

2004

CompactRIO

A Decade of Innovation

2014



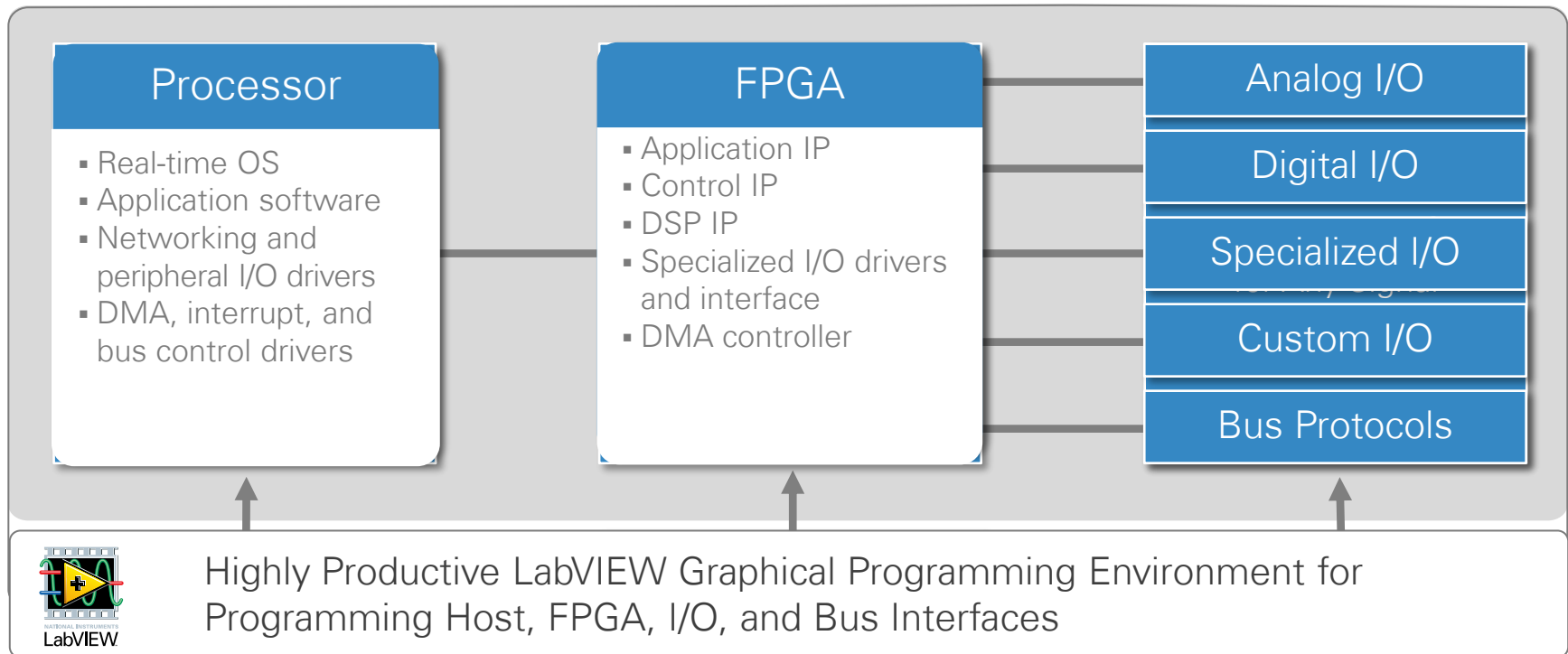
Simplify System Complexity

With the new high-performance CompactRIO controller

NI CompactRIO The NI Approach to Flexible Hardware

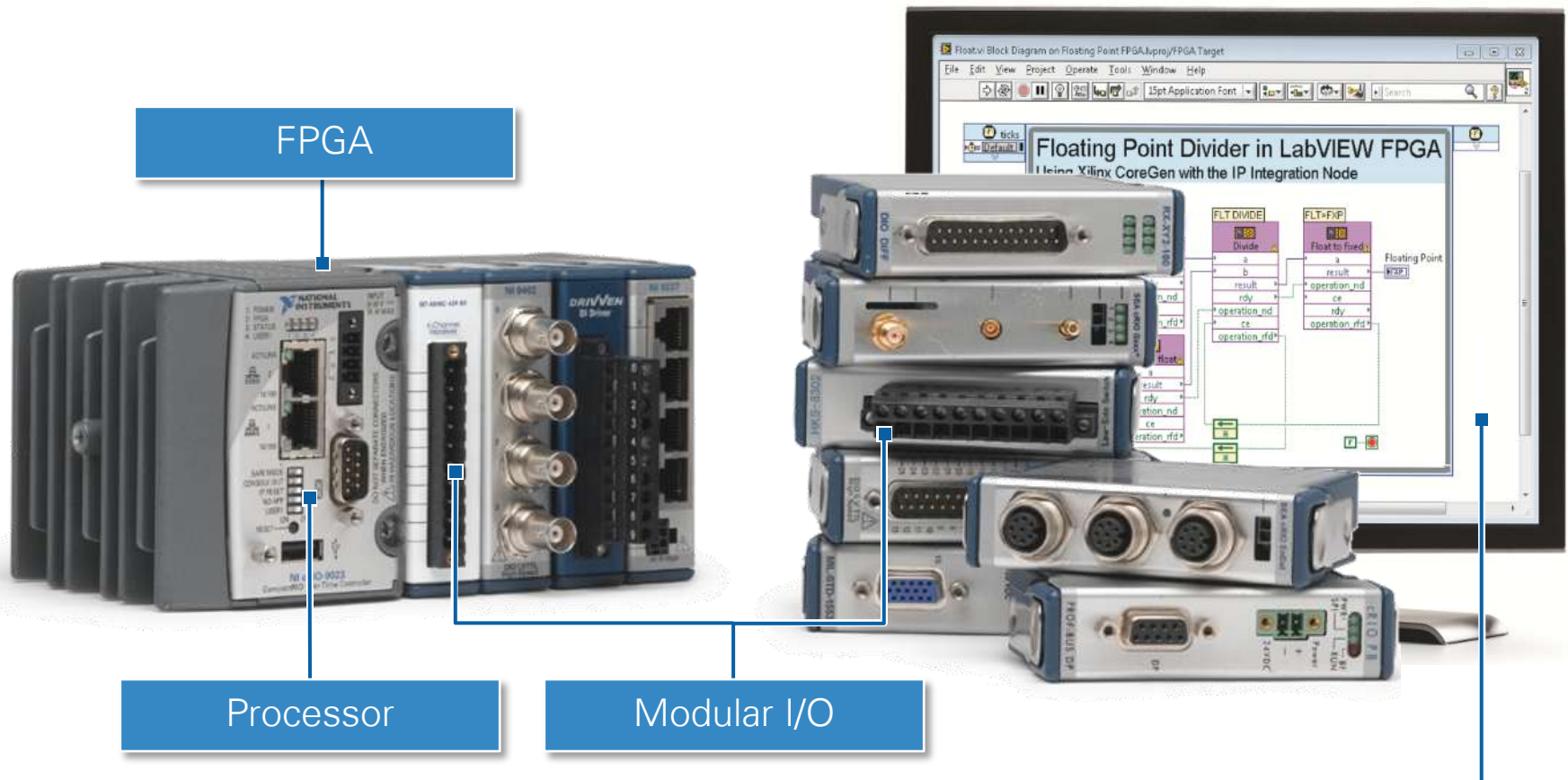
The World's Only Software Designed Controller

We call this the LabVIEW RIO Architecture.



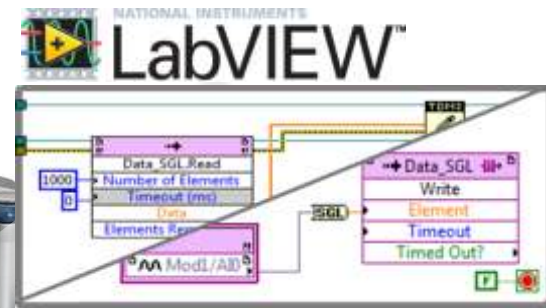
NI CompactRIO

The Worlds Only Software Designed Controller



Extreme Ruggedness: -40 to 70 °C temperature range; 50 g shock, 5 g vibration
Highly Productive: LabVIEW Graphical Programming Environment for
High Performance: Up to 1.33 GHz dual-core i7 processor
Comprehensive I/O: Analog, digital, custom, specialty, bus communication

New Performance CompactRIO



NI LabVIEW System Design

- Program with LabVIEW Real-Time and LabVIEW FPGA modules
- Quickly port existing LabVIEW applications

High Throughput and Performance

- Dual-Core Intel Atom 1.33 GHz processor
- Xilinx Kintex-7 FPGAs with up to 325k logic cells
- 16 DMA FIFO channels for data streaming

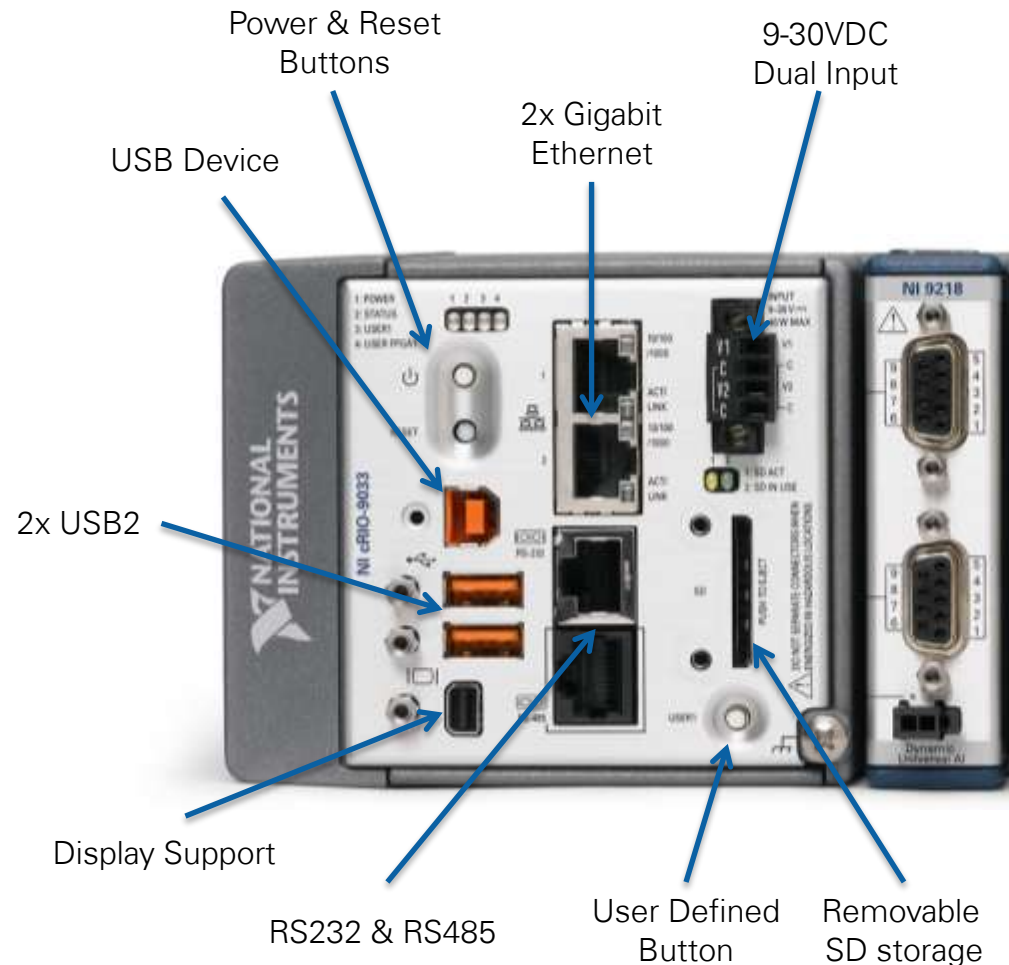
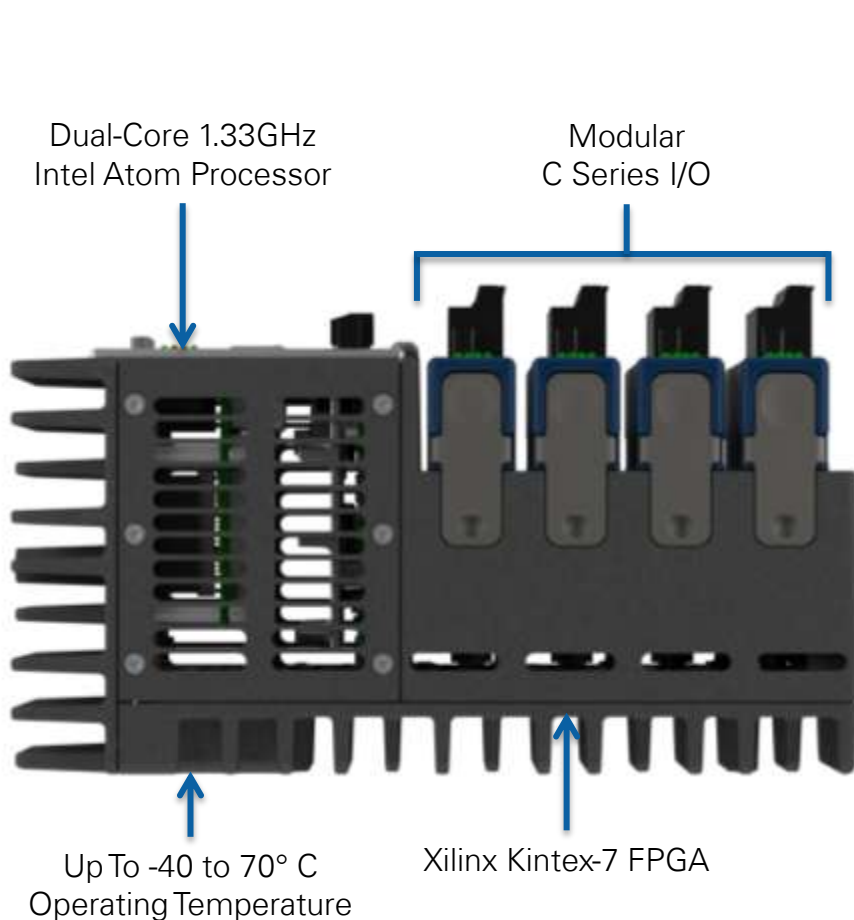
Simplify System Complexity

- Embedded UI driven by NI Linux Real-Time
- Integrate vision with FPGA co-processing
- Removable SDHC data storage

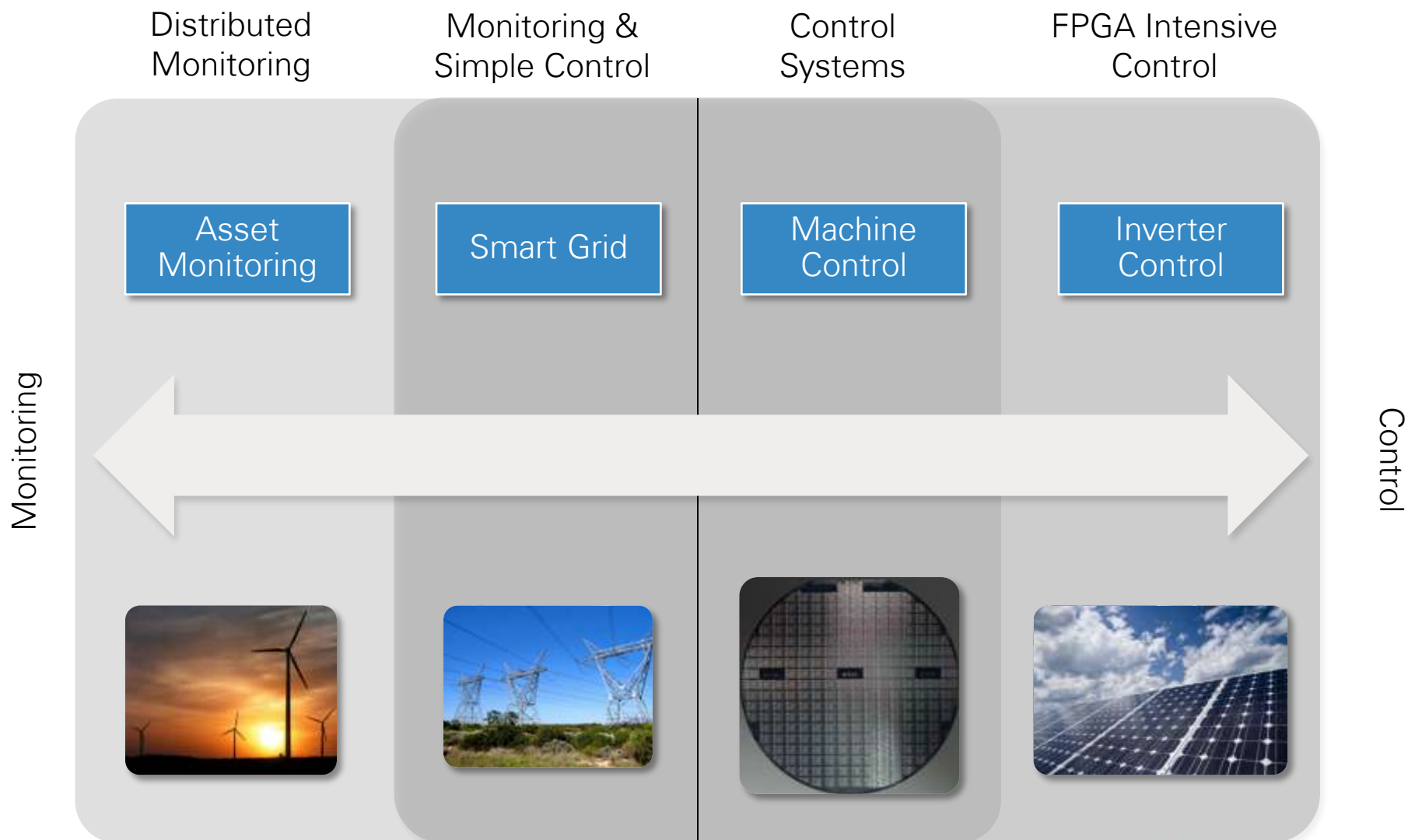
Community and Code Reuse

- NI Linux Real-Time Operating System
- Integrate existing applications and libraries
- Develop, debug, and deploy C/C++ code

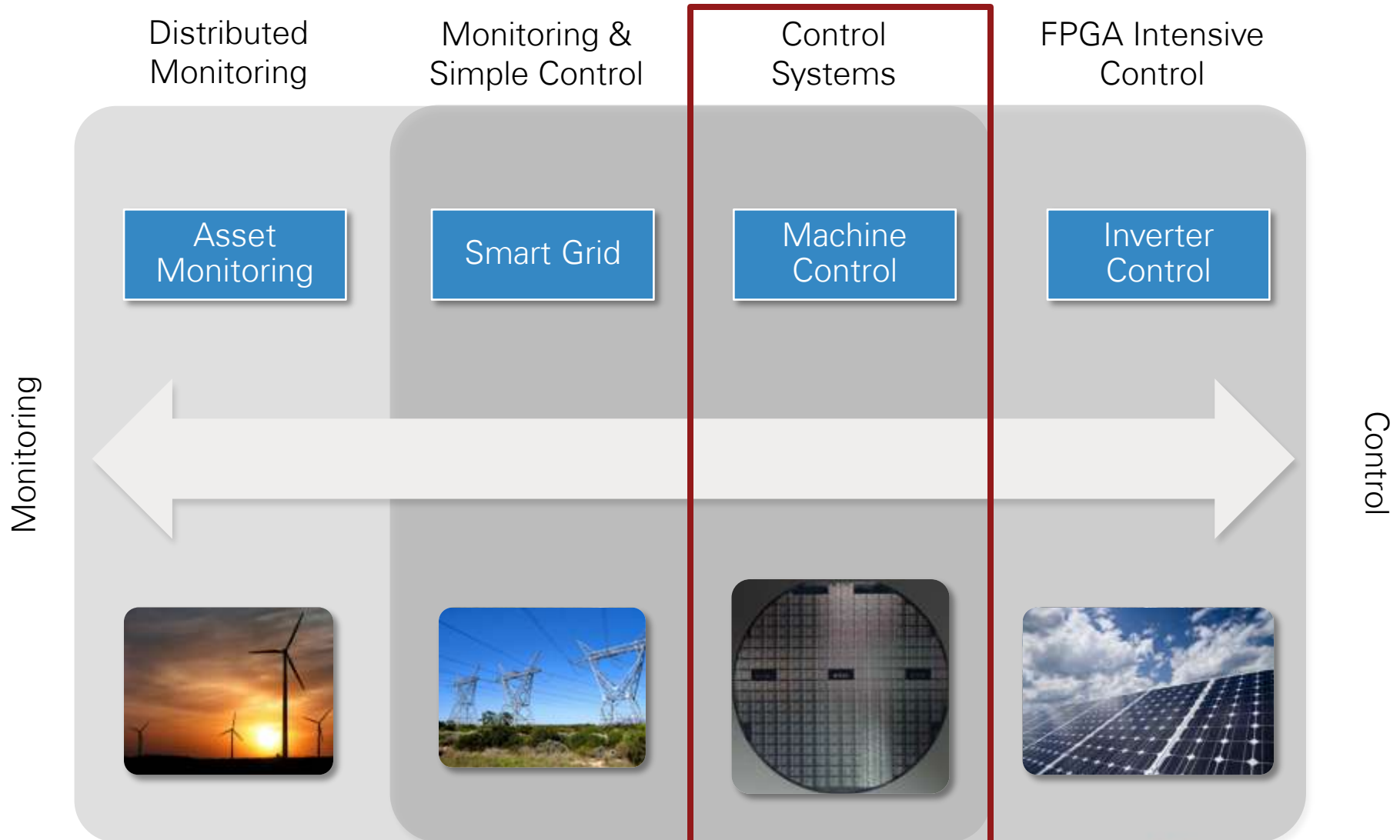
New Performance CompactRIO At-A-Glance



Embedded Control and Monitoring Applications



Embedded Control and Monitoring Applications



Embedded Control and Monitoring Applications

Distributed
Monitoring

Monitoring &
Simple Control

Control
Systems

FPGA Intensive
Control

Heavy Equipment

Smart Machines



Electron Beam Welding Machine

Description

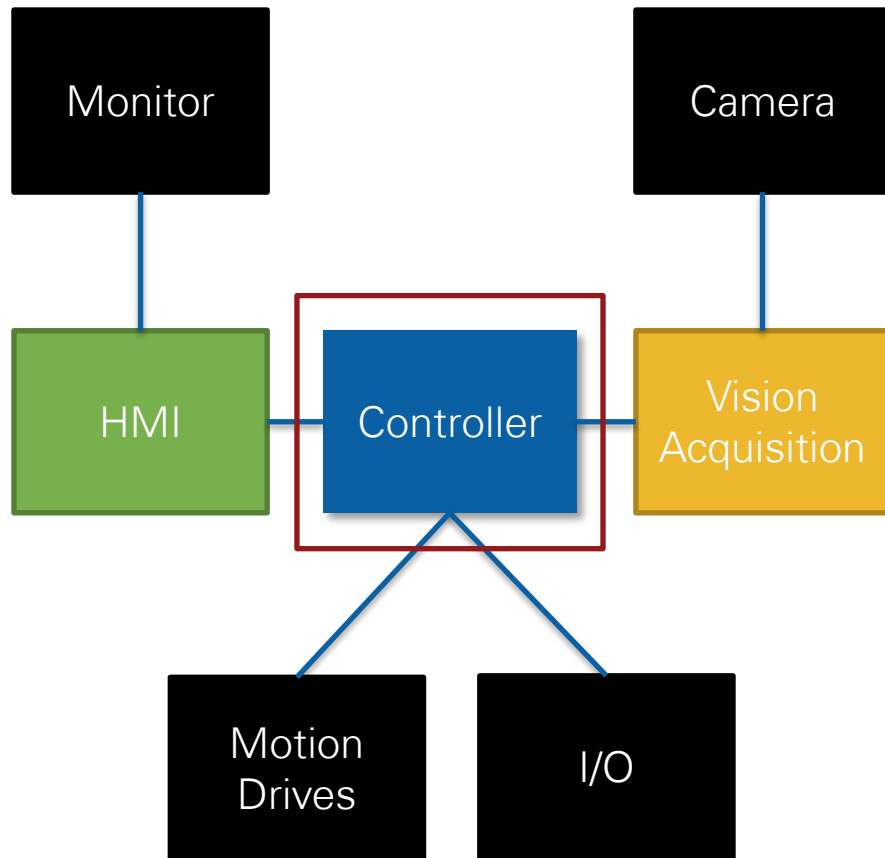
- Electron beam control
- Multiple axis of motion
- Vision guidance
- Local HMI

Challenges

- Increasingly complex control algorithms
- Complicated subsystem integration
- Additional design tools
- Time-to-market pressures



Electron Beam Welding Machine



Intel Atom Dual-Core Processor

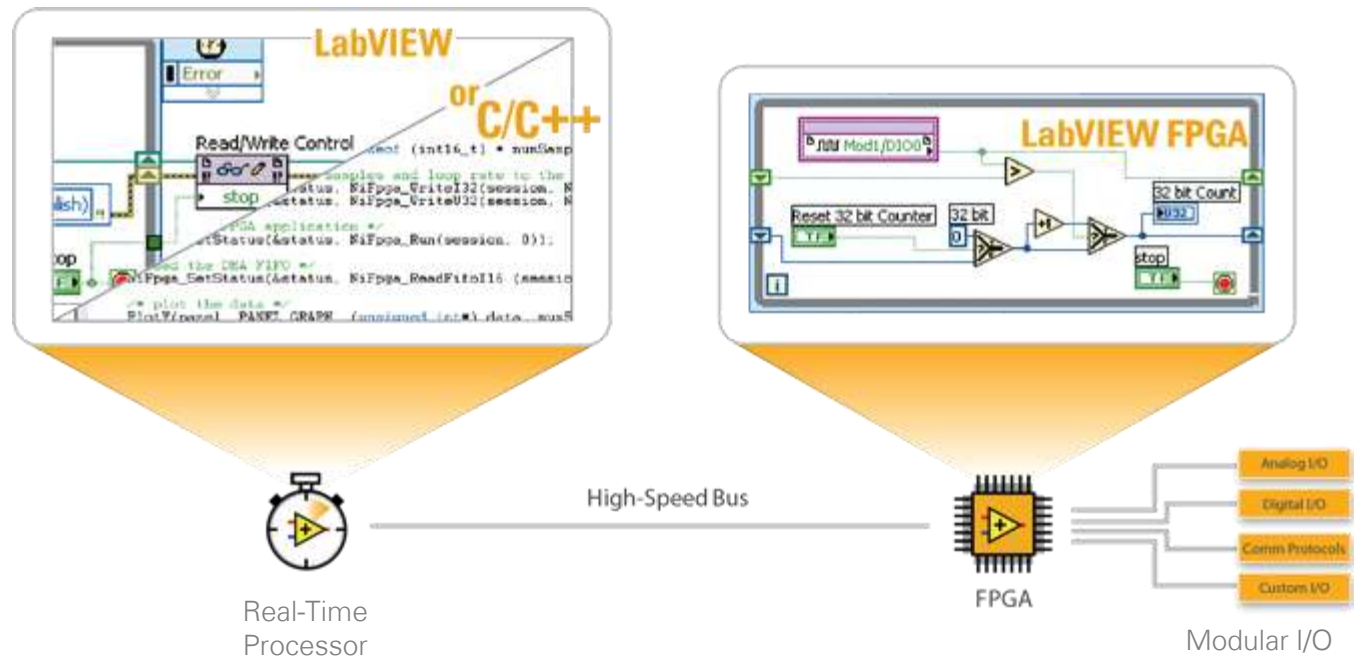
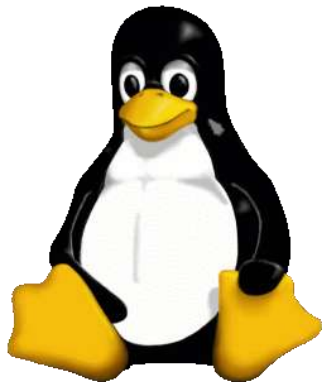


- Cutting edge Intel system-on-chip (SoC) with Silvermont microarchitecture
- High performance, low power, compact size and industrial temperature range
- Rich array of peripherals including GPU, PCIe, and USB (host and device)

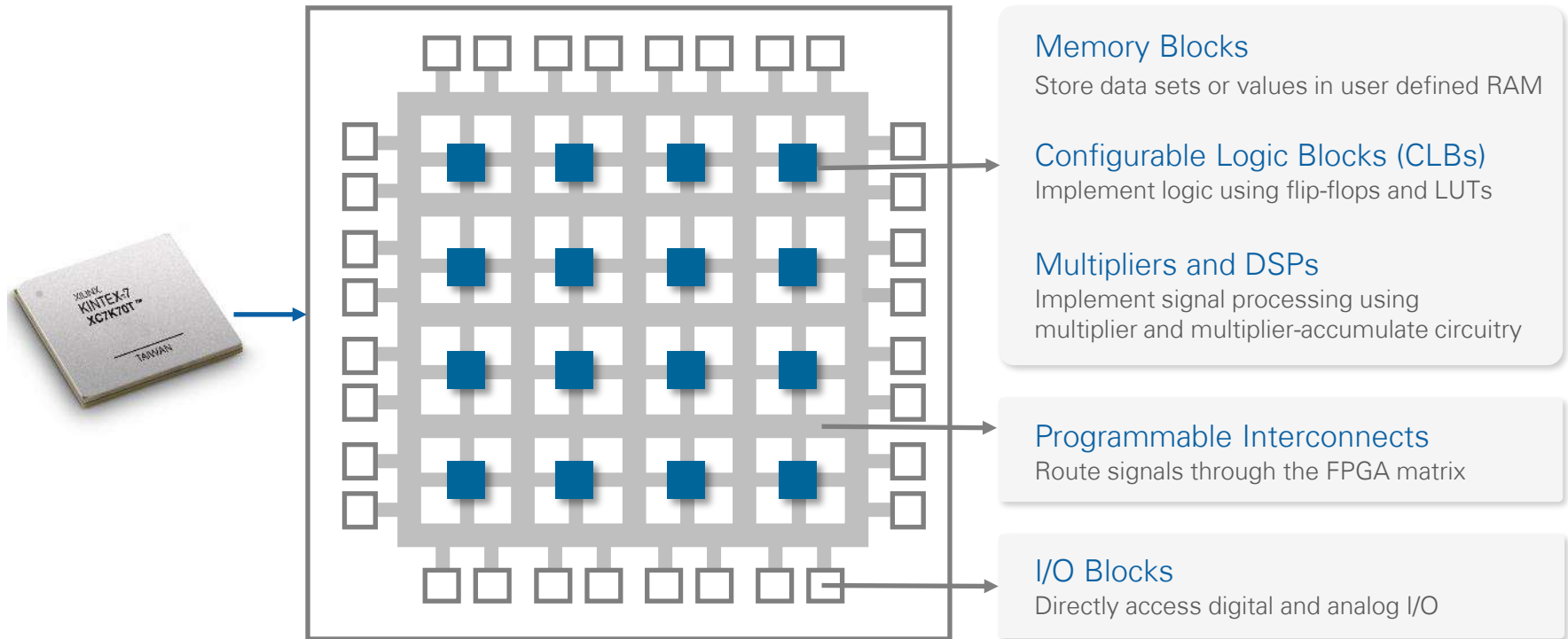
Core Speed	1.33 GHz
Cores	2
L2 Cache	1 MB
Graphics Frequency	533 MHz
Memory	64-bit DDR3L-1066
Memory Density	1 GB or 2 GB

Support for NI Linux Real-Time OS

- Enjoy the **flexibility** of Linux, with the **determinism and reliability** of a real-time operating system.
- **Reuse** C/C++ code in or alongside LabVIEW Real-Time built applications on the latest CompactRIO controllers



Field-Programmable Gate Array (FPGA)



Don't Think You Need an FPGA? Think Again!

– 3 Reasons to Augment your Application with an FPGA –

Future-Proof Your Design

Adapt to changing requirements, evolution of projects

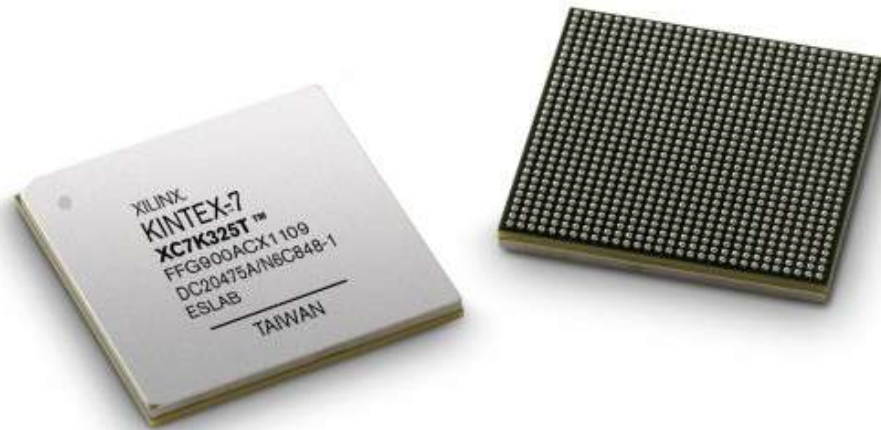
Maximize Reliability and Determinism

For time-critical, safety-critical, and deployed systems

Enhance Performance & Improve Functionality

Offload processing, Ultra-fast control, Custom timing...

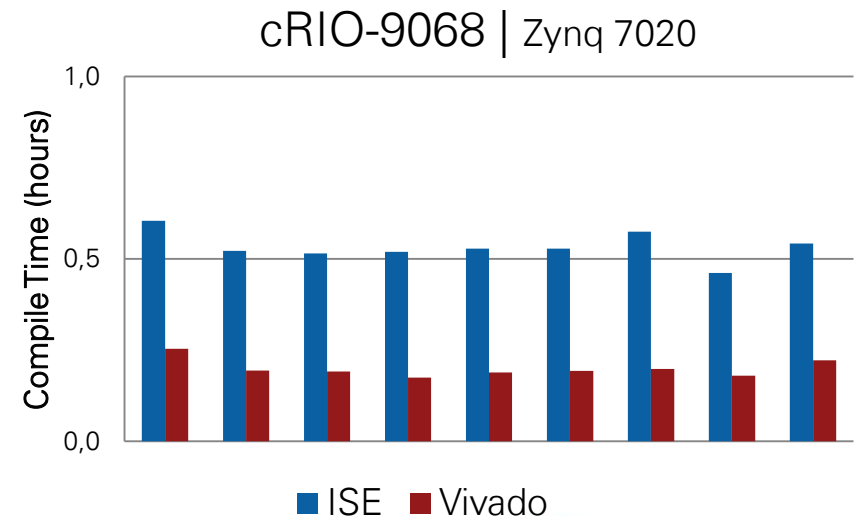
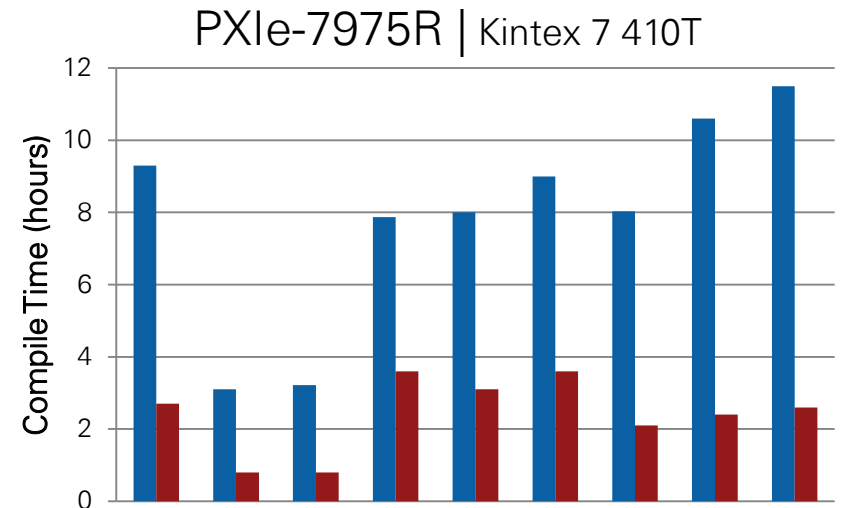
Xilinx Kintex-7 Field Programmable Gate Array



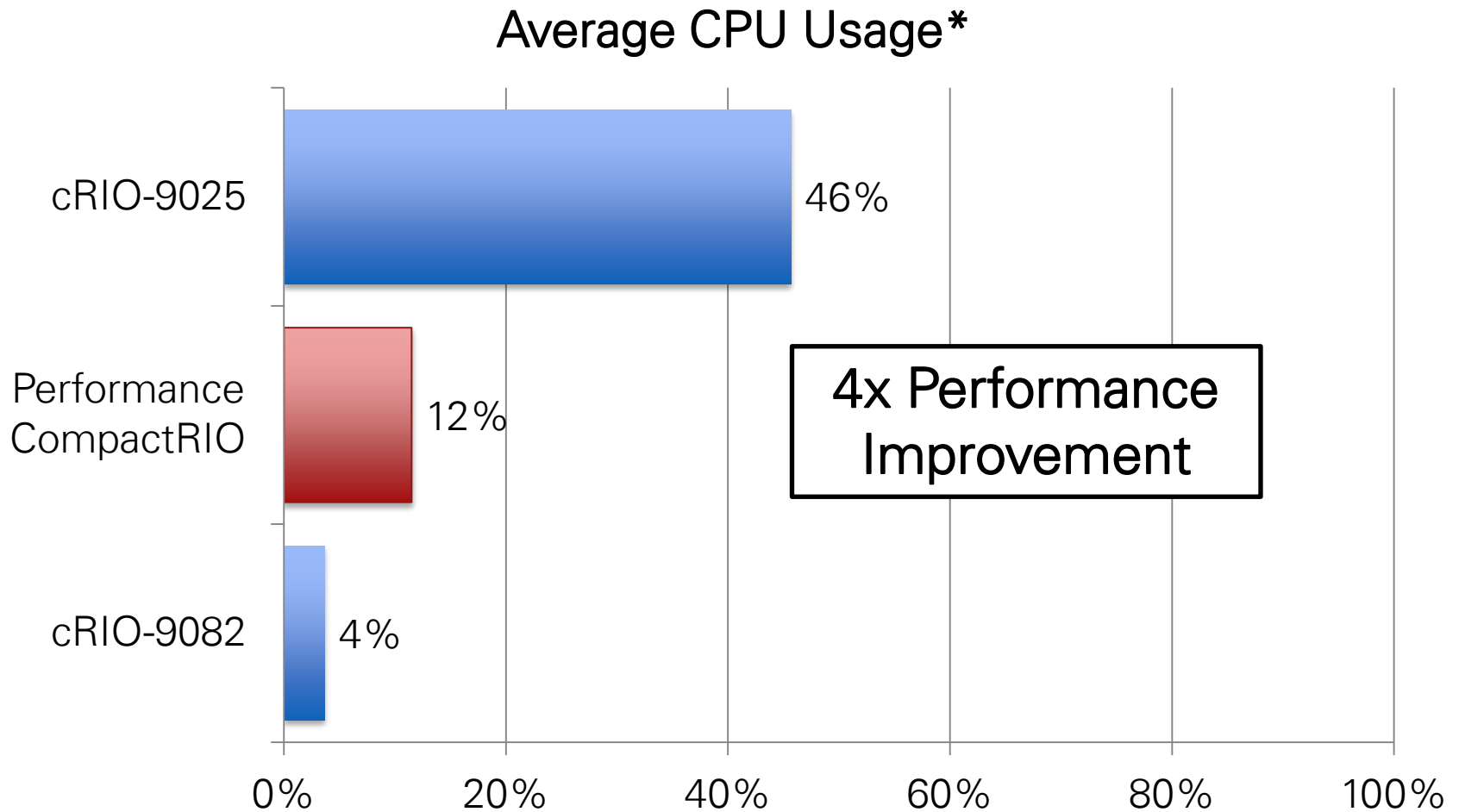
- Almost 3X more CLBs and more than 13X more DSP slices than existing CompactRIO systems
 - Result: Process more channels, develop more complex algorithms, and perform more tasks in FPGA than ever before!
- 16 DMA FIFOs with 250MB/s aggregate streaming bandwidth in both directions
 - Result: You have the freedom to transfer data the way you want.

2-5x Reduction in Compilation Times with Vivado

- LabVIEW FPGA 2014 includes Xilinx Vivado compilation tools for Kintex-7 FPGAs, offering the following benefits:
 - Reliable timing closures
 - Improved resource utilization
 - 2-5x reduction in compilation times

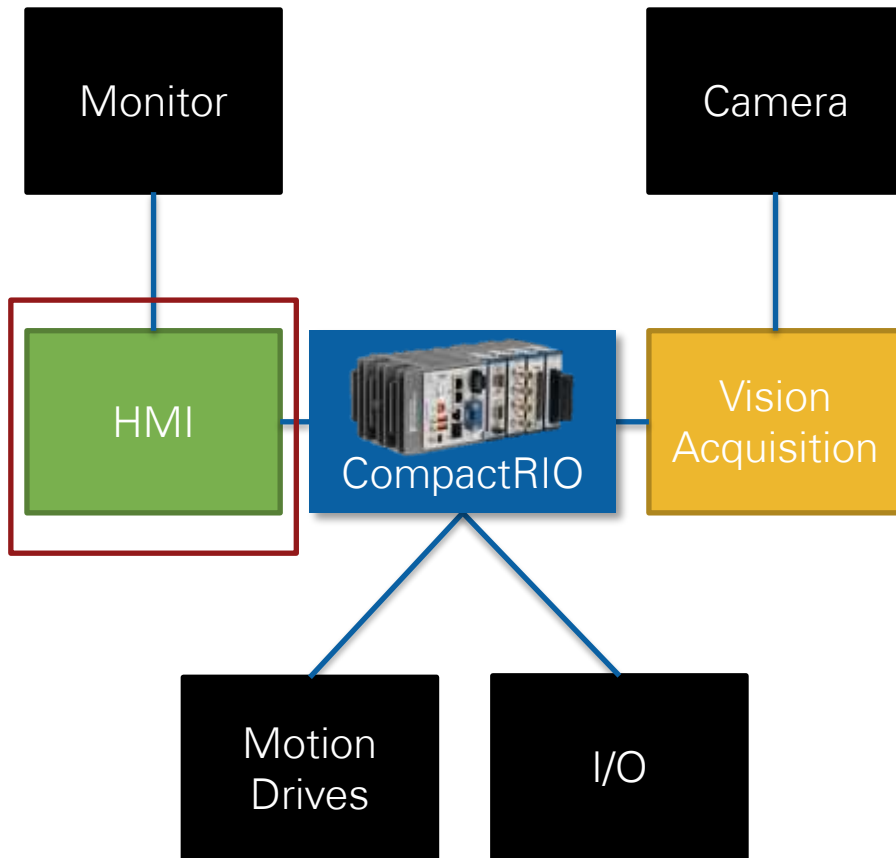


Complex Control Application Benchmark



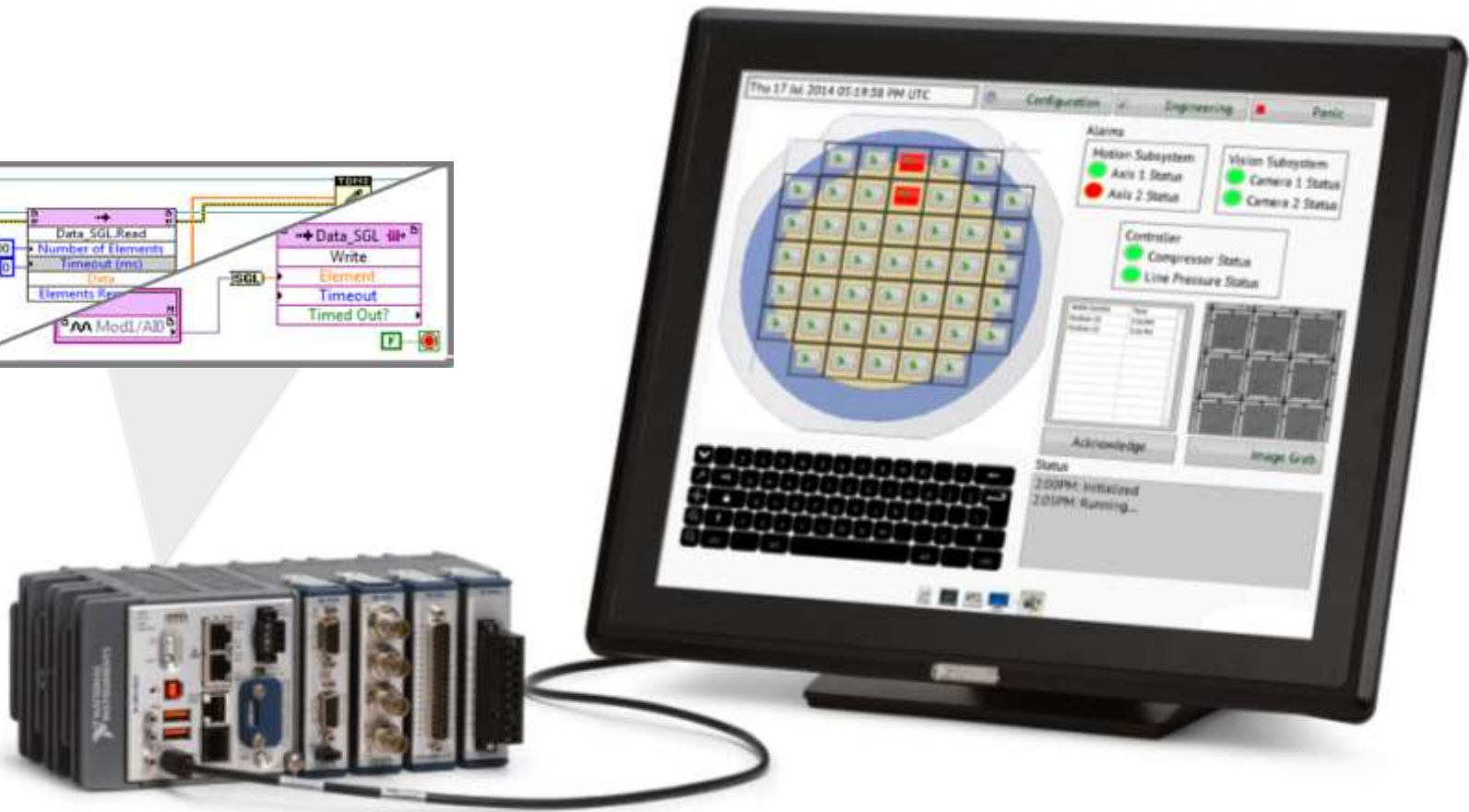
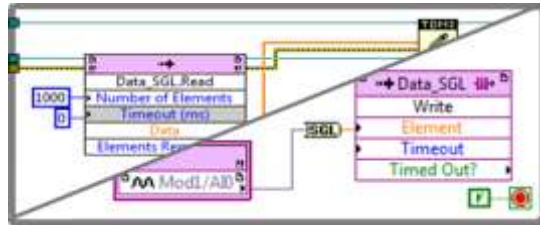
*Control loop rate of 500Hz

Electron Beam Welding Machine

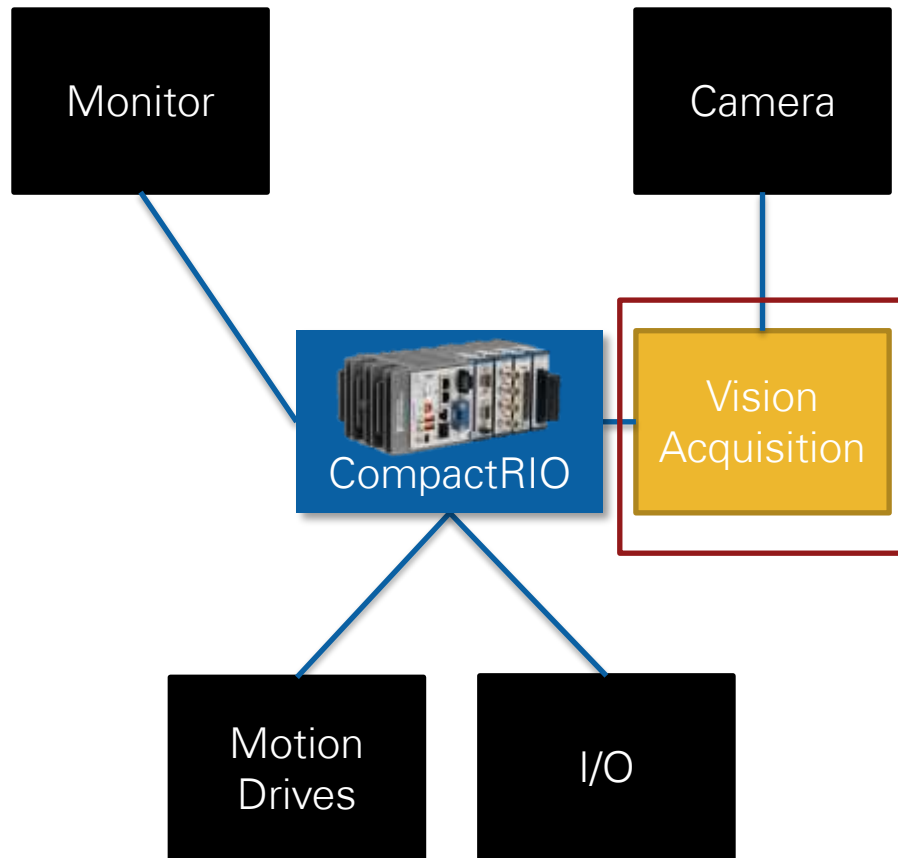


LabVIEW 2014 Real-Time with Embedded UI

Simplify system complexity by implementing a local HMI on CompactRIO

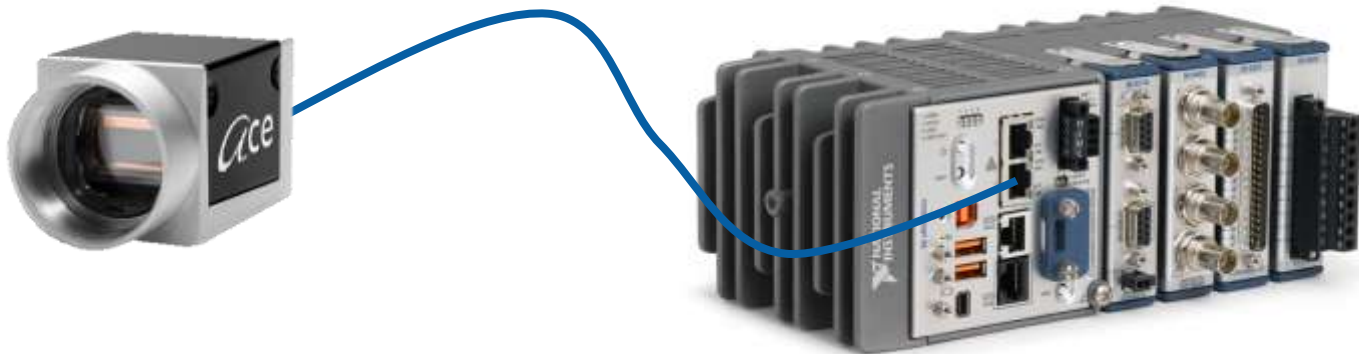


Electron Beam Welding Machine



Implement Local Vision Acquisition

- Connect up to 4 cameras at once
 - GigE Vision provides higher bandwidth and longer cable lengths
 - USB3 Vision through USB 2.0 ports uses less processor resources
- Significant processing power with Intel Atom dual-core processor
 - Use Vision Development module to create advanced image processing algorithms
 - Make control decisions directly from image processing results



Vision Development Module includes Powerful IP

Proven Image Technology

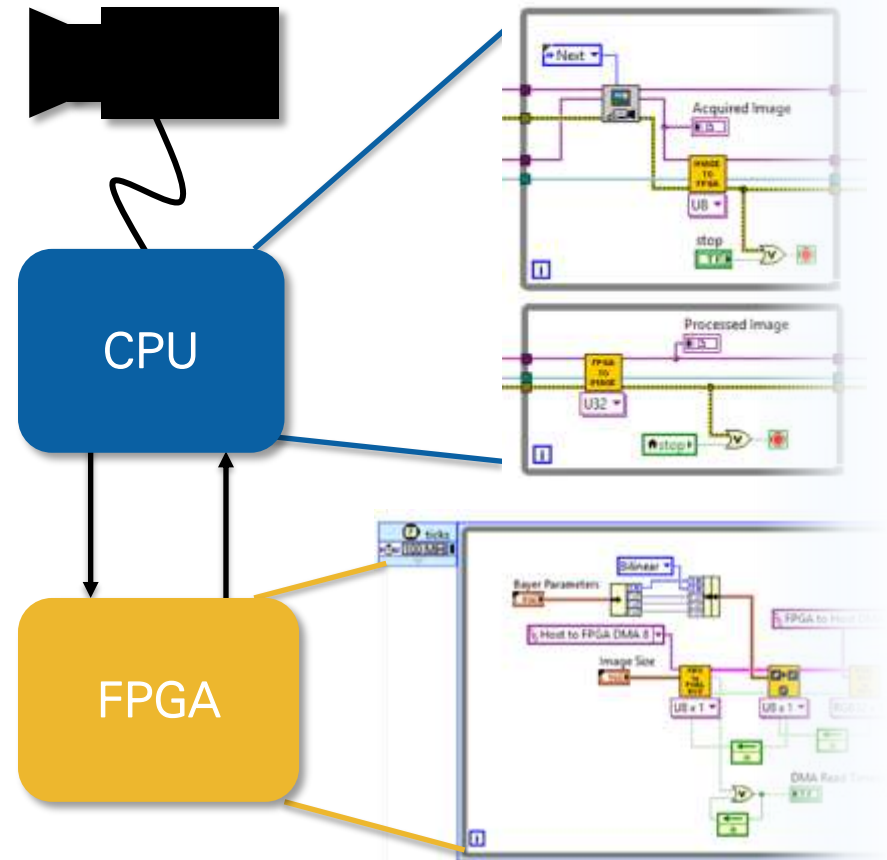
Leverage over **50 FPGA image processing functions** to design high performance vision systems and pass images between CPU and FPGA

Improved Usability

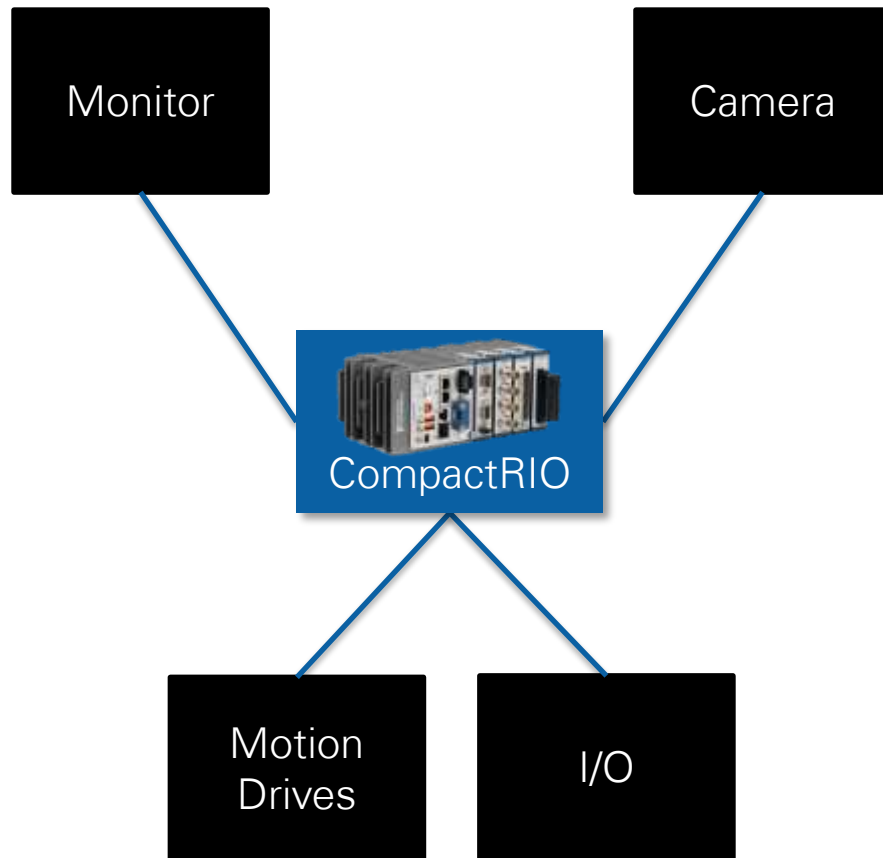
Prototype and generate code using **Vision Assistant** to design high performance vision systems

Find Data Easier

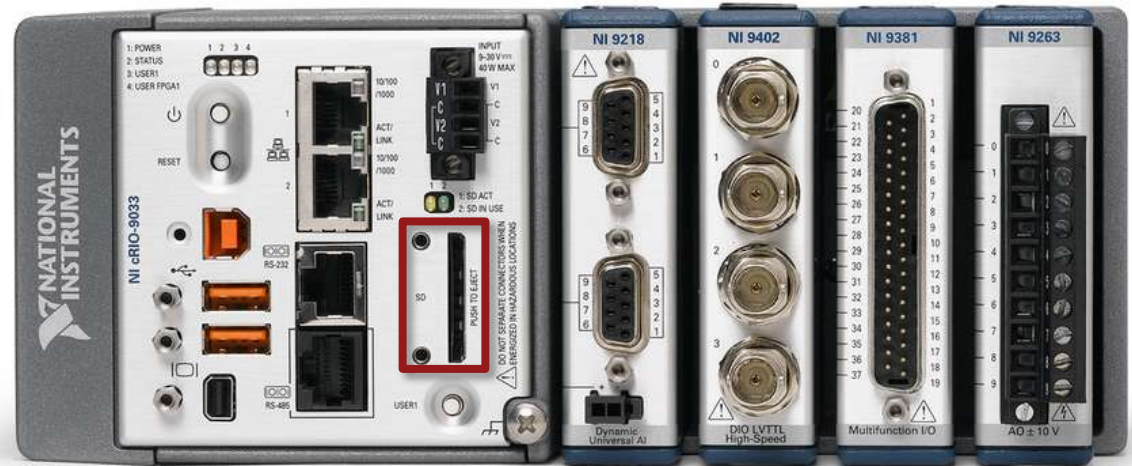
Automatically search an entire image for **1D Barcodes** and perform decoding



Electron Beam Welding Machine



Removable SD Card Storage



- Up to 32GB removable SD or SDHC cards supported
- 16GB and 32GB NI validated cards available at release
- USER1 button configurable to allow online SD card replacement
- NI SD card cover can be tethered to enclosure to prevent loss

Semiconductor Pick And Place

Application: Semiconductor pick and place machine used to package silicon die

Goal: Consolidate subsystems to reduce cost and complexity and improve motion performance

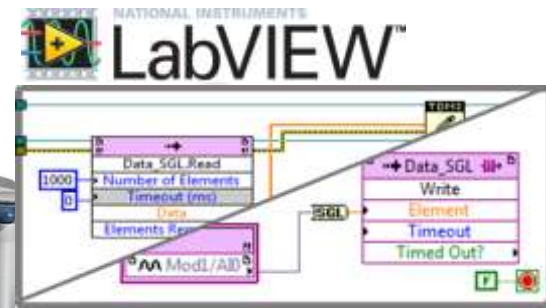
Requirements

- Integrate 2 cameras for vision guidance
- Precisely control 8 axis of motion
- Implement a local HMI used for startup, calibration, and system status

Result: “By using the new CompactRIO controller in our semiconductor pick-and-place machine, we were able to integrate our local HMI and vision components into one device. This not only reduced our system costs, but it also reduced our development time.” – **Kennes Wang, Master Machinery**



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