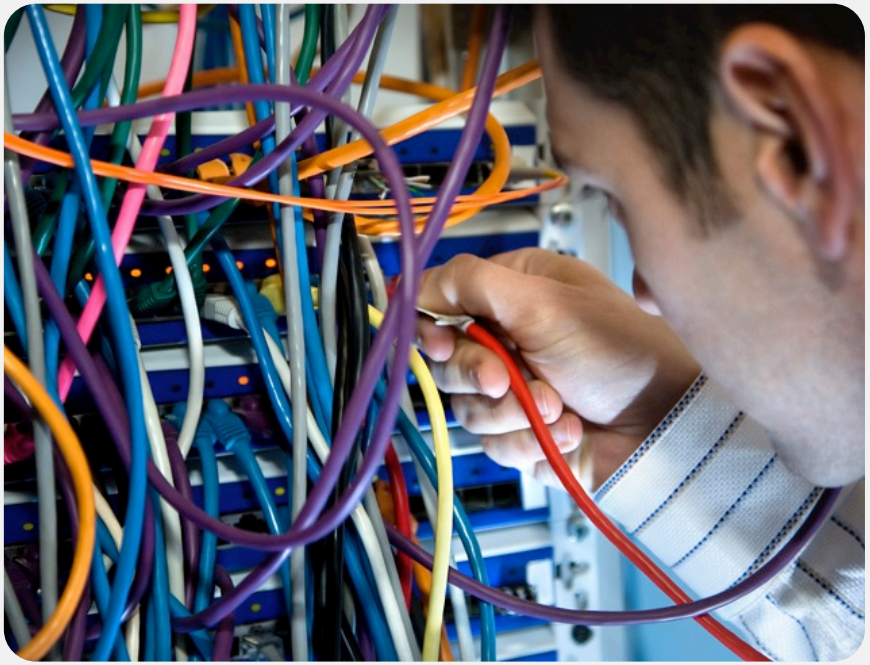
Integrate code and systems

Get increasingly complex products to market faster

Adapt to evolving application requirements

Protect existing investments

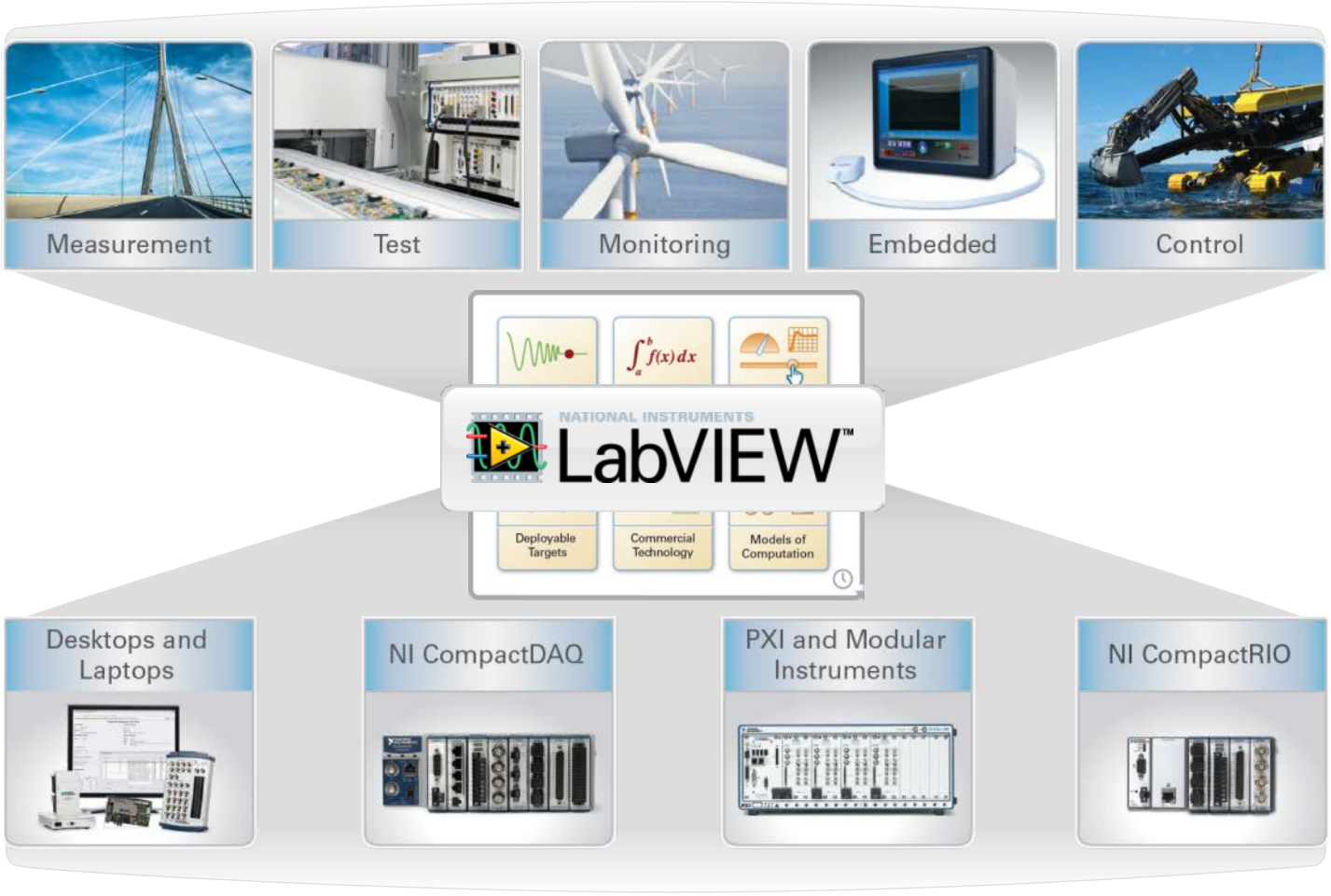
Minimize power consumption



A software-centric platform that accelerates the development and increases the productivity of test, measurement, and control systems.

Graphical System Design

A platform-based approach for measurement and control



Our Customers' Success

Industrial Machinery	Aerospace and Defense	Electronics and Semiconductor	Academic and Research
Industrial Machinery	Aerospace and Defense	Electronics and Semiconductor	Academic and Research
Wireless	Transportation and Heavy Equipment	Automotive	Energy
Wireless	Transportation and Heavy Equipment	Automotive	Energy

More than 35.000 companies

…including 90% of Fortune 500 manufacturing companies

INDUSTRIAL MACHINERY

SIEMENS

"LabVIEW graphical system design allows us to design modular software that can be easily scaled to meet the growing requirements of rapidly evolving wind energy technology."

—Morten Pedersen, CIM Industrial Systems A/S

ni.com/innovations

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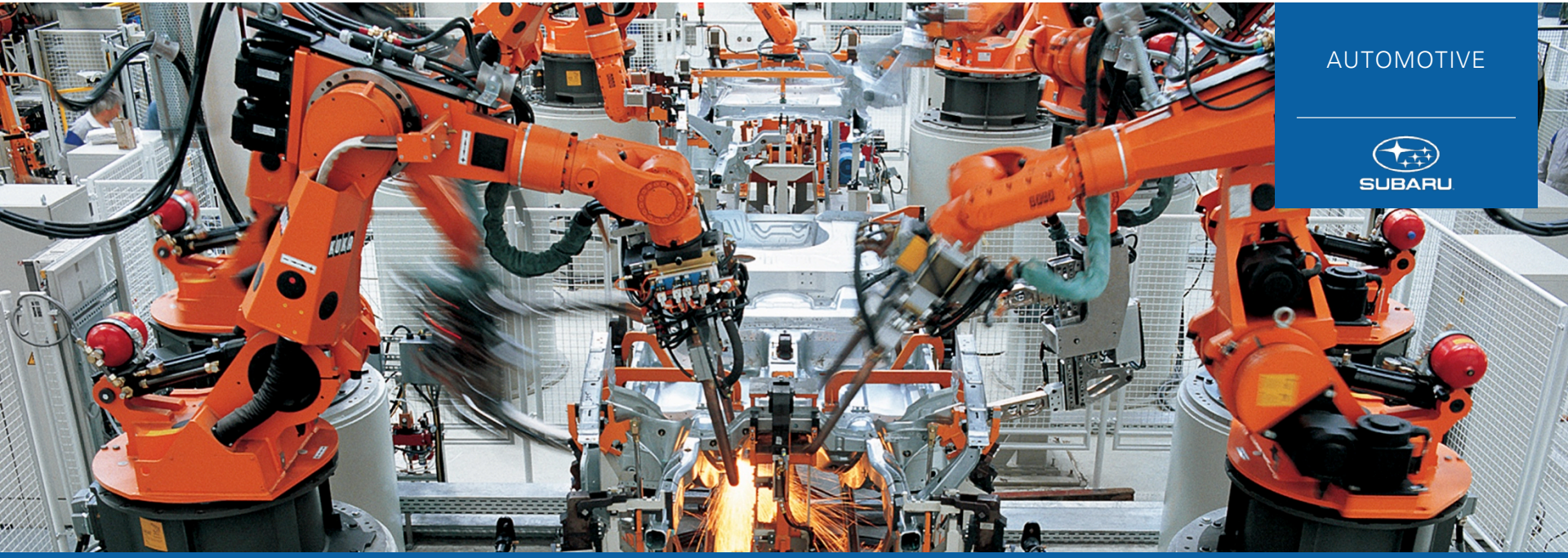

AUTOMOTIVE

SUBARU

"By adopting FPGA-based simulation using the NI hardware and software platforms, we achieved the simulation speed and model fidelity required for verification of an electric motor ECU. We reduced test time to 1/20 of the estimated time for equivalent testing on a dynamometer."

—Tomohiro Morita, FUJI Heavy Industries, Ltd.

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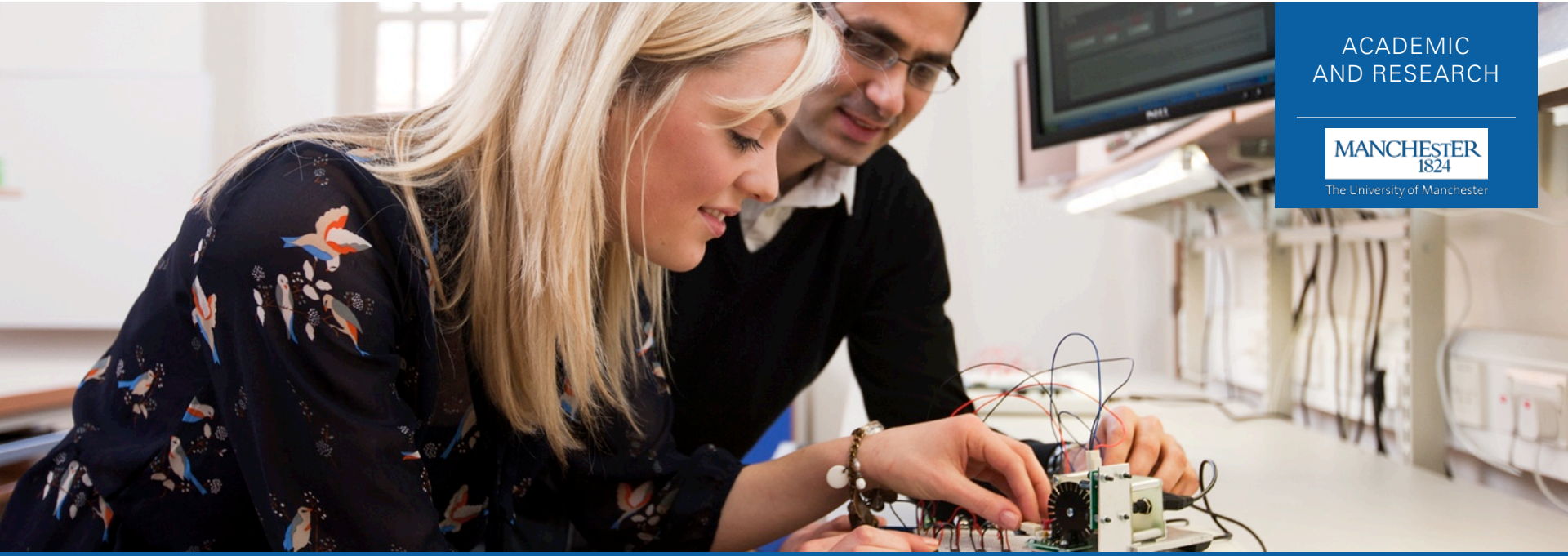

ACADEMIC
AND RESEARCH

MANCHESTER 1824
The University of Manchester

"Electronics used to seem so cryptic to me, but using NI tools in the new labs made everything so much more understandable. It's given me the confidence to experiment with electric circuits and try out some of my own projects."

—Joshua Elijah, Second-Year Student, The University of Manchester

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Direct Operations in More than 40 Countries

- Global team of technical sales engineers
- Systems engineers to assist with reference and application designs
- Local technical support worldwide
- World class NI Services
- 600+ Alliance Partners worldwide

Introduction to NI LabVIEW

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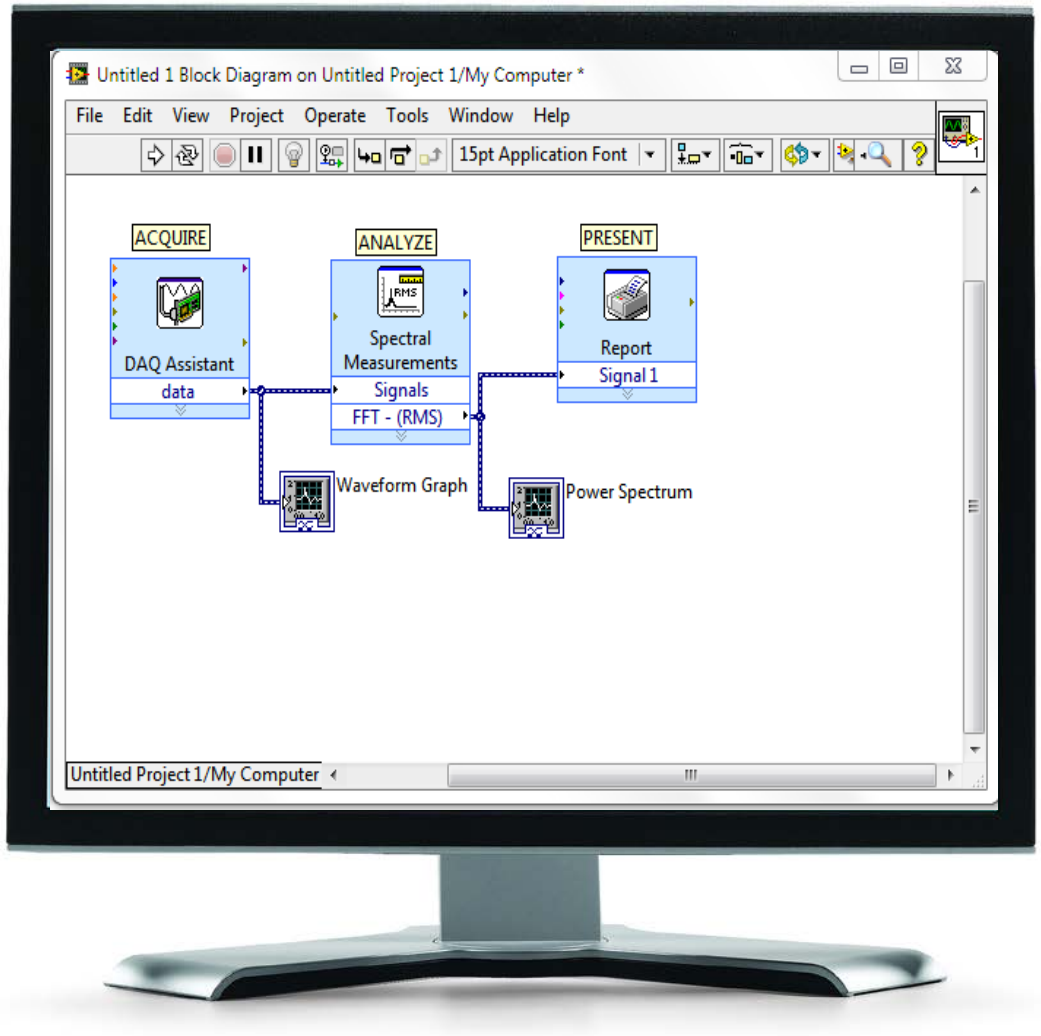
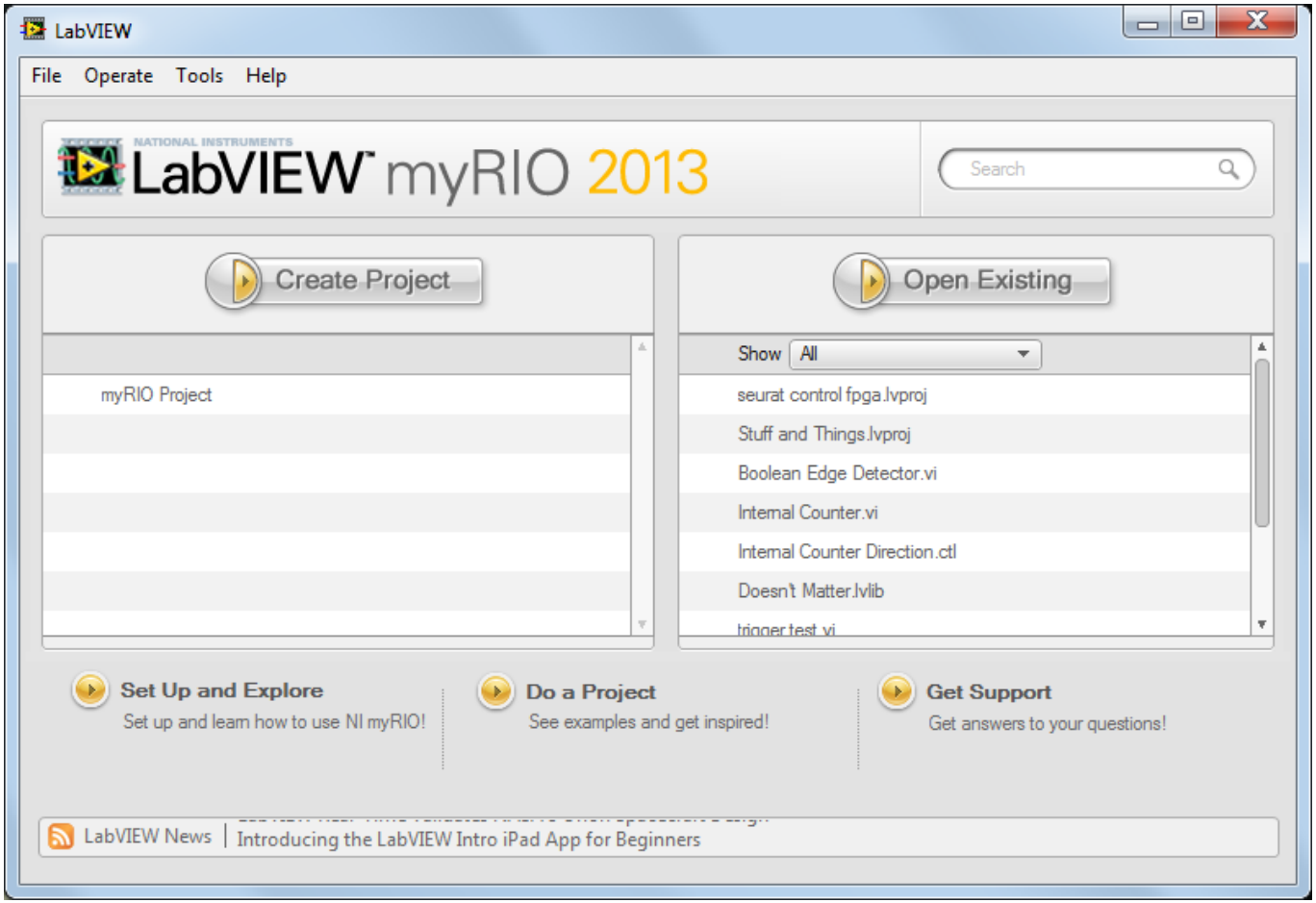
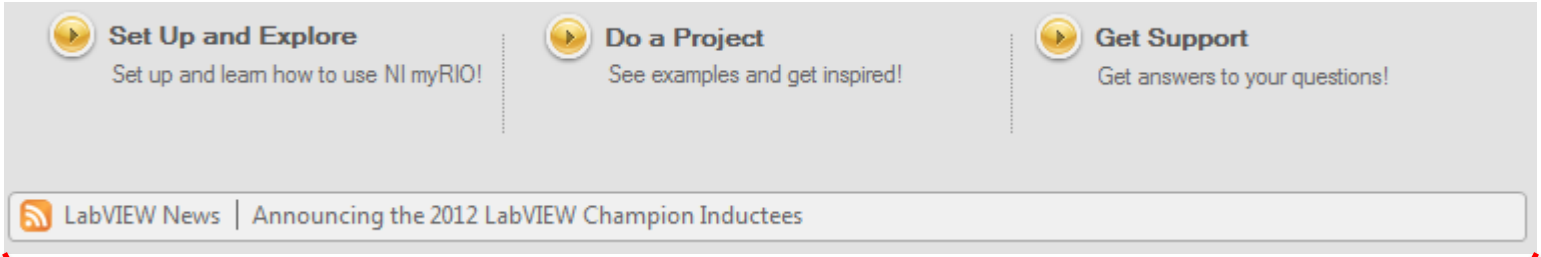
Data Flow


Untitled 1 Block Diagram on Untitled Project 1/My Computer *
File Edit View Project Operate Tools Window Help
15pt Application Font
ACQUIRE
DAQ Assistant
data
ANALYZE
Spectral Measurements
Signals
FFT - (RMS)
PRESENT
Report
Signal 1
Waveform Graph
Power Spectrum
Untitled Project 1/My Computer

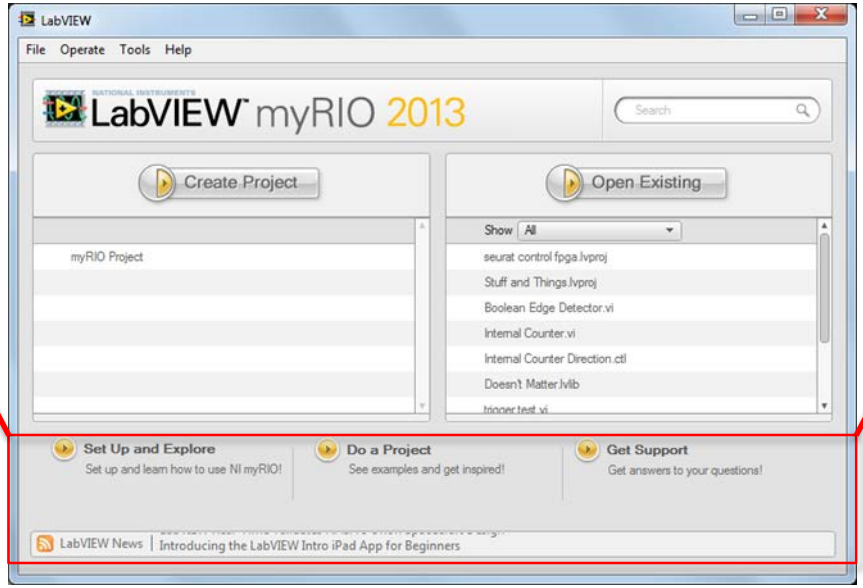
LabVIEW Getting Started Window



LabVIEW Getting Started Window



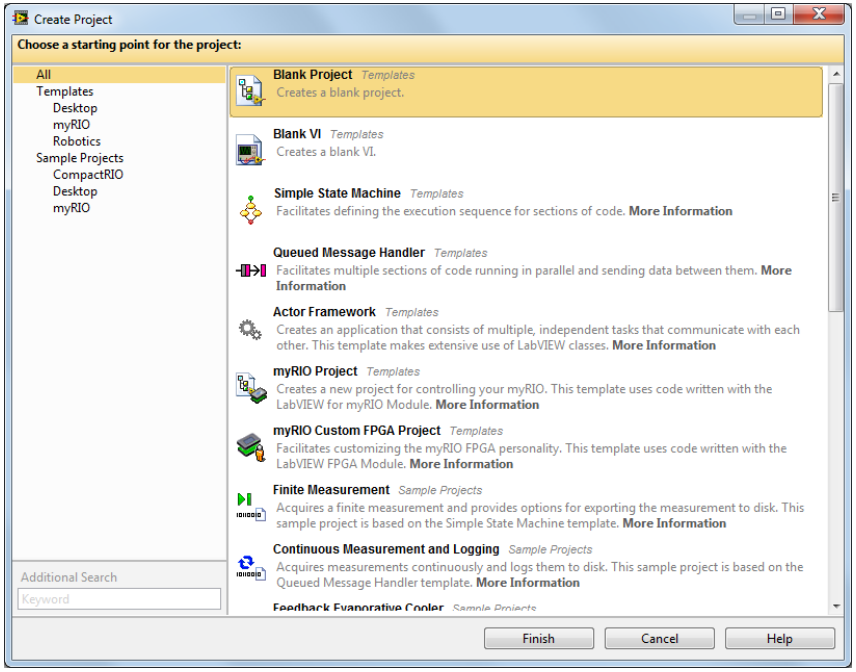
Additional support, tutorials, and explanations can all be found using the links here. These are specifically tailored to NI myRIO users.



Create a Project

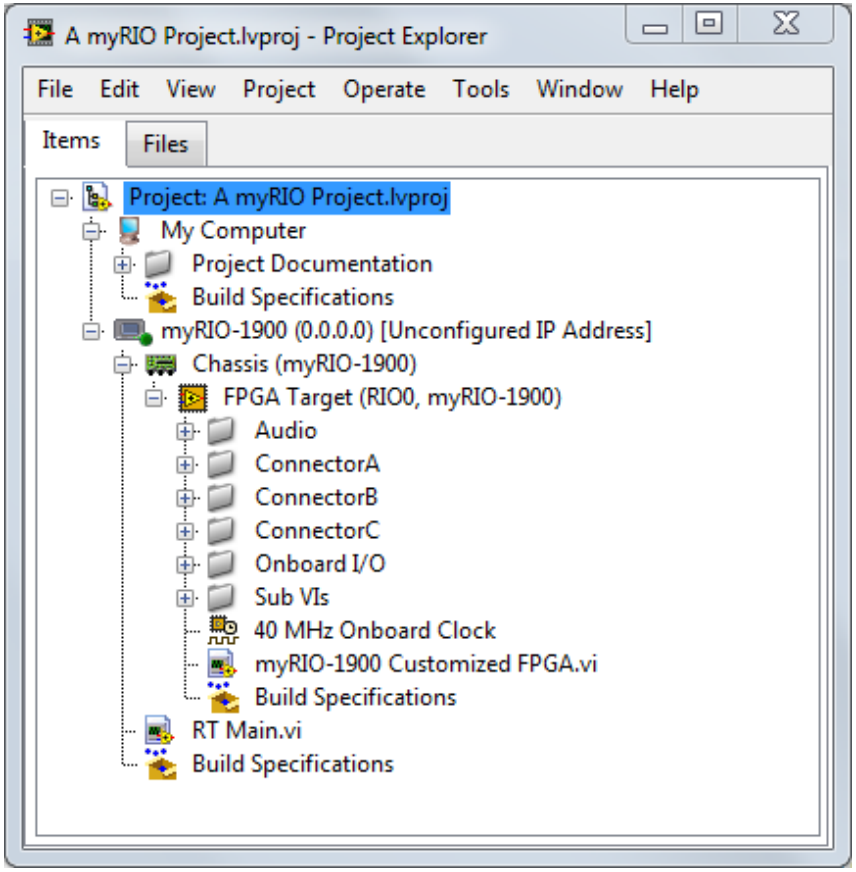
- Click the **Create Project** button
- Select **Blank Project**.
- Click **Finish.**

- To save the project:
  - **File >> Save**
  - Select the desired directory and choose a meaningful name.
  - Remember, two LabVIEW projects cannot share the same directory.



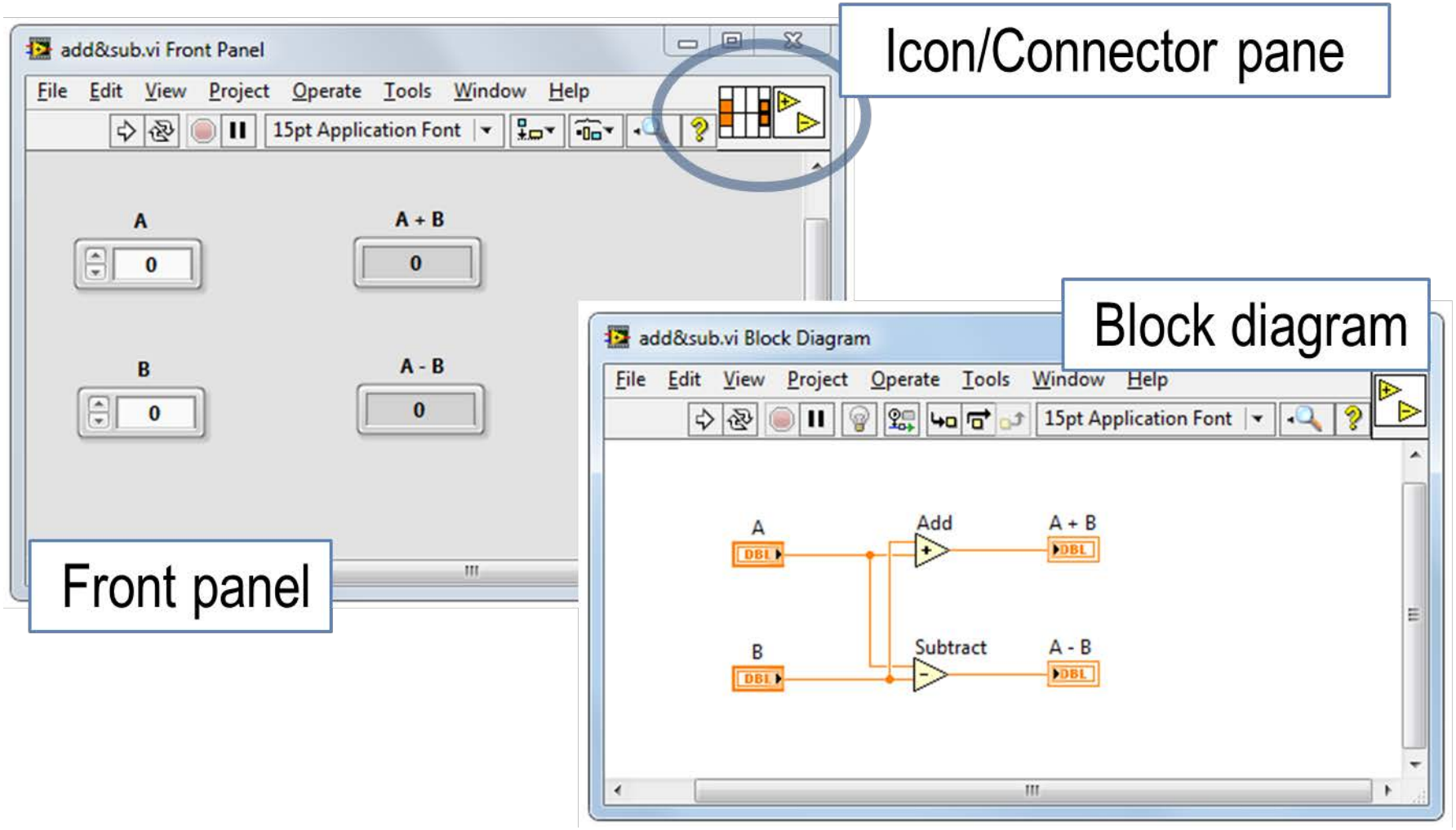
Project Explorer

- Find, access, and organize project files
- Deploy or download files to targets
- Manage code for build options
  - Executables, installers, and zip files



Parts of a VI

VIs have three main components:



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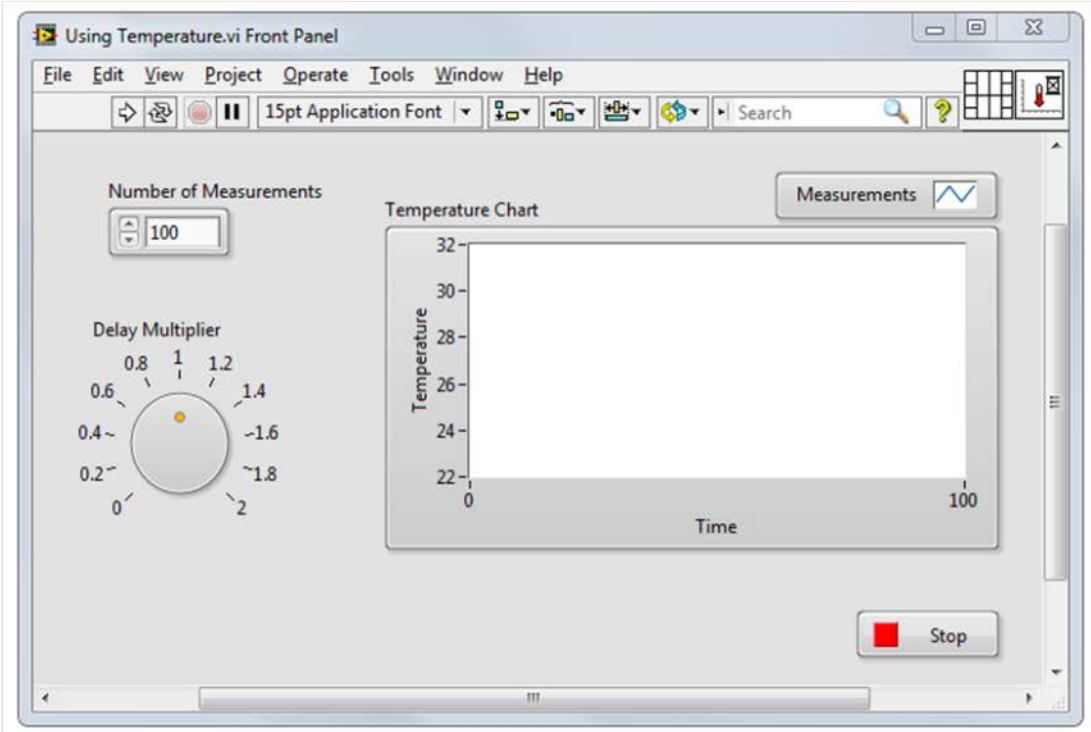
Parts of a VI – Front Panel

Front Panel – User interface for the VI

The front panel is constructed using controls (inputs) and indicators (outputs).

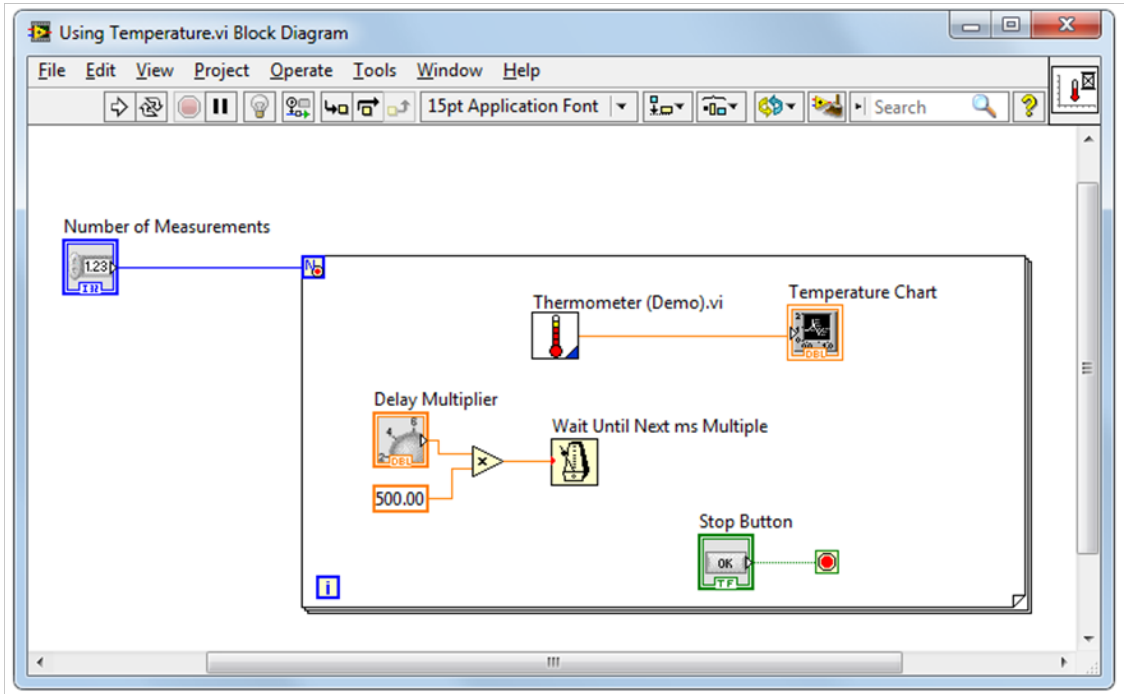


Parts of a VI – Block Diagram

Block Diagram – Contains the graphical source code

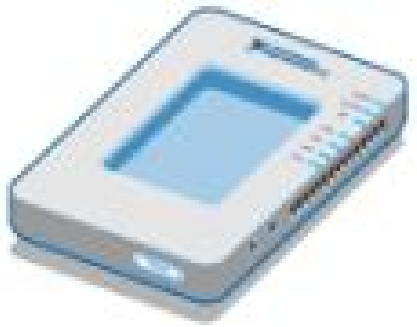
Front panel object appear as terminals on the block diagram.

This is where "programming" is done in LabVIEW.



DEMO

Exploring LabVIEW



Overview of NI myRIO

Portable system to measure force occurring in ultra-endurance races

UNIVERSITÀ DEGLI STUDI DI UDINE

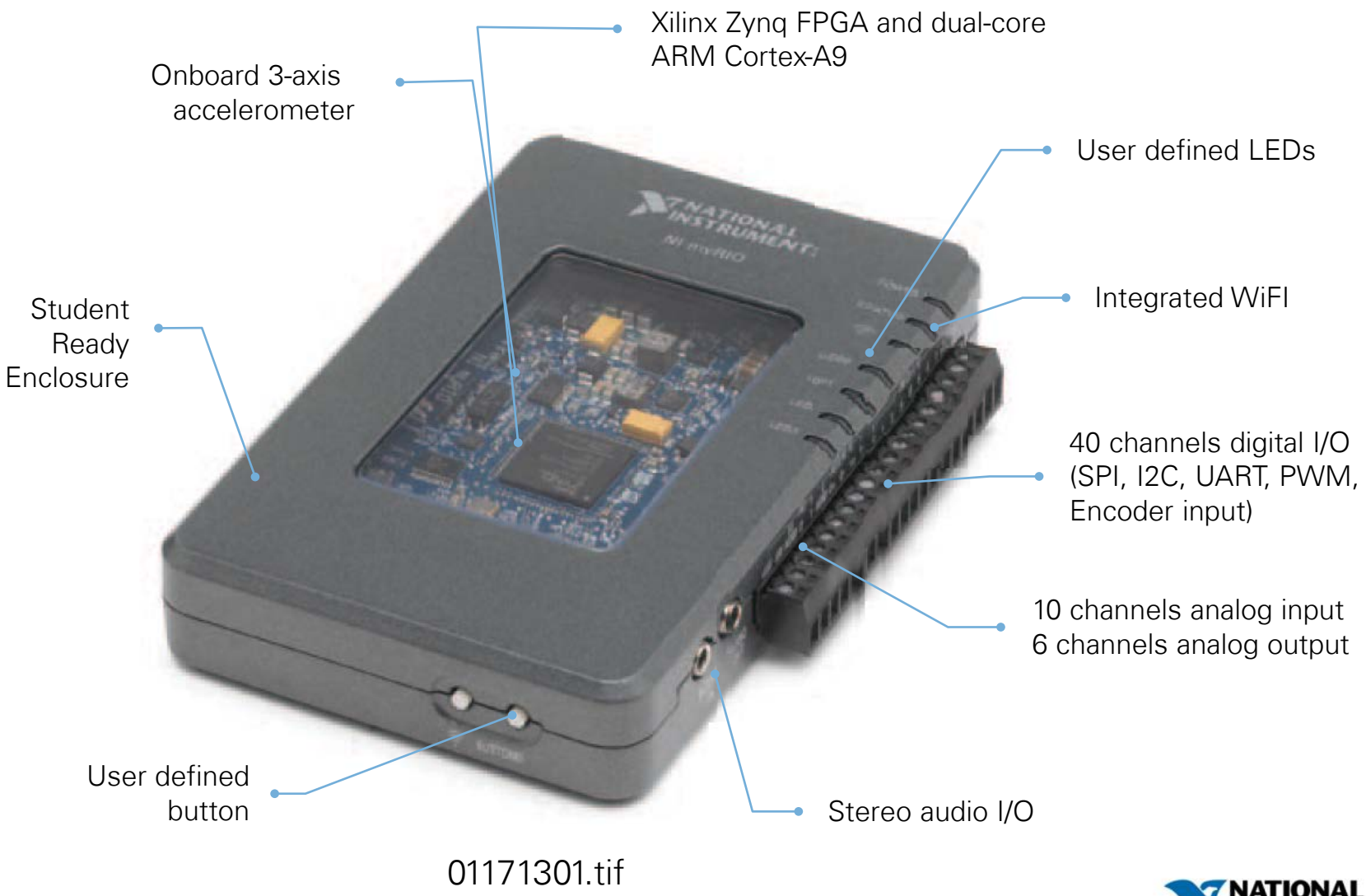
The Challenge

Develop a device capable of measuring and recording the contact forces between the foot and the ground for athletes running at a professional and amateur level.

The Solution

NI myRIO allowed to rapidly develop an advanced data acquisition system of integrated sensors installed inside the athlete's shoe sole.

NI myRIO



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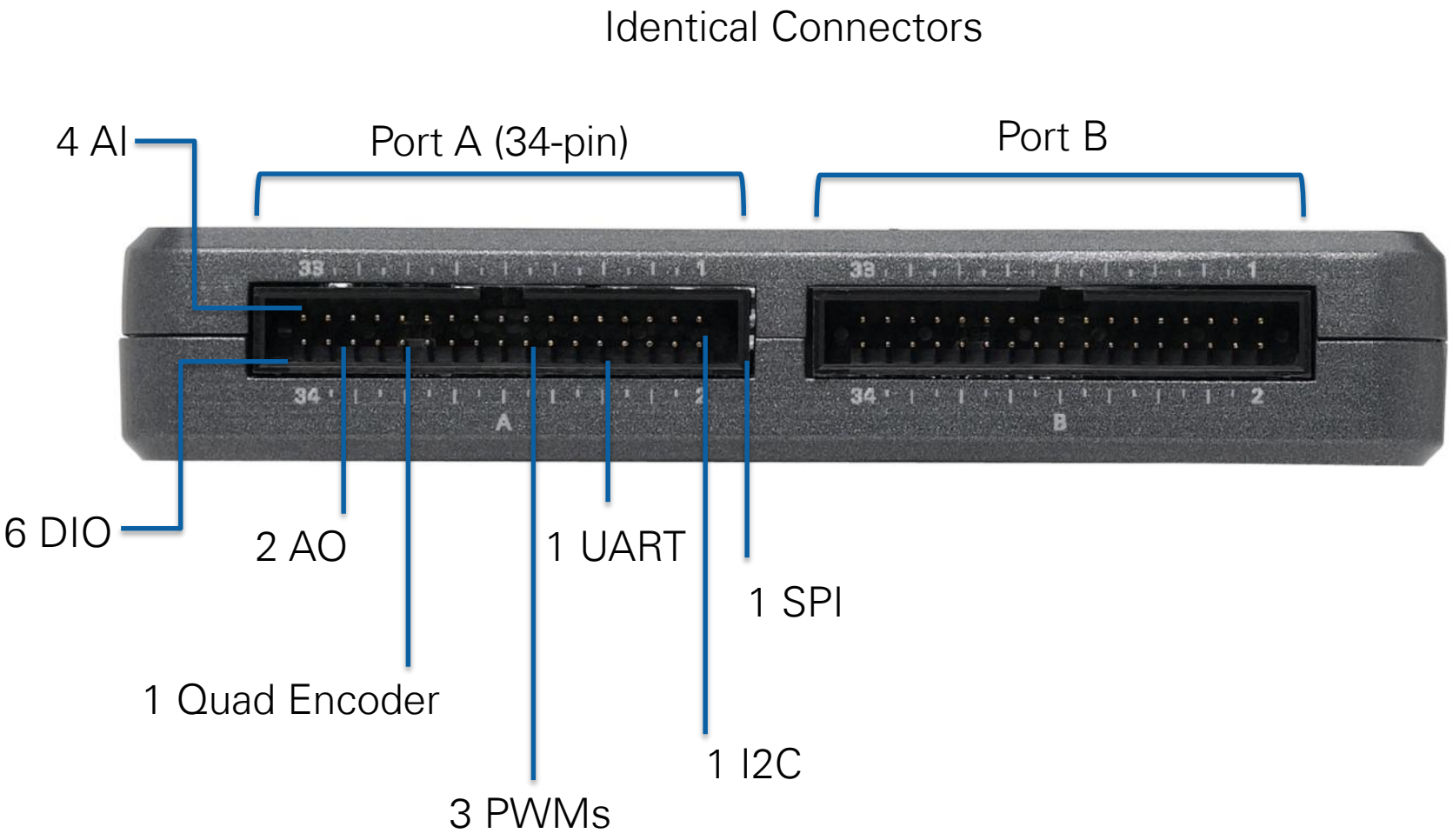
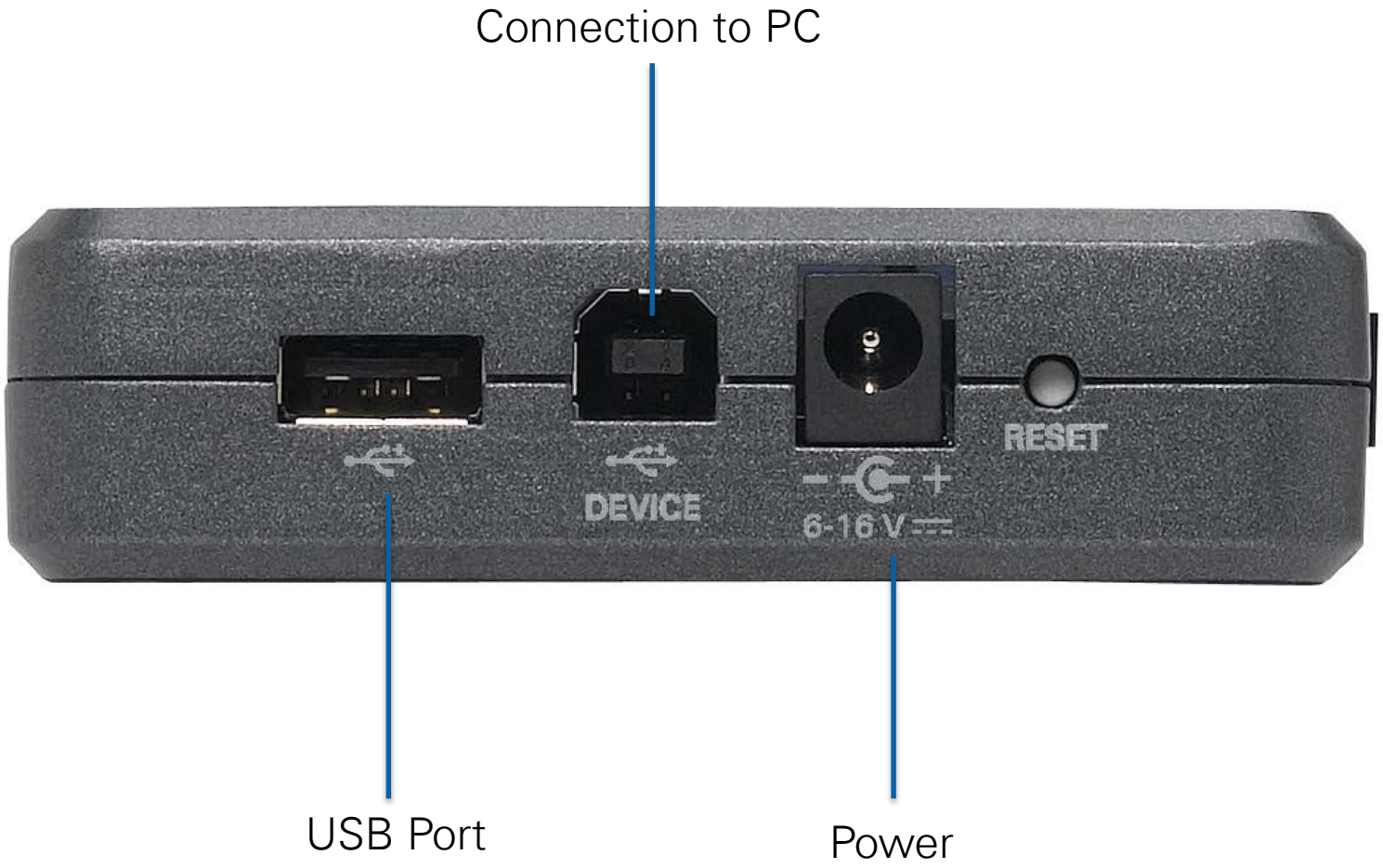
Additional Features

- Fully programmable FPGA through LabVIEW FPGA
- Dual-Core ARM Cortex-A9 processor
- Expandable ecosystem of sensors and actuators
- Ready to use projects and courseware
- Deploy code to real-time processor and FPGA via USB
- Minutes to first measurement
- Processor programmable in C/C++

NI myRIO Expansion Port (MXP)



Top View



NI miniSystems Port (MSP)

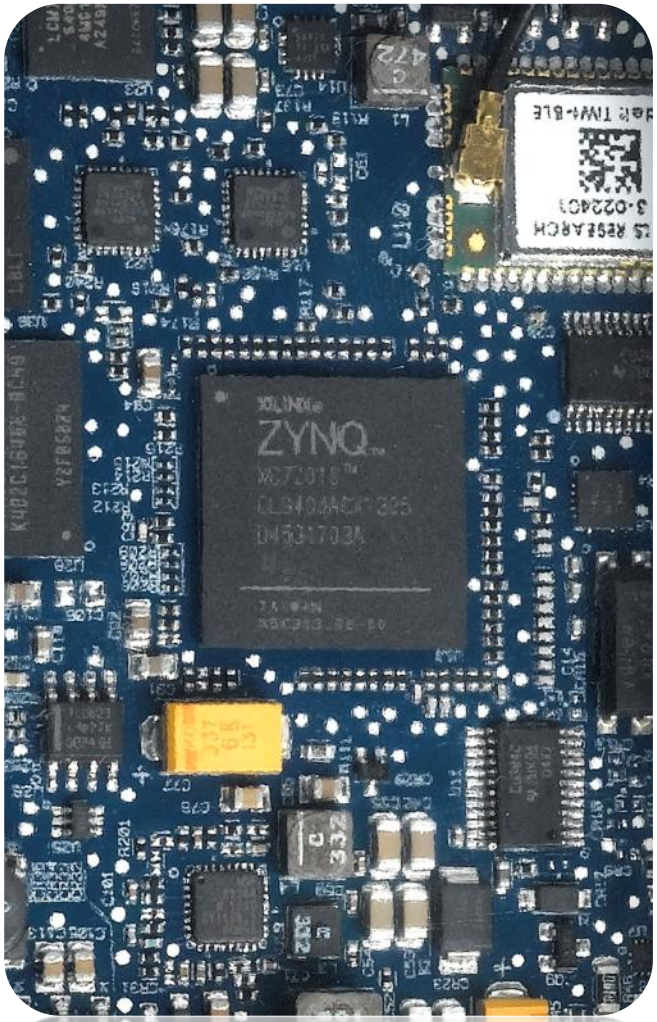
Back View

Built-in Accelerometer

Mounting Holes

Getting Started

Why myRIO **Really** Matters in Education



Leading Industry Grade Technology

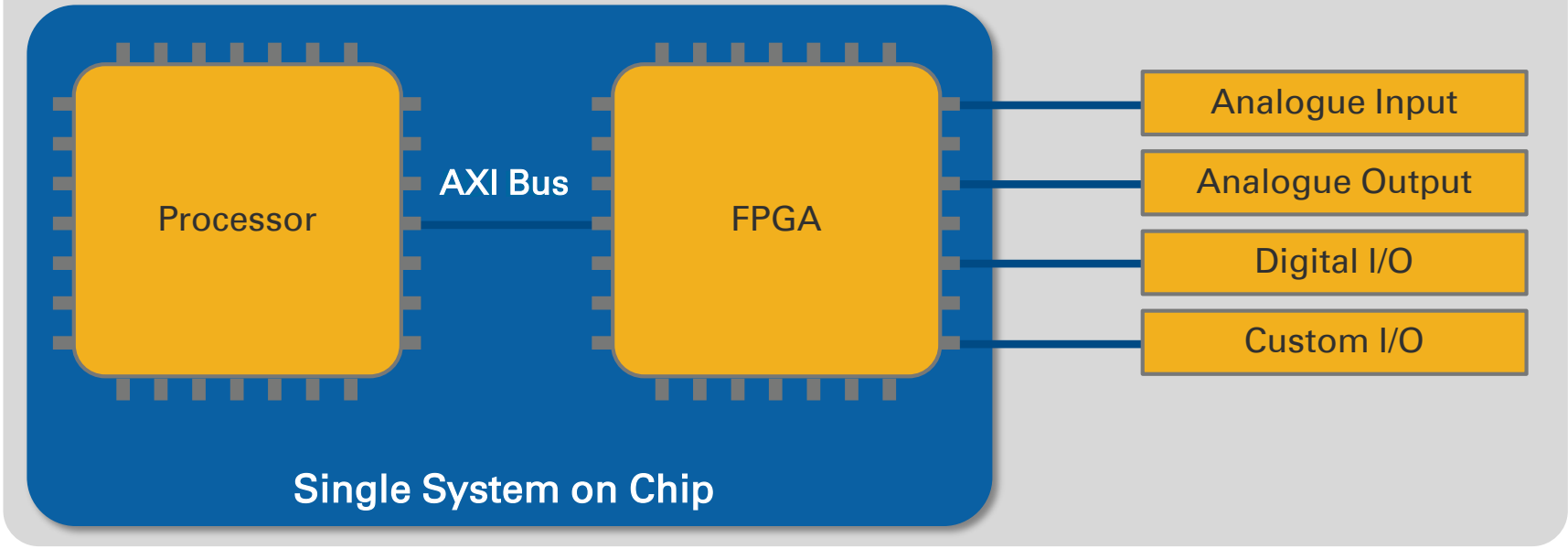
The same technology is used in our latest industry and research ready Compact RIO systems

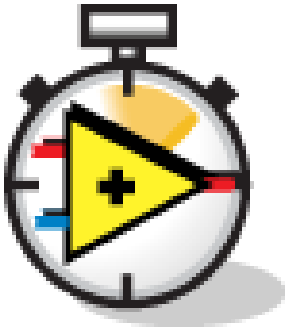
NI myRIO Product Overview: Front View

XILINX Zynq SoC

What is Zynq?

Traditional Implementation





Introduction to LabVIEW Real-Time

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What is Real-Time?

- Real-time **does not** always mean real fast
- Real-time means **absolute reliability**
- Real-time systems have timing constraints that must be met to avoid failure
- Determinism is the timing reliability of the system

Critical Applications to Consider

Event Response

Closed-Loop Control

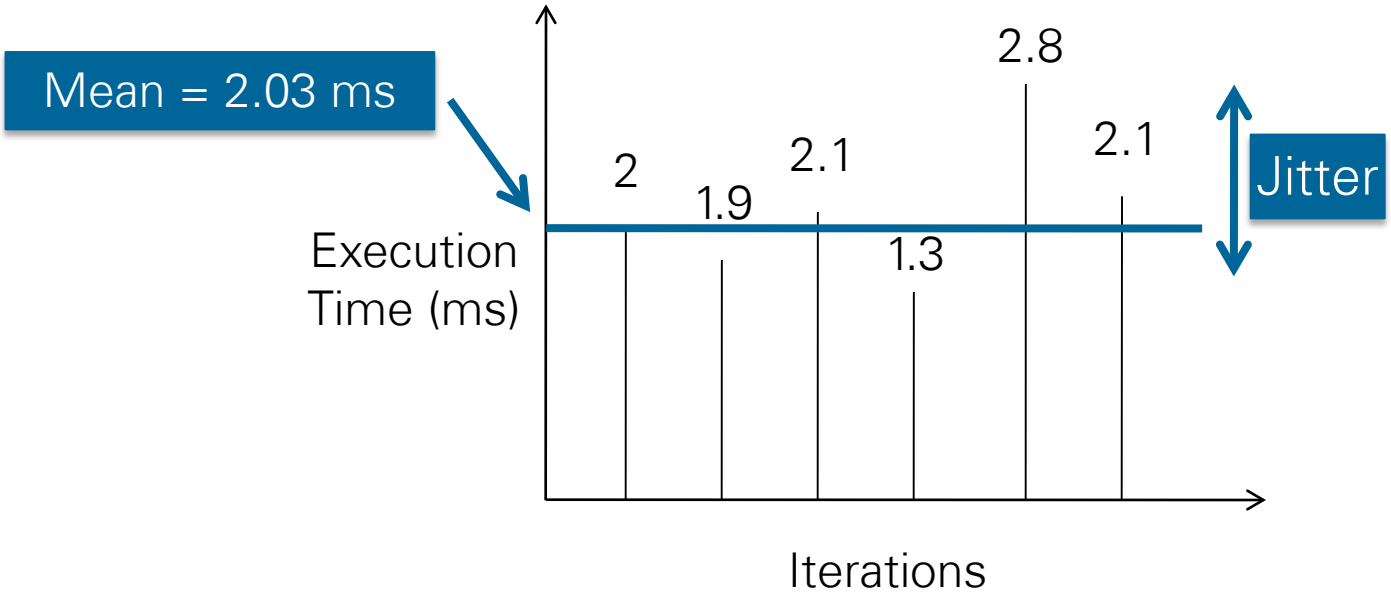
Critical Tests

When General Purpose OSs Fall Short

- Design for fairness and user responsiveness vs. strictly prioritizing tasks
- Focus on multitasking instead of maximum reliability / uptime
- Not the result of bad products, only certain design goals

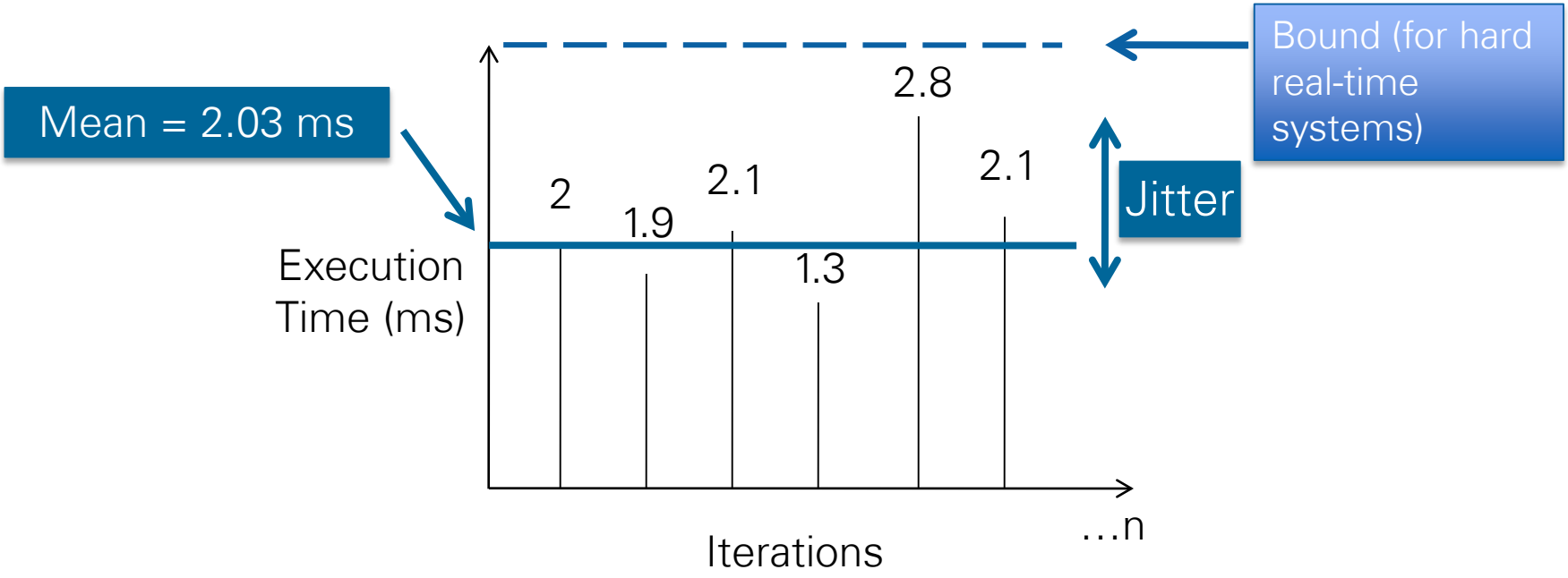
Key Careabouts for Critical Applications

- **Jitter:** execution time variability of a given operation or application

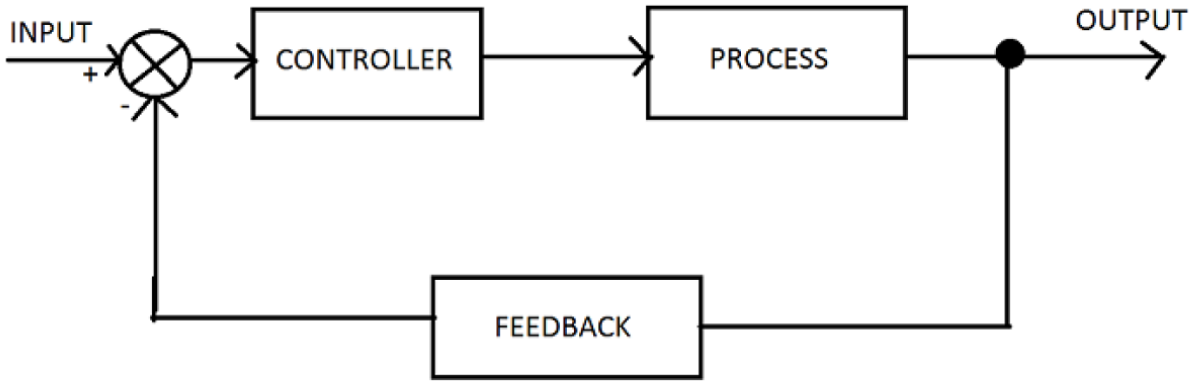


Key Careabouts for Critical Applications

- **Determinism:** a condition that is met if an operation or application has bounded jitter



Control System with myRIO and Labview



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Resources and Next Steps

ni.com
ni.com/students/learn-rio

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Learn More About Programming NI myRIO

http://www.ni.com/academic/students/learn-rio/applications/

LabVIEW LINX Library

LINX provides easy to use Labview VIs for interacting with common embedded platforms like **Arduino**, **Rasperry PI**, **chipKIT** and **myRIO**.

https://www.labviewmakerhub.com/

NI myRIO Kits | ni.com/myrio

Starter

LEDs & switches
7-segment display
Potentiometer
Thermistor
Photo resistor
Hall effect
Microphone/Speaker
Battery holder
DC motor

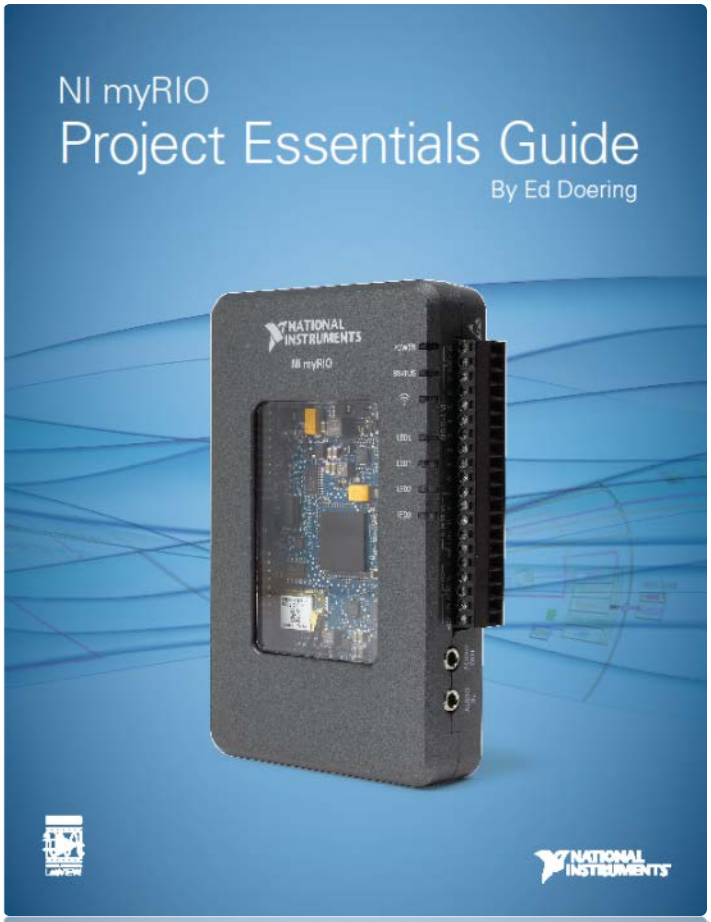
Mechatronics

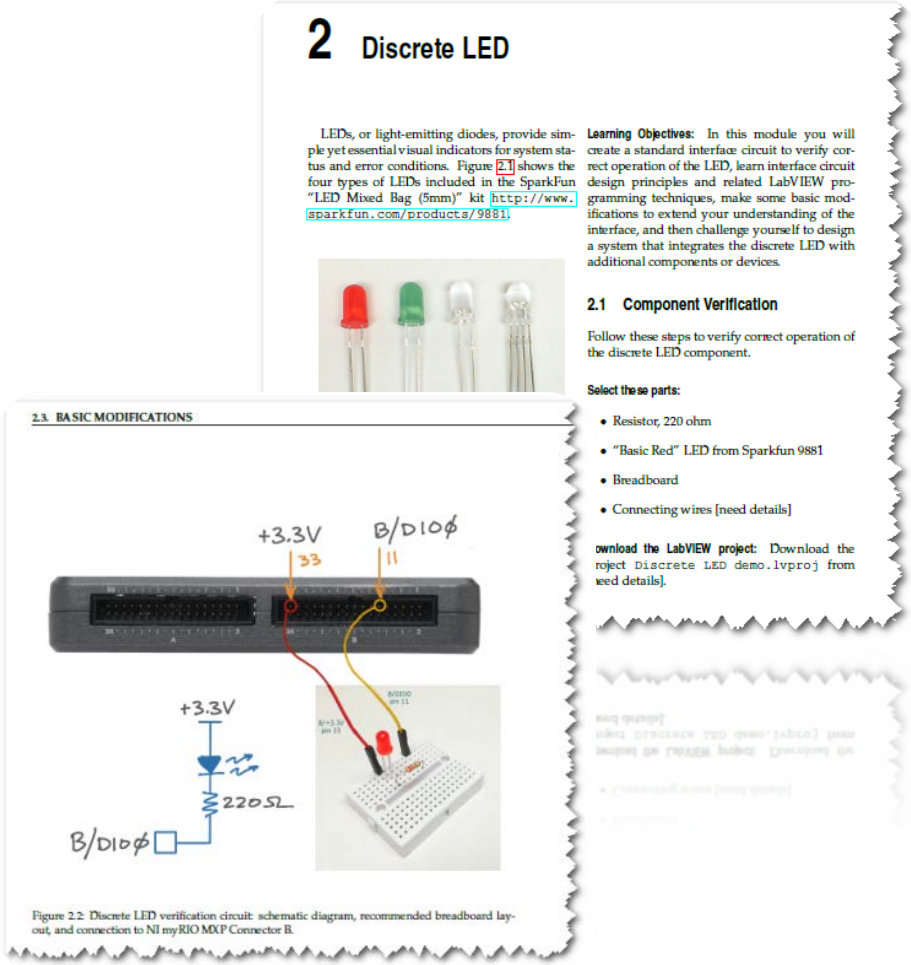
DC gear motors/encoders
H-bridge driver
Accelerometer
Triple-axis gyro
Infrared proximity sensor
Ambient light sensor
Ultrasonic range finder
Compass
Hobby servo motors

Embedded

RFID reader kit
Numeric keypad
LED matrix
Digital potentiometer
Character LCD
Digital temp sensor
EEPROM

NI myRIO | Courseware





2 Discrete LED

LEDs, or light-emitting diodes, provide simple yet essential visual indicators for system status and error conditions. Figure 2.1 shows the four types of LEDs included in the SparkFun "LED Mixed Bag (5mm)" kit http://www.sparkfun.com/products/9881.

Learning Objectives: In this module you will create a standard interface circuit to verify correct operation of the LED, learn interface circuit design principles and related LabVIEW programming techniques, make some basic modifications to extend your understanding of the interface, and then challenge yourself to design a system that integrates the discrete LED with additional components or devices.

2.1 Component Verification

Follow these steps to verify correct operation of the discrete LED component.

Select these parts:

- Resistor, 220 ohm
- "Basic Red" LED from Sparkfun 9881
- Breadboard
- Connecting wires [need details]

ownload the LabVIEW project: Download the roject `Discrete LED demo.lvproj` from eed details].

2.3. BASIC MODIFICATIONS

Figure 2.2: Discrete LED verification circuit: schematic diagram, recommended breadboard layout, and connection to NI myRIO MXP Connector B.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