myRIO: Design Real Systems, Fast

Systems are Everywhere

Tesla Motors

Red Bull Stratos

Space X

Insulin Pump

Elevators

Smartphone

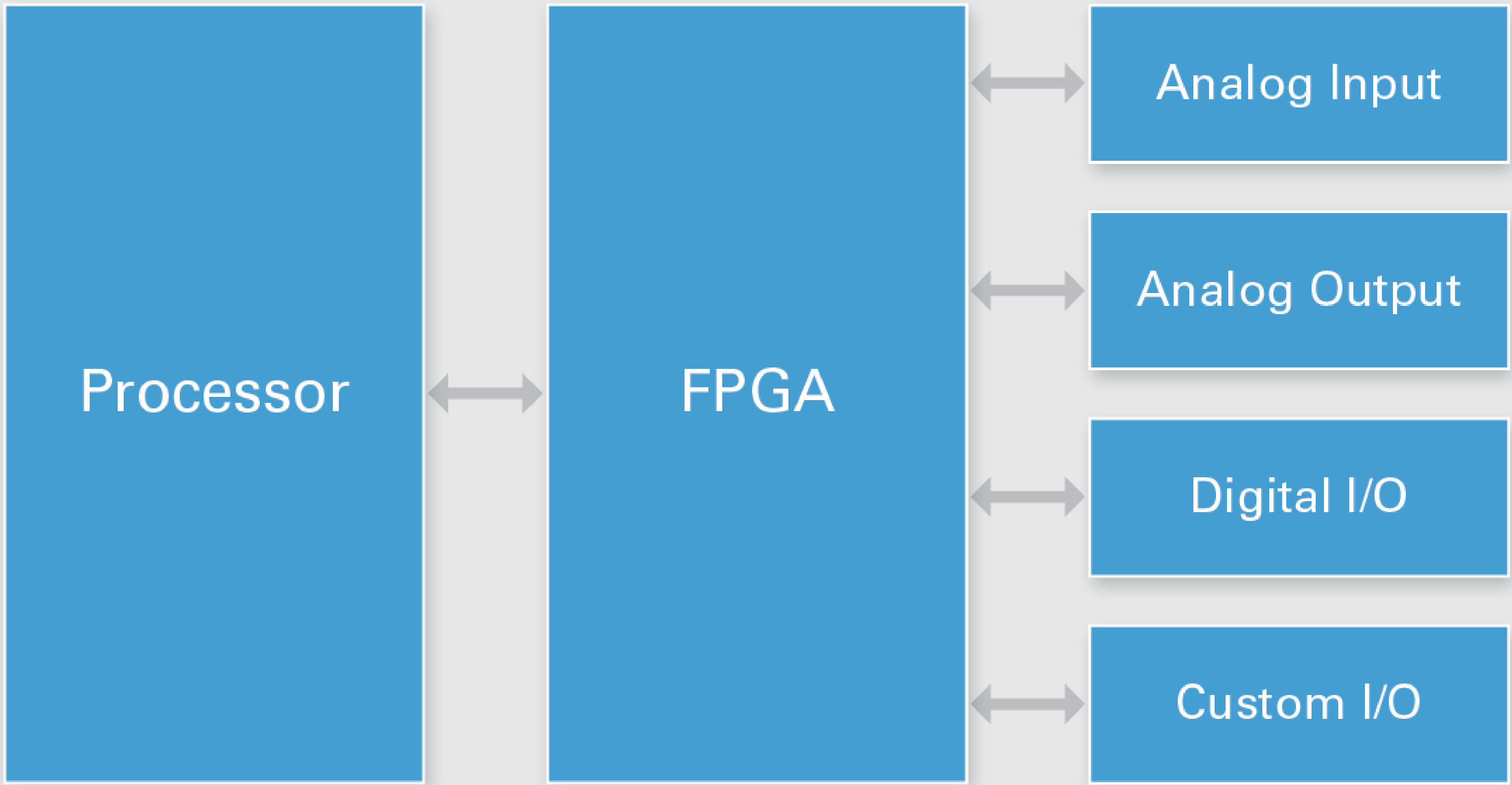
NI CompactRIO and Single-BoardRIO

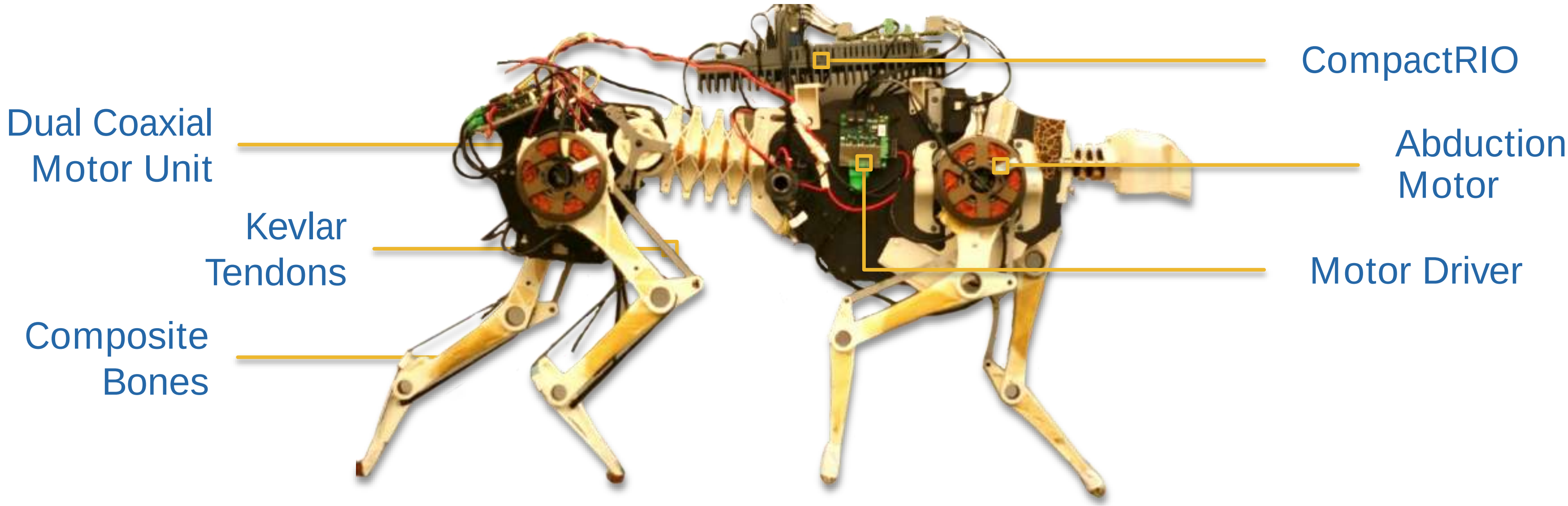
NI CompactRIO

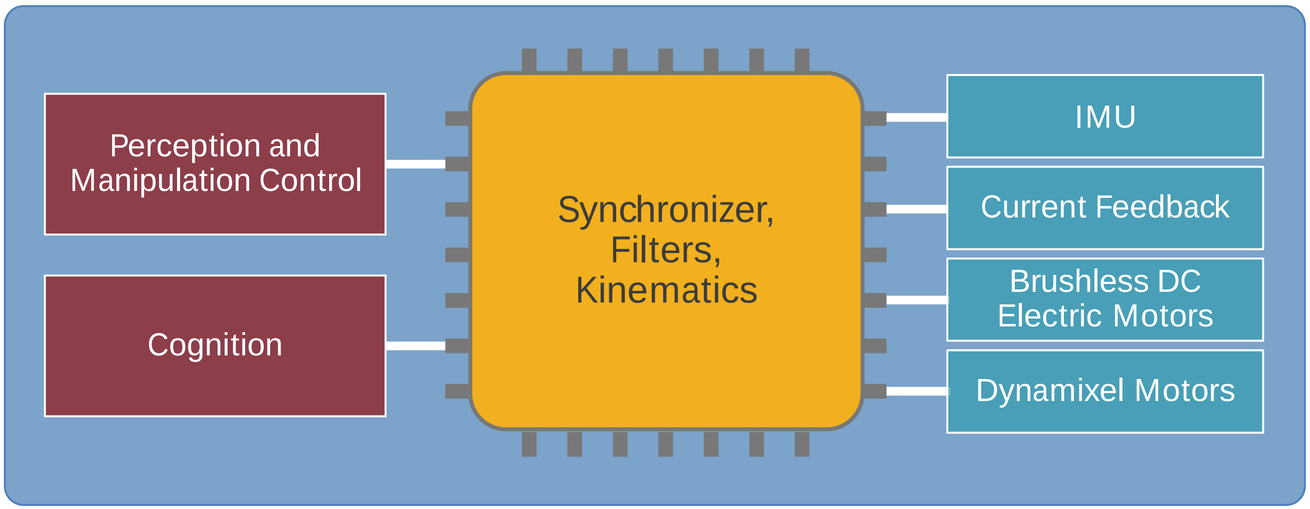
Programmable FPGA and Processor
Real-Time Operating System
Various I/O Count and Type

NI Single-BoardRIO

NI LabVIEW RIO Architecture




CompactRIO
Dual Coaxial Motor Unit
Abduction Motor
Kevlar Tendons
Motor Driver
Composite Bones


Perception and Manipulation Control
Cognition
Synchronizer, Filters, Kinematics
IMU
Current Feedback
Brushless DC Electric Motors
Dynamixel Motors

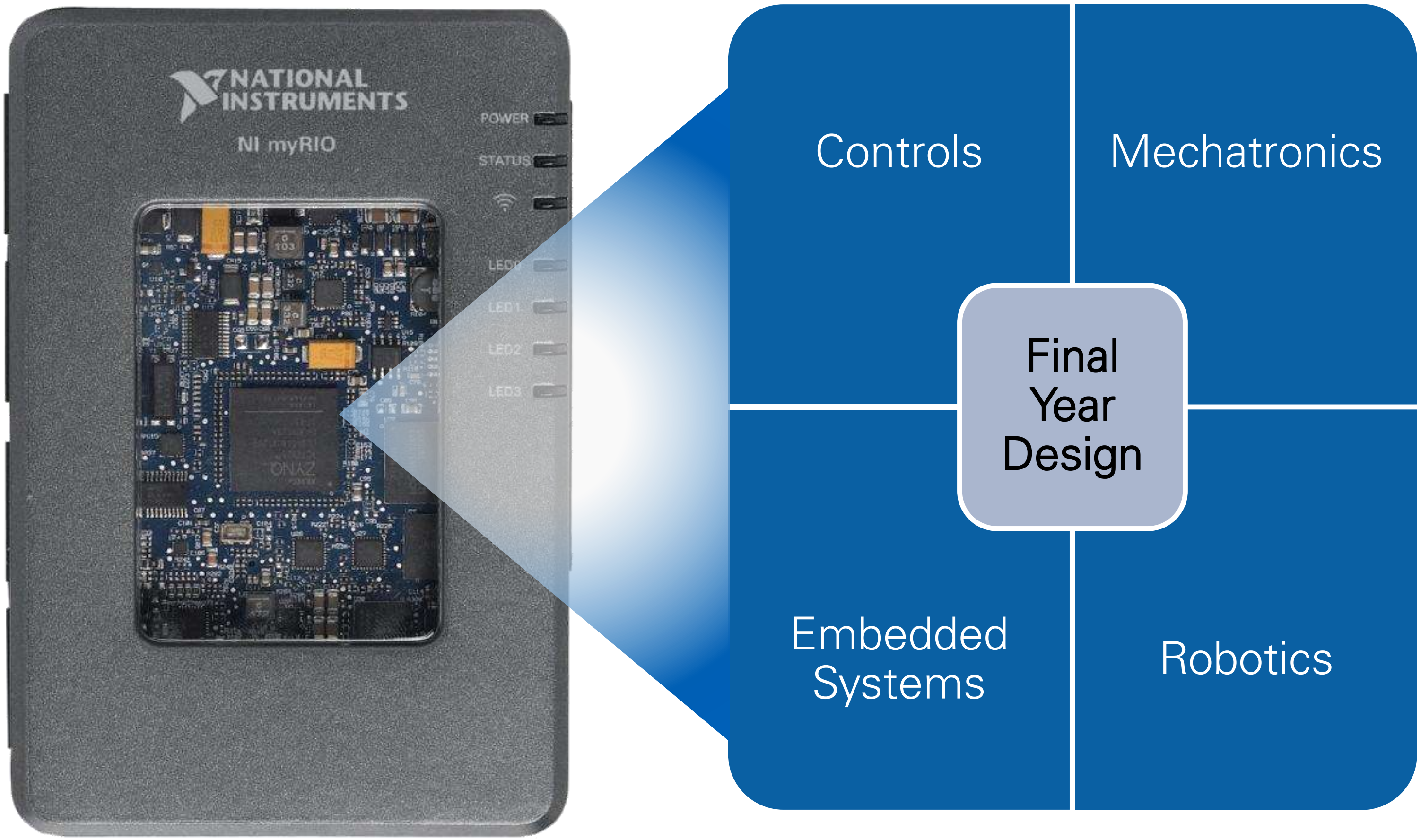
"We have used LabVIEW to develop various aspects of every fuel cell electric vehicle that we produce and to successfully design and implement a real-time embedded control system for an automotive FCS."

Kurt D. Osborne, Ford Motor Company

How Do We Teach Students to Design Systems?


NATIONAL INSTRUMENTS
NI myRIO
POWER
STATUS

From Core Concepts to System Design



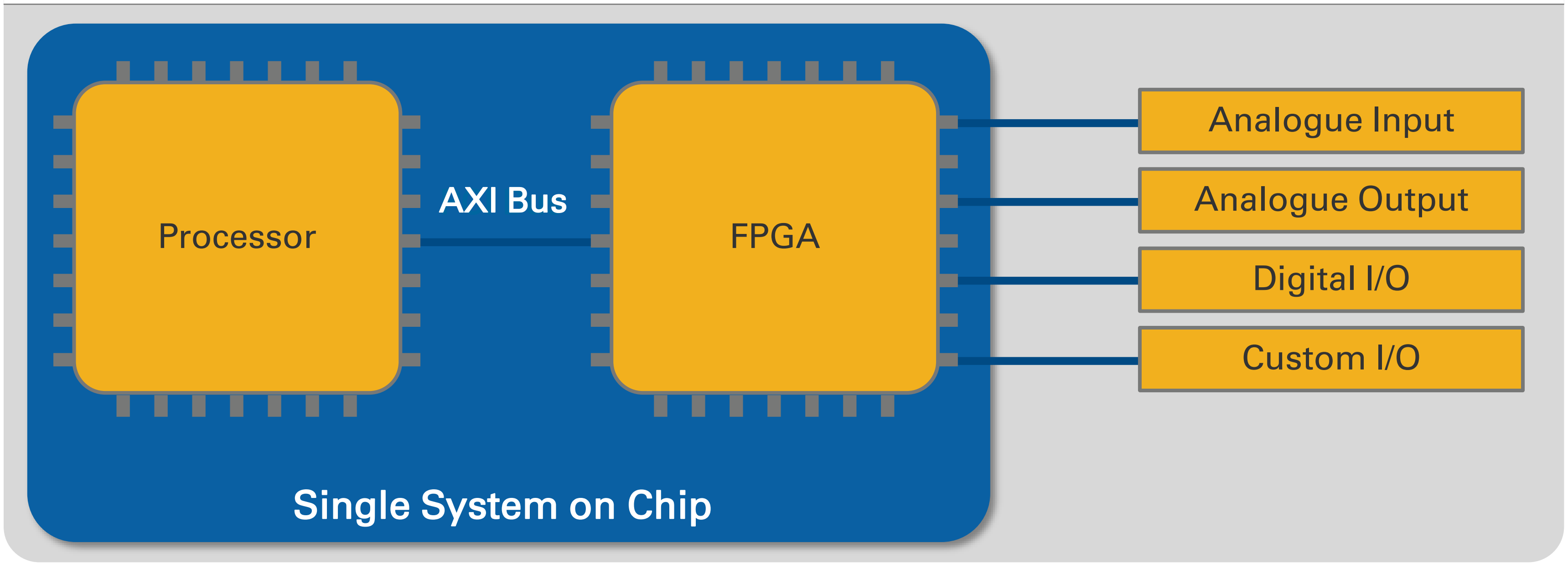
Demonstration

NI myRIO Product Overview

XILINX Zynq

What is Zynq?

Traditional Implementation



Why Zynq Really Matters in Education

Leading Industry Grade Technology

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

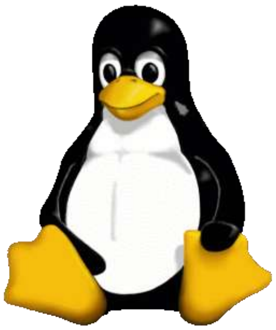
LabVIEW Support for NI Linux Real-Time

LabVIEW Real-Time module supports developing, debugging and deploying to NI Linux Real-Time

- Unlock the vast Linux ecosystem

- Reuse C/C++ code in and alongside LabVIEW Real-Time built applications

- Freedom in connectivity



NI myRIO Product Overview

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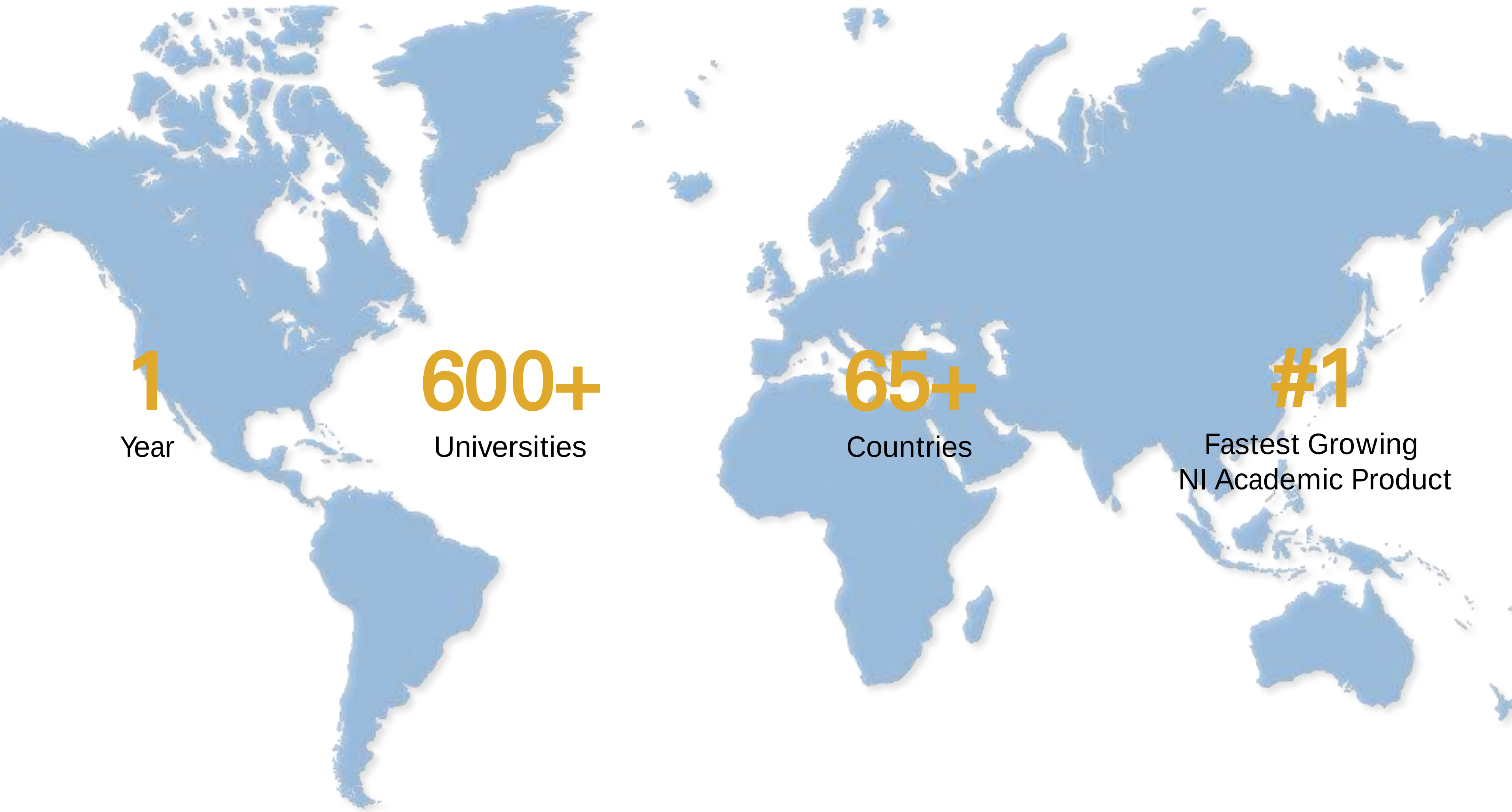
USB and Wi-Fi integration

10 Analog Input
6 Analog Output

40 lines of digital I/O with SPI, I2C, UART, PWM, encoder, etc.

Xilinx Zync FPGA and dual-core ARM Cortex-A9

Demonstration

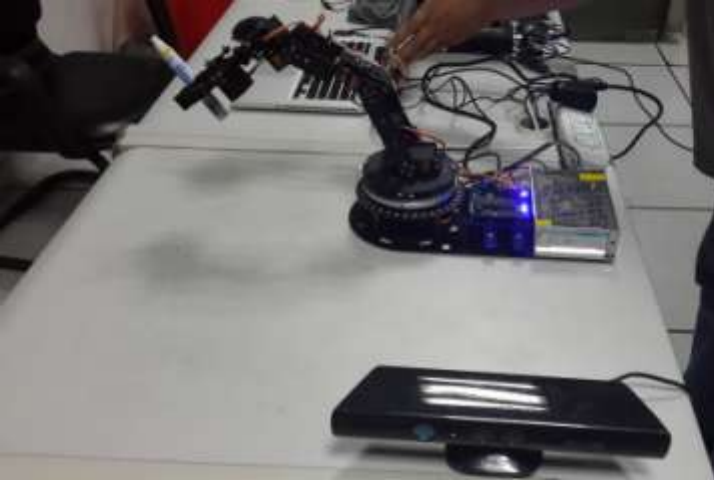
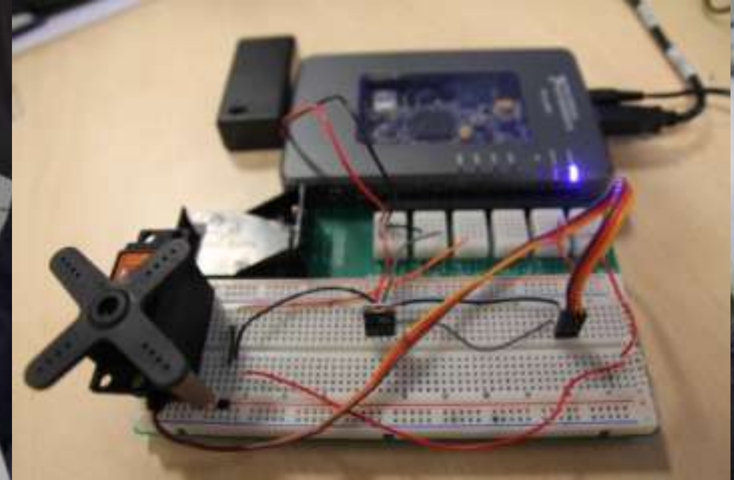


1
Year

600+
Universities

65+
Countries

#1
Fastest Growing
NI Academic Product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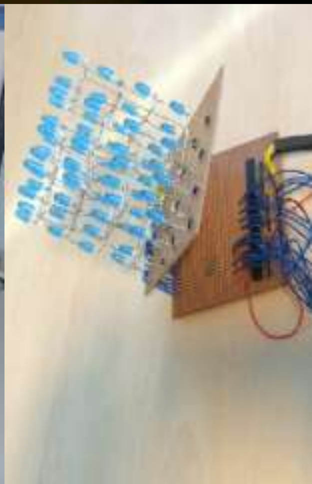
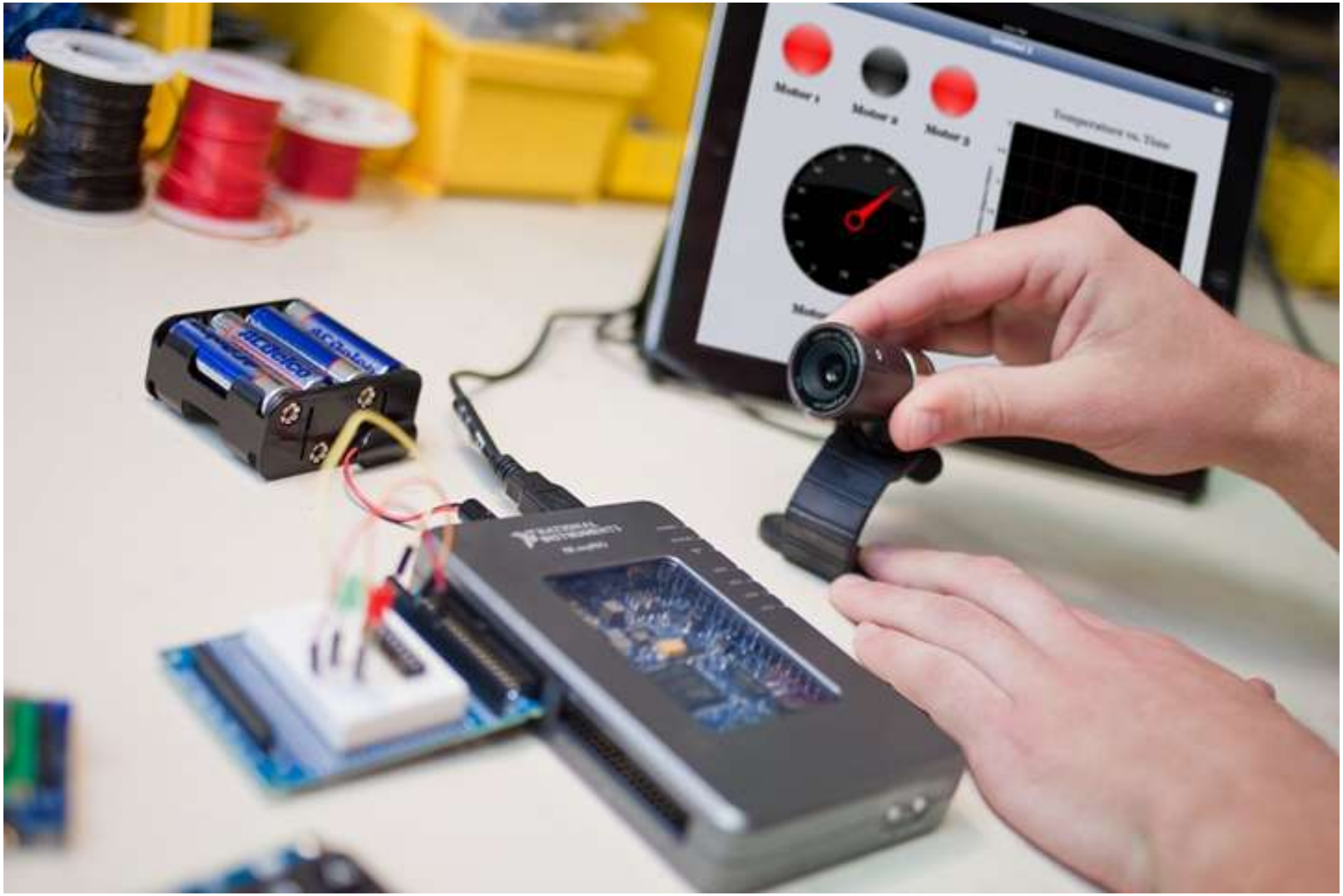
LabVIEW







Demonstration



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NI myRIO Accessory Kits

Starter

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

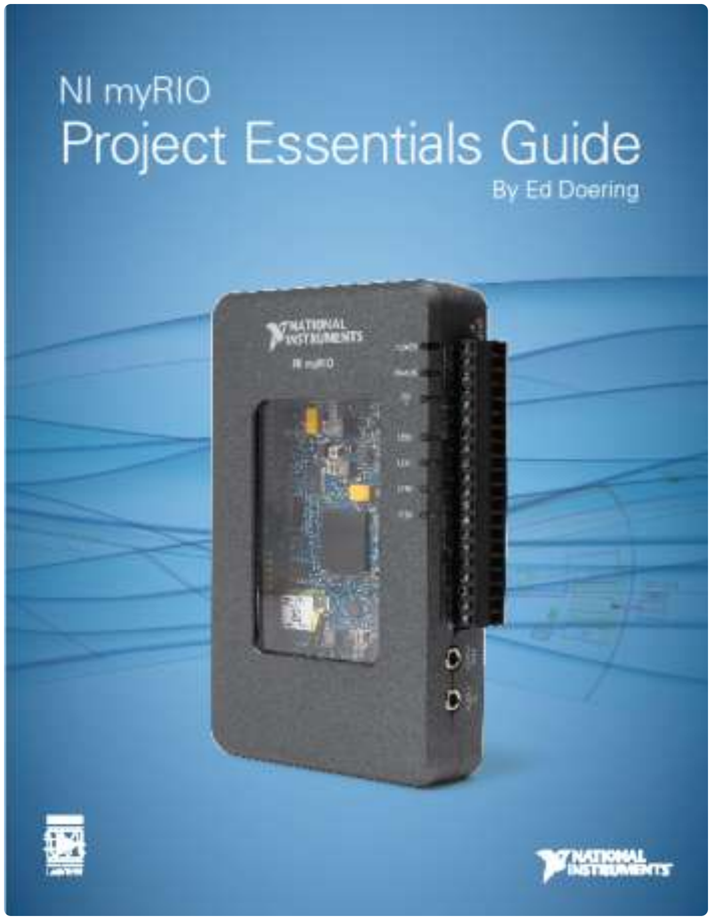
Mechatronics

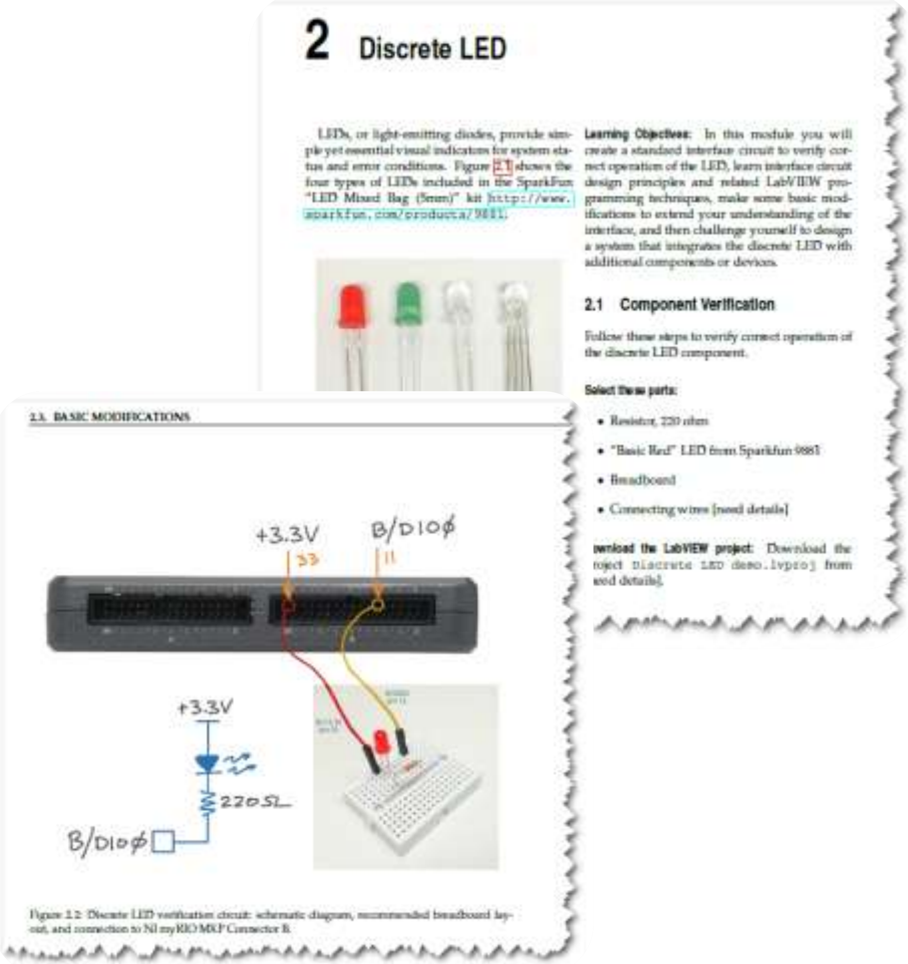
DC gear motors/encoders
H-bridge driver
Accelerometer
Triple-axis gyro
Infrared proximity sensor
Ambient light sensor
Ultrasonic range finder
Compass
Hobby servo motors

Embedded

Numeric keypad
LED matrix
Digital potentiometer
Character LCD
Digital temp sensor
Bluetooth

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]

...wnload 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.

New in 2014 for myRIO

Software

Demonstration

myRIO Apps on the LabVIEW Tools Network

Audio Analyzer
Sprinkler Controller
Position Tracer
Programmable Switch
Oscilloscope/FGEN
Web Messaging
Quiz Buzzer
Voice Remover
Lock-In Amplifier
Tilt Sensor
LED PWM API
Pedometer
Visual Edge Detector

NATIONAL INSTRUMENTS

Demonstration

Introducing myRIO Apps on
the LabVIEW Tools Network

New in 2014 for myRIO

Hardware

Quanser QUBE-Servo

Magnetic quick connect interface

Inertial disk module

Sturdy, precision-machined aluminium housing

Encoder angle sensed inverted pendulum module

Brushed DC motor with optical encoder

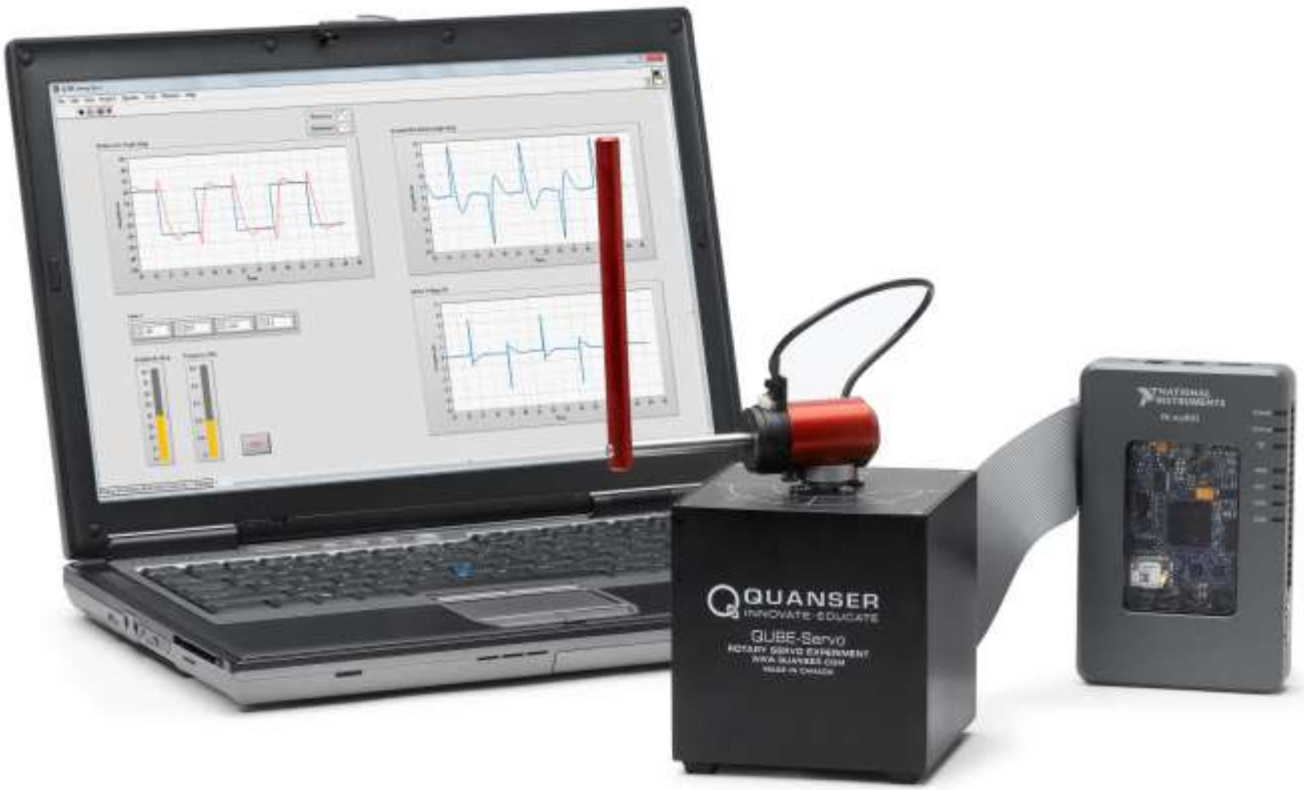
Textbook Mapping Guide

QUBE-Servo Curriculum Textbook Mapping	Norman S. Nise *Control Systems Engineering* [illegible] Edition [illegible]	Karl Johan Åström Richard M. Murray *Feedback Systems* Electronic Edition [illegible] [illegible]	Gene F. Franklin J. David Powell Abbas Emami-Naeini *Feedback Control of Dynamic Systems* [illegible] Edition [illegible]	Richard C. Dorf Robert H. Bishop *Modern Control Systems* [illegible] Edition [illegible]	Katsuhiko Ogata *Modern Control Engineering* [illegible] Edition [illegible]	Farid Golnaraghi Benjamin C. Kuo *Automatic Control Systems* [illegible] Edition [illegible]	I.J. Nagrath M. Gopal *Control Systems Engineering* [illegible] Edition [illegible]	W. Bolton *Mechatronics* [illegible] Edition [illegible]
Integration Lab			p. 577 (Hardware Characteristics)			p. 195 (Incremental Encoder)	p. 146-148 (Optical Encoders)	p. 26-30 (Encoders) p. 110-112 (DAQs and LabVIEW) p. 254-261 (MATLAB/Simulink)
Filtering Lab		p. 308 (Filtering the Derivative)	p. 371 (Design Considerations)	p. 246-247 (Measurement Noise Attenuation)		p. 411 (Frequency Response of Closed-Loop Systems) p. 497 (Summary of Effects of PD Control)		p. 66-67 (Filtering)
Bump Test Lab	p. 166-168 (First-Order Transfer Functions via Testing)	p. 47-48 (Modeling from Experiments)			p. 161-162 (Unit-Step Response of First-Order Systems)	p. 83-84 (First-Order Prototype System)	p. 197-198 (Time Response of First-Order Systems)	[illegible]
First Principles Modeling Lab	p. 79-84 (Electromechanical System Transfer Functions)	p. 26-31 (Modeling Concepts)	p. 47-49 (Modeling a DC Motor)	p. 70-74 (Transfer Function of the DC motor)	p. 95-97 (A-3-9) (Mathematical Modeling of Mechanical Systems and Electrical Systems)	p. 198-205 (DC Motors in Control Systems)	p. 135-137 (DC Servomotors)	[illegible]
Second Order Systems Lab	p. 173-186 (The General Second-Order System)	p. 183-185 (Second-Order Systems) p. 233-236 (Damped Oscillator)	p. 111-113 (Effect of Pole Locations)	p. 308-314 (Performance of Second-Order Systems)	p. 164-179 (Second-Order Systems)	p. 275-288 (Transient Response of a Prototype Second-Order System)	p. 199-210 (Time Response of Second-Order Systems)	[illegible] [illegible] (Frequency Response for a Second-Order System)
PD Control Lab	p. 470-477 (Ideal Derivative Compensation) p. 500-503 (Minor-Loop Feedback Compensation)	p. 293-298 (PID Control)	p. 186-191 (The Three-Term Controller: PID Control) p. 184-185 (System Type for a DC Motor Position Control)	p. 480-488 (PID Controllers)	p. 567-569 (PID Control) p. 590-591 (PI-D Control)	p. 289-293 (Speed and Position Control of a DC Motor) p. 492 (Design of the PD Controller) p. 314-318 (Basic Control Systems Utilizing Addition of Poles and Zeros)	p. [illegible]-219 (Derivative Error Compensation) p. 477-483 (Tuning of PID Controllers)	p. 288-290 (Derivative Control) p. 297-299 (Control System Performance) p. 301-302 (Velocity Control)
Stability Analysis Lab	p. 303-305 (Stability)	p. 162-167 (Stability)	p. 108 (Effect of Pole Locations) p. 130-133 (Stability)	p. 387-390 (The Concept of Stability)	p. 182 (Stability Analysis in the Complex Plane)	p. 73 (Bounded-Input, Bounded-Output (BIBO) Stability) p. 74 (Relationship Between Characteristic Equation Roots and Stability)	p. 270-275 (The Concept of Stability)	p. 276-279 (Stability)
Pendulum Modeling Lab	p. 142 (Simple Pendulum)	p. 36 (Cart-Pendulum System)	p. 32 (Pendulum) P.37 (Inverted Pendulum)		p. 68 (Inverted Pendulum System)	p. 227 (Inverted Pendulum on Cart)	p. 42-43 (Dynamics of Robot Mechanisms)	

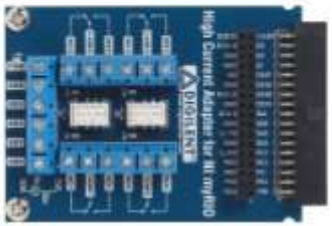
Åström and Murray Wikibook *Feedback Systems*

NATIONAL INSTRUMENTS

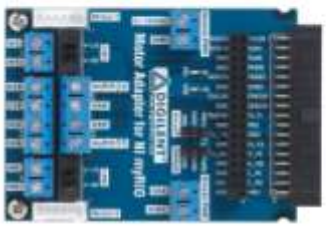
Demonstration



myRIO Hardware Ecosystem



High Current



Motors

Control Plant

NXT Sensors

Shield Adapter

CAN


Do Engineering