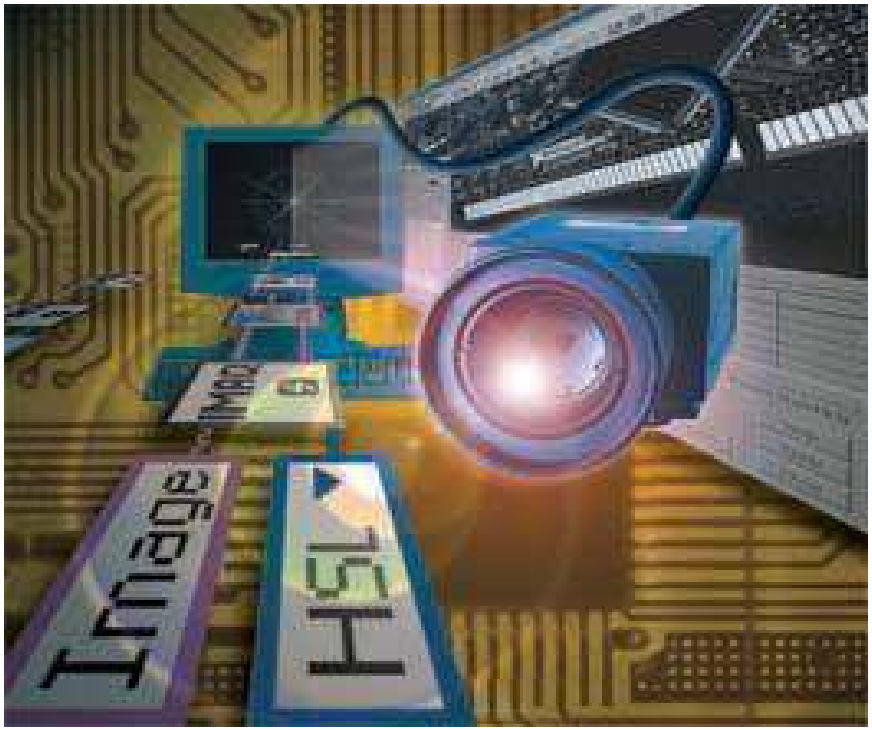
Develop Efficient Industrial Vision Applications with National Instruments Systems

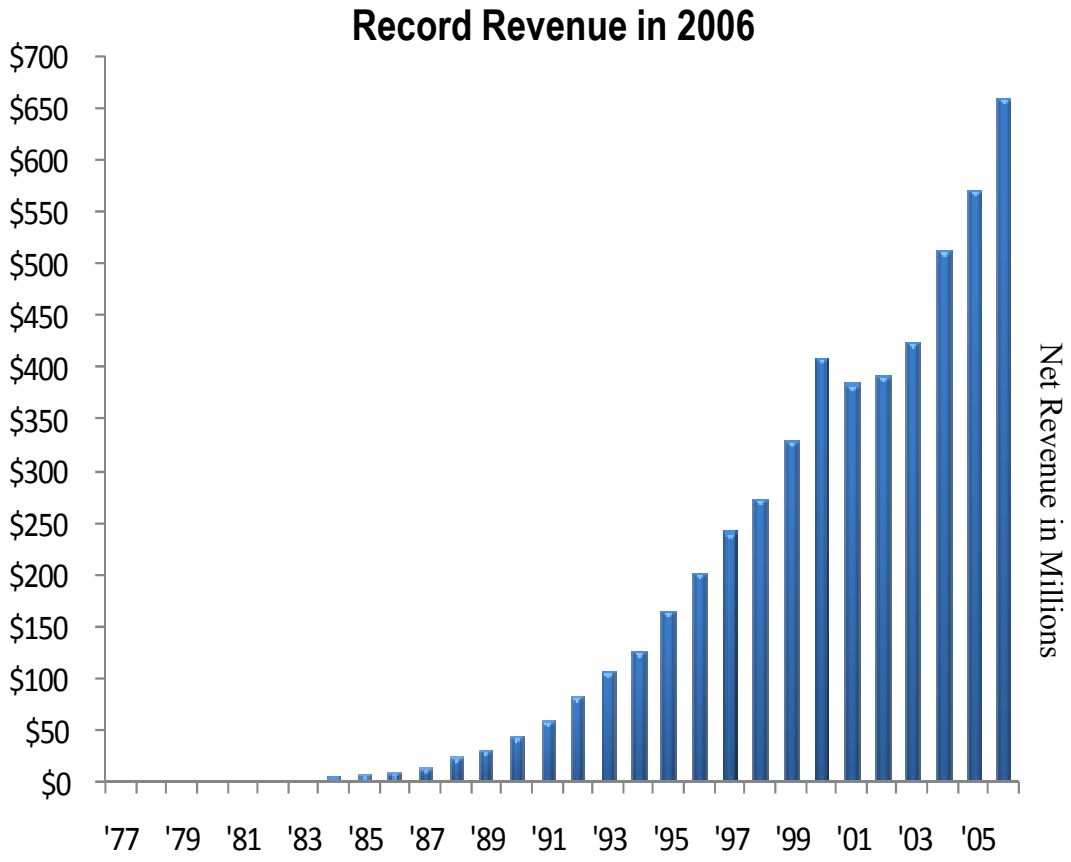


Agenda

- Benefits of Machine Vision for Manufacturing and Industrial Automation Applications
- NI Vision Framework
- Developing Automated Inspections with Vision Software
- Deploying Visual Inspections to Acquisition Hardware
- The Vision Ecosystem

Profile

- *Leaders in Computer-Based Measurement and Automation*
- Long-term Track Record of Growth and Profitability
- $660M Revenue in 2006
- $179.5M Revenue in Q2 2007
- More than 4,300 employees; operations in 40+ countries
- *Fortune's* 100 Best Companies to Work For Eighth Consecutive Year



Worldwide Presence

★ **Direct Sales Offices**

● **Distributors**

What We Do

Low-Cost Modular Measurement and Control Hardware

Productive Software Development Tools

Highly Integrated Systems Platforms

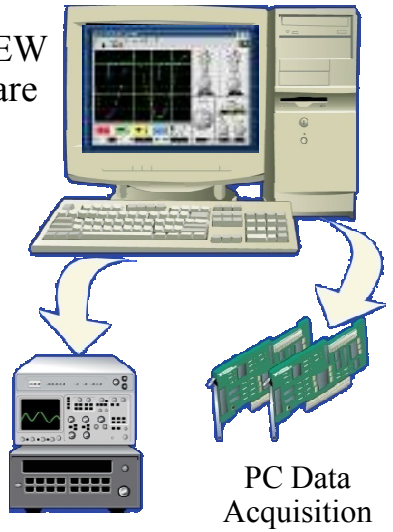
Used By Engineers and Scientists for Test, Design and Control

NI's Increased Value to Customers

Control Traditional Instruments + Simple PC-Based Measurements + Complete System Solutions

GPIB Instrument Control

LabVIEW Software



PC Data Acquisition

PXI System Platform

Compact FieldPoint System Platform

LabVIEW Real-Time

CompactRIO Industrial System Platform

$10 K-$100 K+

$1 K - $15 K

< $2 K

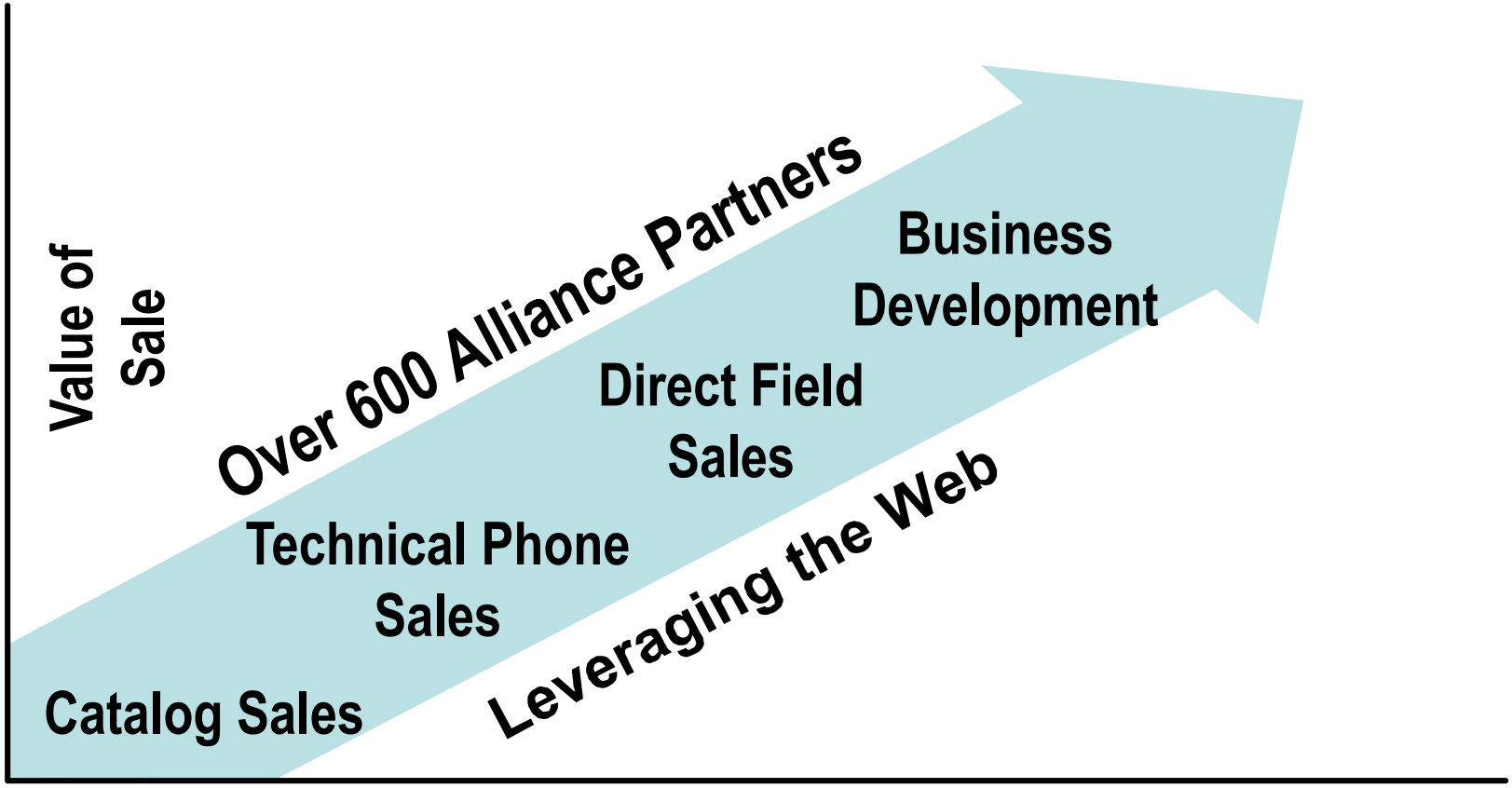
1980s 1990s 2000s

Typical Order Size

NI Products – Diversity of Customers

- 95% of Fortune 500 manufacturing companies have adopted Virtual Instrumentation
- More than 25,000 Companies in more than 80 countries

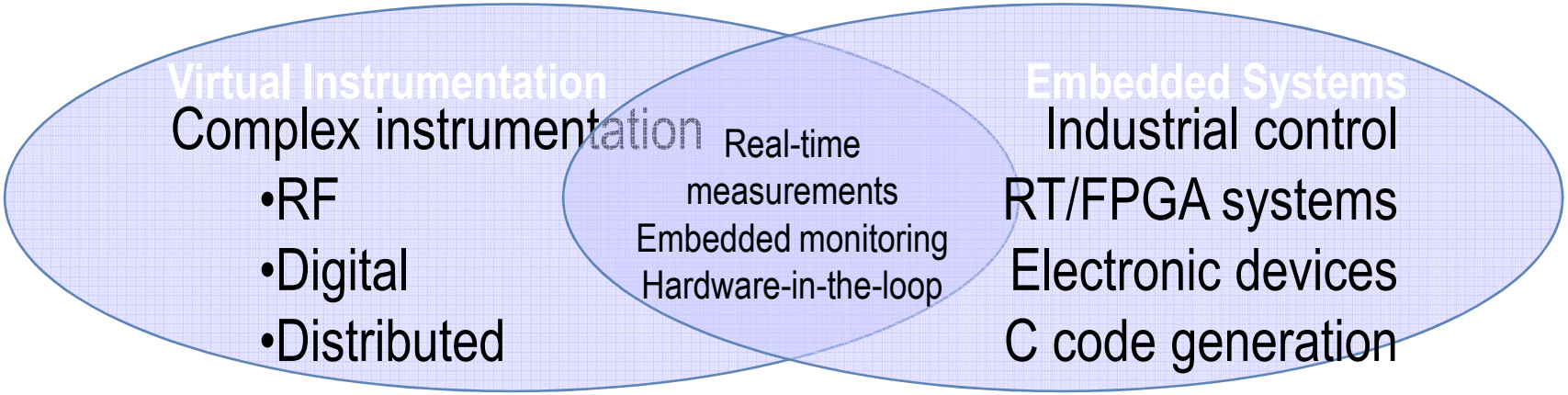
Direct Sales Advantage

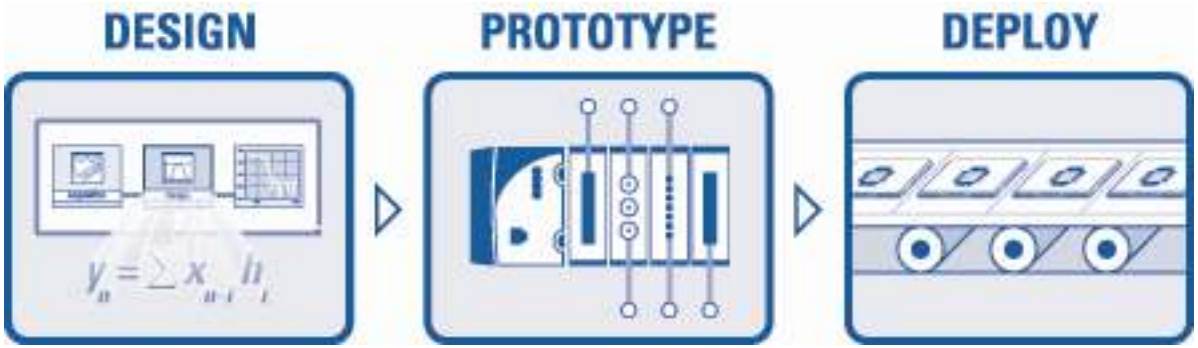


National Instruments Vision *Evolved*

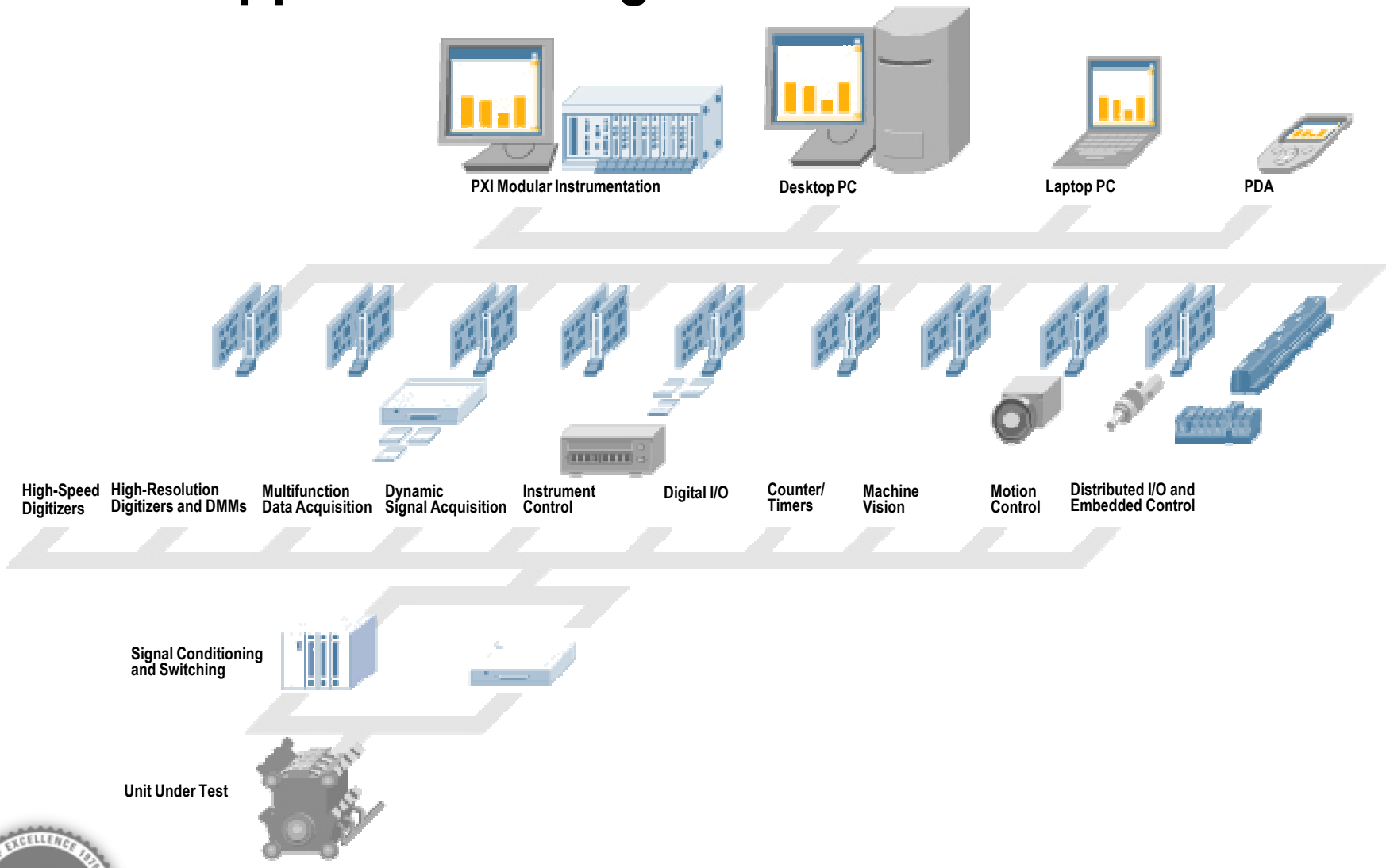
"To do for embedded what the PC did for the desktop."

Graphical System Design



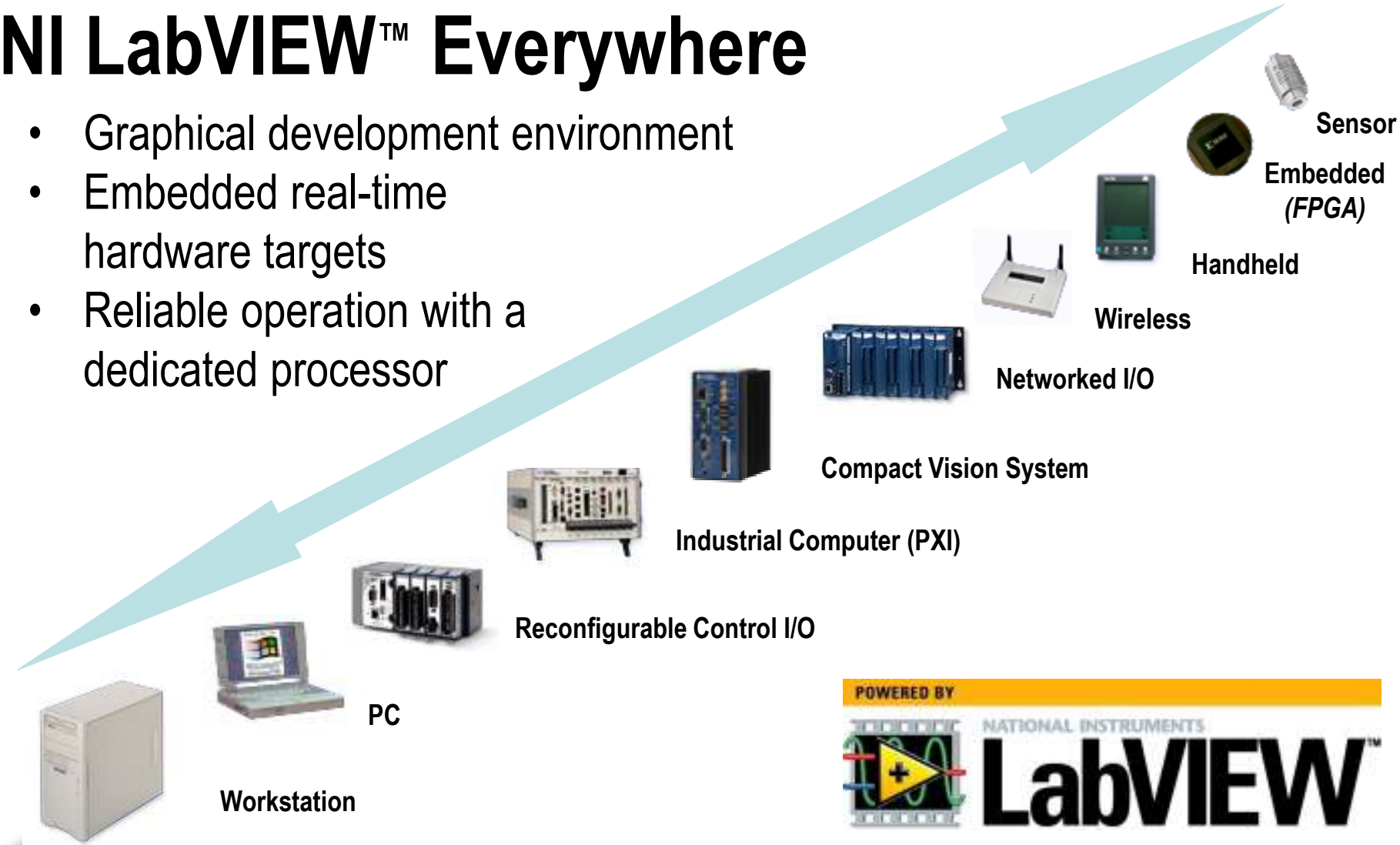


The NI Approach – Integrated Hardware Platforms



NI LabVIEW™ Everywhere

- Graphical development environment
- Embedded real-time hardware targets
- Reliable operation with a dedicated processor



POWERED BY NATIONAL INSTRUMENTS LabVIEW™

Benefits of Machine Vision for Manufacturing and Industrial Automation Applications

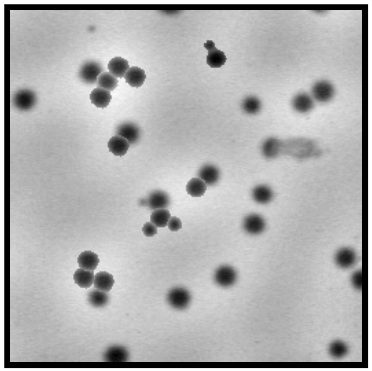
The Two Sides of Vision

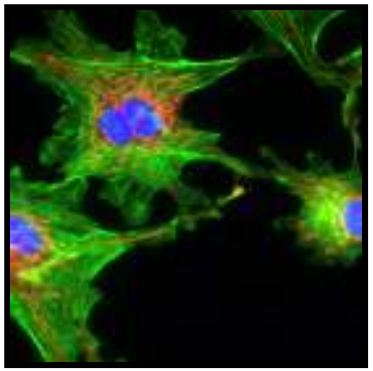
Scientific Imaging and R&D

- Frame Grabbers
- Programmable (LV & VDM)
- Research & Development, Lab, Validation, OEMs
- LabVIEW, DAQ, Sig Cond Approach

Industrial Machine Vision

- Vision Systems (CVS)
- Configurable (VBAI)
- Manufacturing, Production, EOL testing
- Automation, PLC Approach



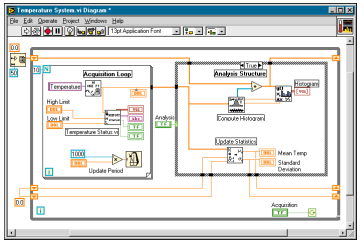


Scientific Imaging Approach

Lighting, Lens, Camera, HW, SW

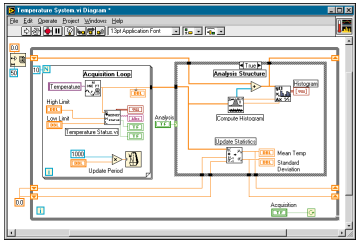






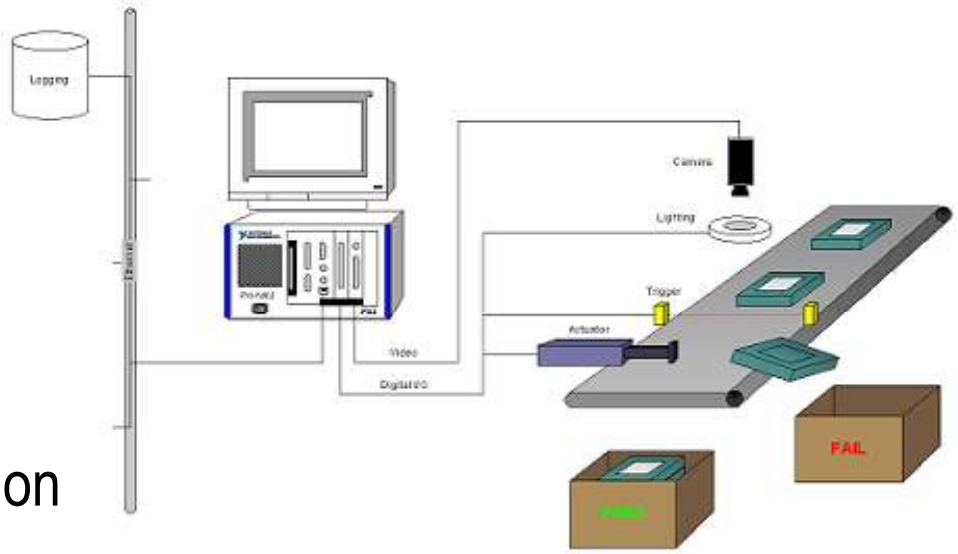
Transducer, Signal Conditioning, A/D, SW





Machine Vision Approach

- More demanding:
  - Triggering and I/O
  - Difficult lighting
  - Actuators and PLCs
  - Mechanical fixturing
  - Industrial communication
  - Nonprogrammers



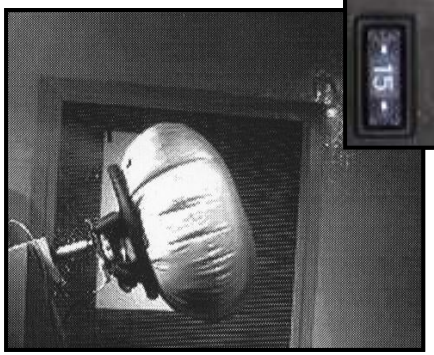
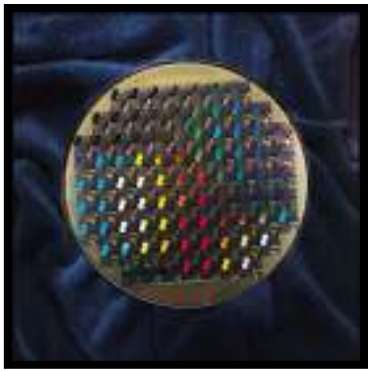
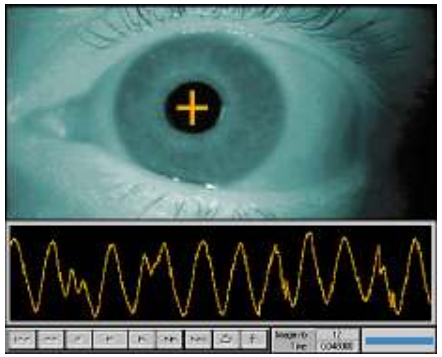
Reality of Industrial Machine Vision Apps

- Lighting and optics
- PLC communication
- Mechanical design
- Triggers/encoders
- Actuators
- PACs
- Part Handling
- High-speed DAQ

National Instruments Machine Vision

- Solutions for
  - Every industry
  - Every budget
  - Every level of experience



Machine Vision Challenges in Manufacturing

- Flexibility with illumination and lens choice
- Selecting the proper illumination intensity, angle and wavelength for light sources
- Machine vision equipment inexpensive and easy to use
- Understanding of machine vision concepts, setup, and programming terminology
- Quick-fix cure-all for quality control issues
- Ability to communicate with other automation products
- Flexibility of systems for different part inspection
- Throughput and measurement speed

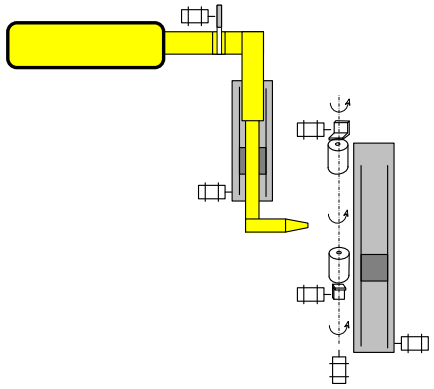
NI Precision motion and vision for halogen light bulbs

Application:

- Machine for developing new halogen light bulbs

Challenge:

- Build an accurate and flexible research and development production machine for a metal halide lamp.



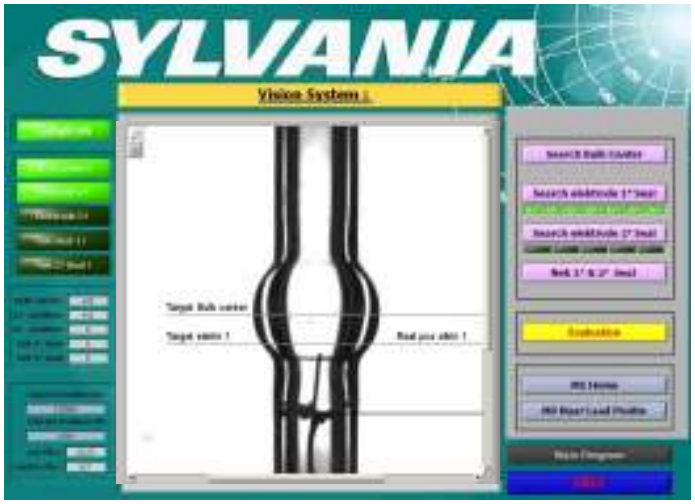
NI Precision motion and vision for halogen light bulbs

NI Products Used:

- LabVIEW FPGA
- NI Motion
- NI Vision

Benefits of the system:

- Vision system with +/- 20 µm accuracy
- Motion up to 0,01µm accuracy



"With the LabVIEW platform, we can easily adapt to different process requirements and adapt the software for future enhancements."

Defect Detection on Fast-moving Aluminum

Application:

- Defect detection on cast aluminum.

Challenge:

- Detecting 100 micrometer-size cracks on both sides of a fast-moving cast aluminum slab with a surface temperature of 400˚C and marking the defective slabs in real time.

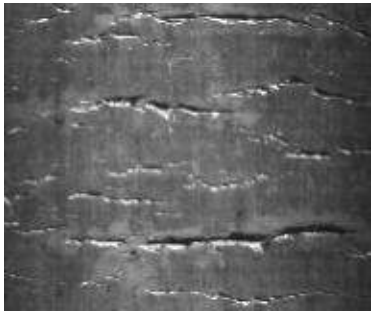
Defect Detection on Fast-moving Aluminum

NI Products Used:

- PCI digital frame-grabbers
- NI Vision Builder
- NI LabVIEW & Vision Dev Module

Benefits of the system:

- 80 Mbytes data throughput
  - 8000 pixels x 5000 l/s x 2 cameras
- Visually detect 100um defect in 0.5M



"From conception to deployment, we developed the system in a short period of five months, and saved more than $200,000. "

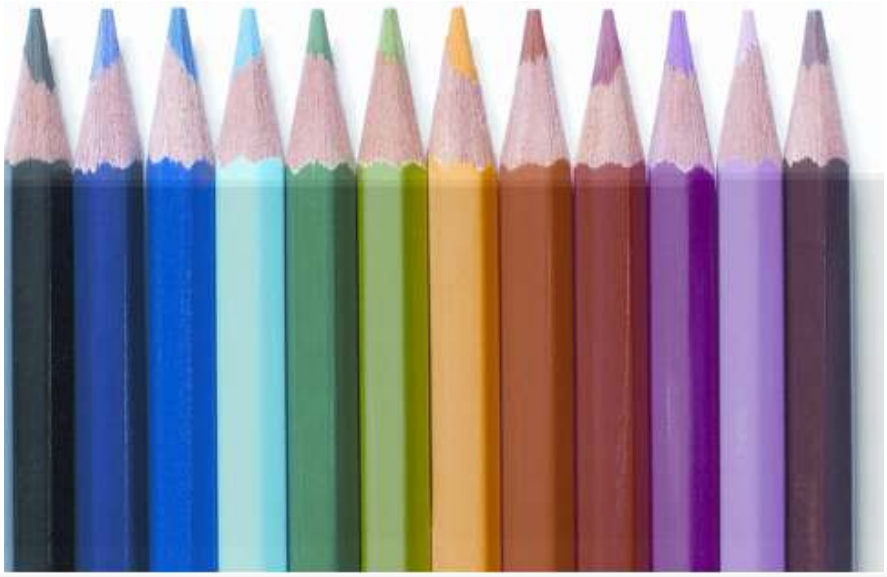
High Throughput Pencil Sorting System

Application:

- Pencil Sorting System.

Challenge:

- Developing a machine vision-based automated sorting system that can sort two million pencils per day of different wood types, textures, and lead colors, that also can perform high-speed image acquisition, real-time processing, and precise synchronization of ejectors.



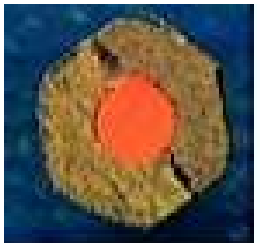
High Throughput Pencil Sorting System

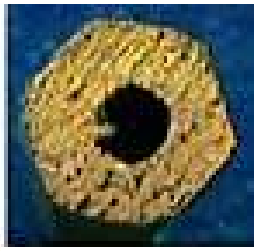
NI Products Used:

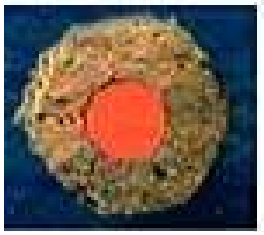
- PCI digital frame-grabbers
- NI LabVIEW
- NI Vision Development Module

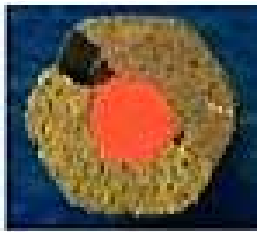
Benefits of the system:

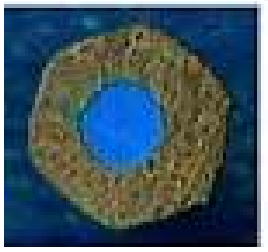
- Complete Inspection and classification at 25 pencils/second
- 300um tolerance


Wood mismatch


Absence of Lead


Roughness in Wood


Chipped Wood


Lead off center


Wood texture mismatch

"We found vision development tools such as NI IMAQ Vision Builder indispensable from specifying the type of processor needed to the development of robust algorithms. Without these tools, we certainly could not have successfully completed such a demanding, high-speed sorting application within a period of 16 weeks."

Why use NI for Machine Vision?

- Better Products
  - Superior hardware
  - Easy to use software
  - Extensive algorithms
- Key Differentiators
  - Open, scalable platform
  - Low cost of ownership
- Additional
  - We consistently solve tough applications
  - We leverage the latest technologies

NI Vision Framework

NI Vision Platform

NI Vision Development Module

Programming tools for LabVIEW, C/C++, Visual Basic, and .NET

NI Vision Builder for Automated Inspection

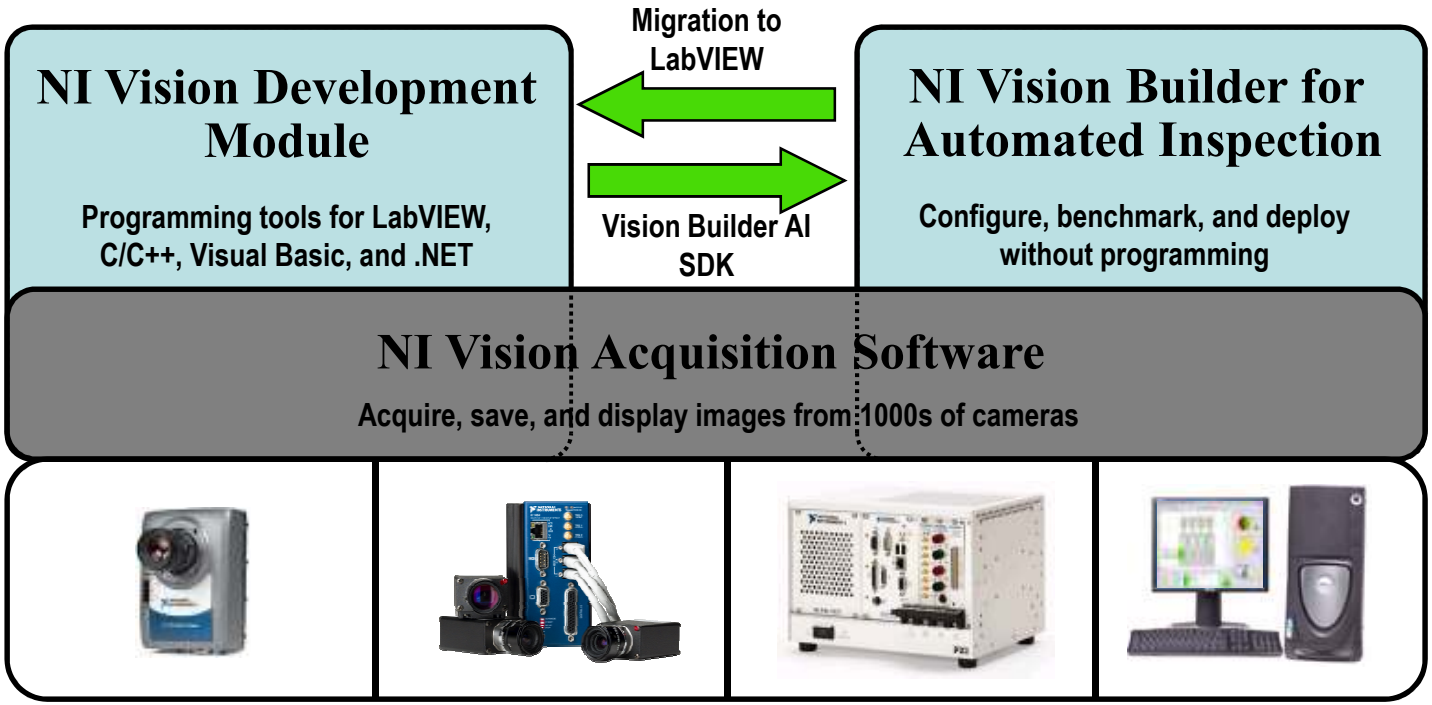
Configure, benchmark, and deploy without programming

NI Vision Acquisition Software

Acquire, save, and display images from 1000s of cameras

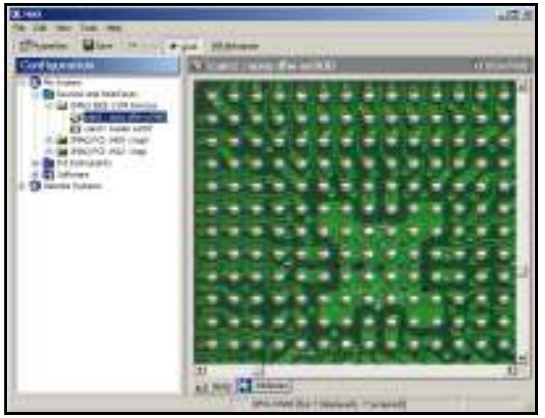
Developing Automated Inspections with Vision Software

NI Vision Platform SW Advantage

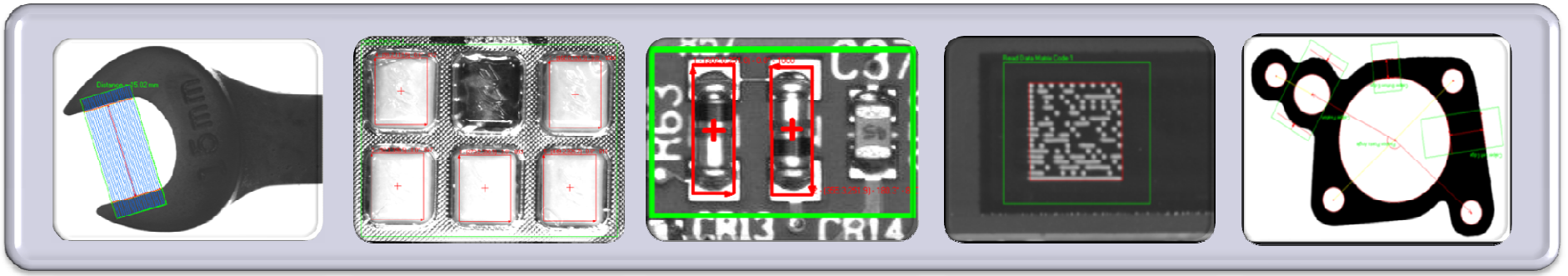


Vision Acquisition Software

- Driver software included with NI frame grabbers
- Included with Compact Vision System & Smart Camera
- Support for IEEE 1394 (FireWire) cameras
- Support for GigE cameras
- Tools to manage, display, and save images



NI Vision Capabilities



Enhance

- Calibrate image
- Filter noise
- Remove distortion

Check

- Measure intensity
- Count particles
- Match colors

Locate

- Match patterns
- Match geometry
- Detect edges

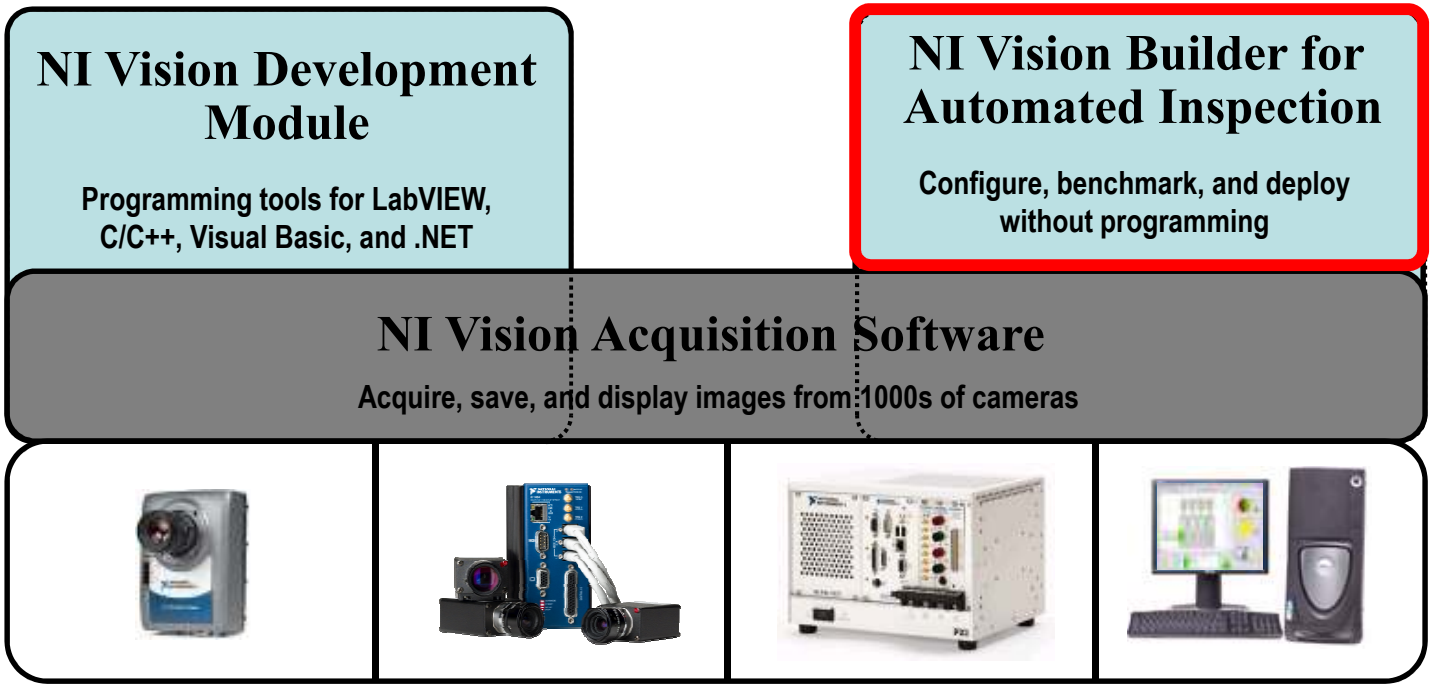
Identify

- Read text (OCR)
- Read 1D barcodes
- Read 2D codes
- Classify shapes

Measure

- Detect edges
- Measure distance
- Calculate geometry

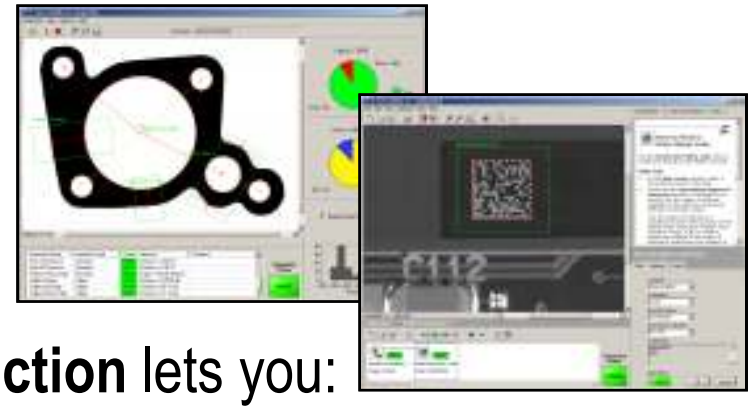
NI Vision Platform



The NI Vision Product Family

Vision Builder for Automated Inspection

Configure, benchmark, and deploy without programming

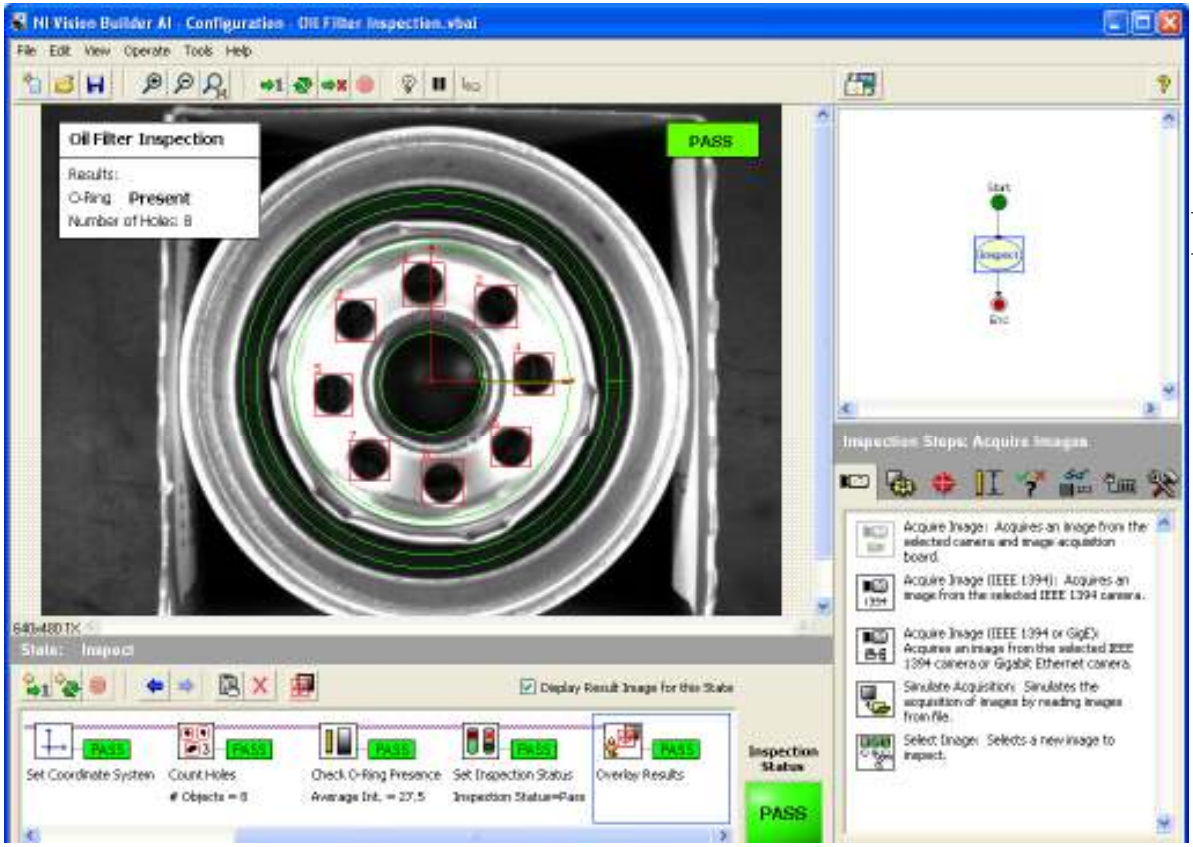


- **Vision Builder for Automated Inspection** lets you:
  - Acquire and process images with any NI frame grabber, more than 100 IEEE 1394 cameras, or the NI Compact Vision System
  - Build, benchmark, and deploy complete machine vision applications without programming
  - Configure more than 100 powerful machine vision tools including geometric matching, OCR, and particle analysis
  - Communicate triggering and inspection results directly to industrial devices over digital I/O, serial and Ethernet protocols

Vision Builder AI Configuration Window

Inspection Window

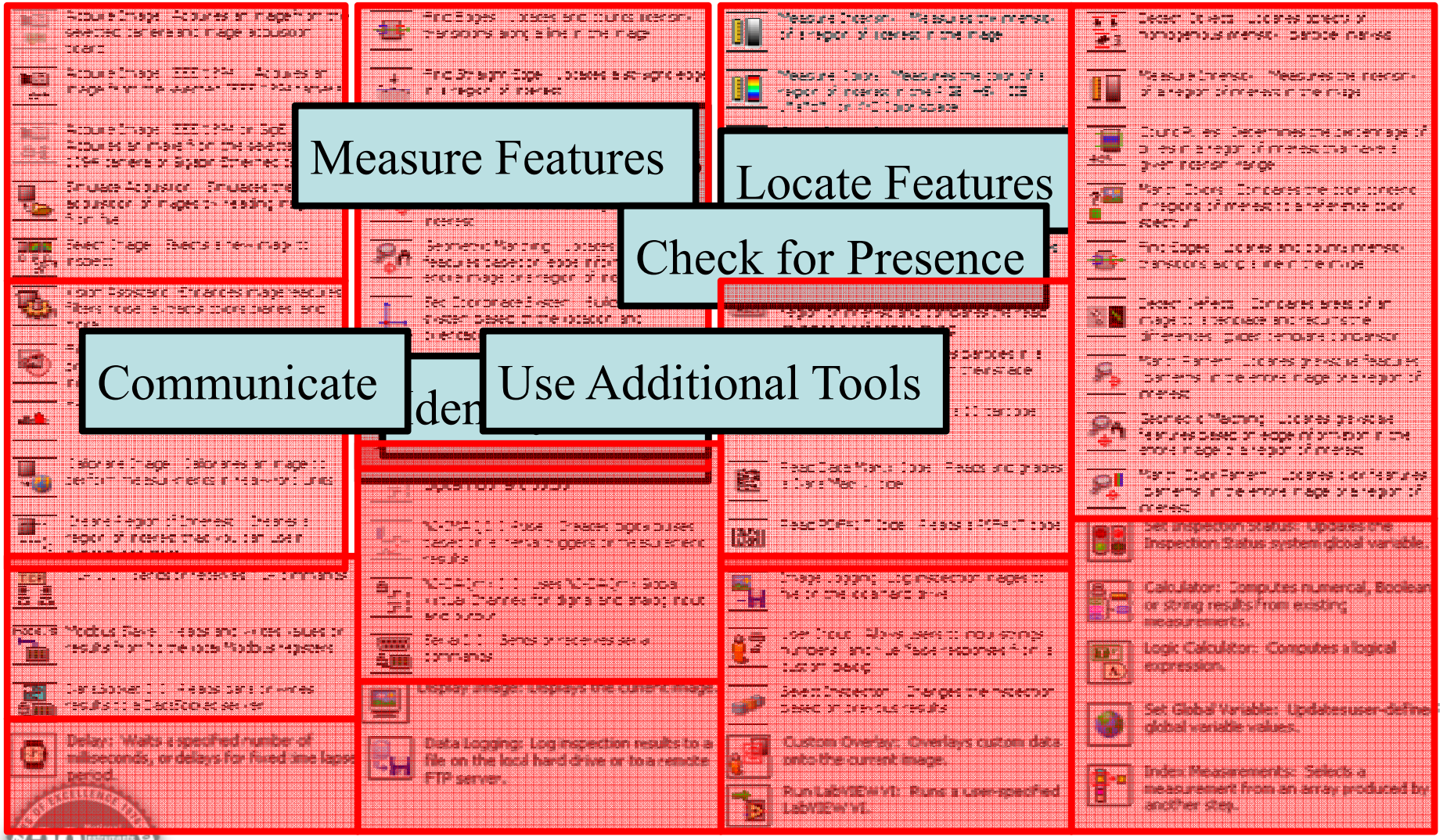
State Diagram



Steps in Current State

Inspection Steps

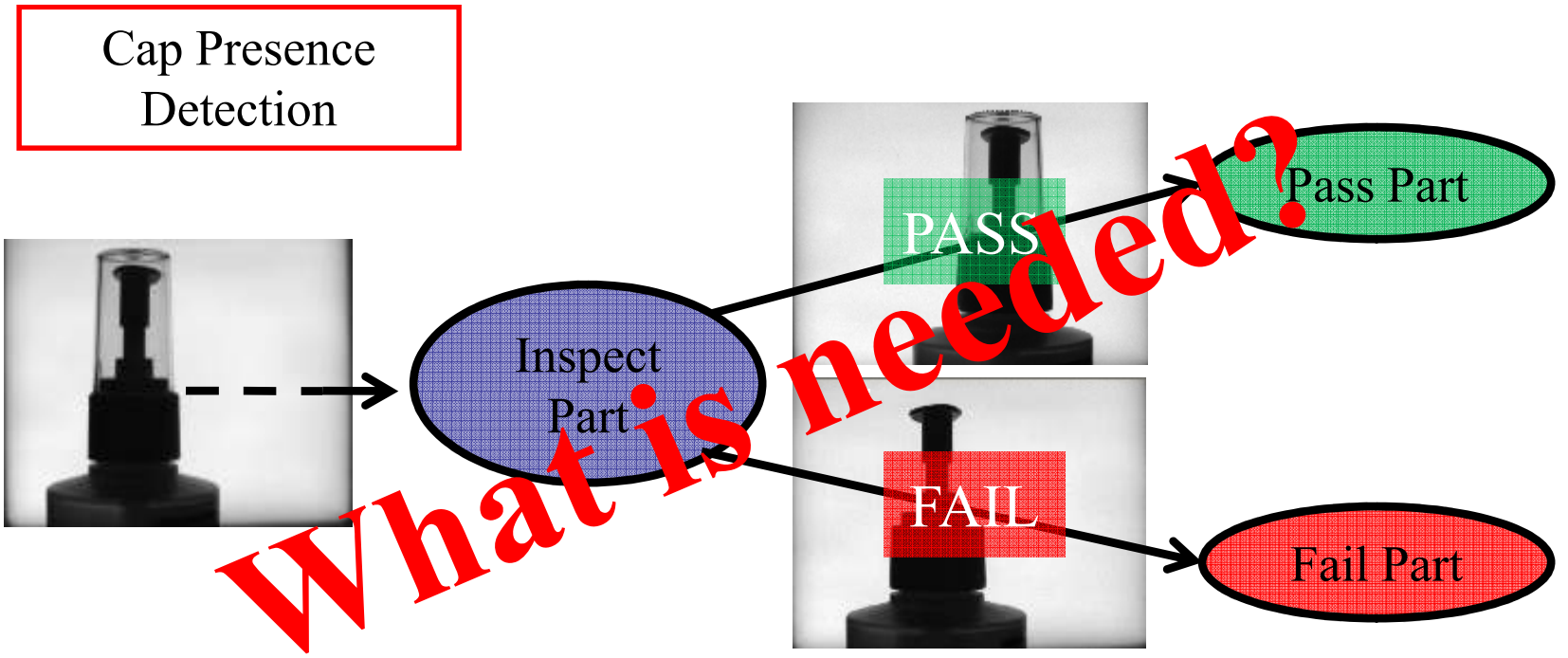
Vision Builder AI Inspection Steps



Introduction to Vision Builder for Automated Inspection

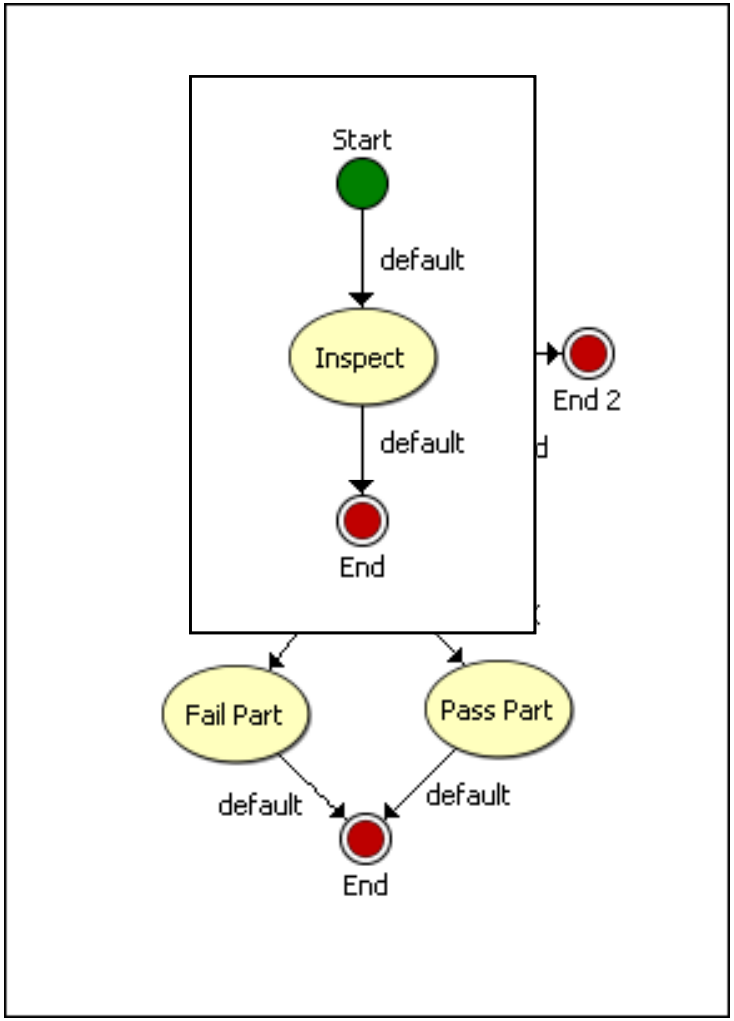
Instructor Demo

Decision Making



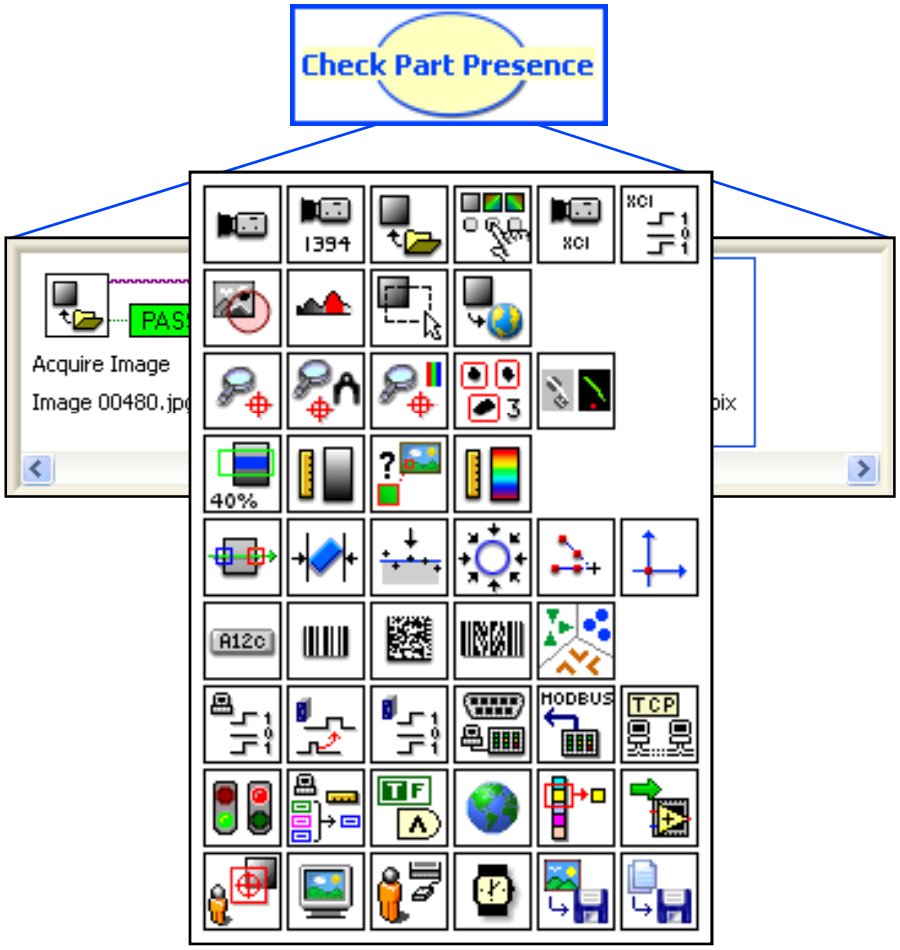
State Machine in Vision Builder AI

- Inspections are based on a state diagram
- Default state diagram contains a single state
- The inspection state diagram executes from the Start point to an End point, and repeats
- An inspection state diagram contains:
  - One Start point
  - One or more states
  - One or more End points



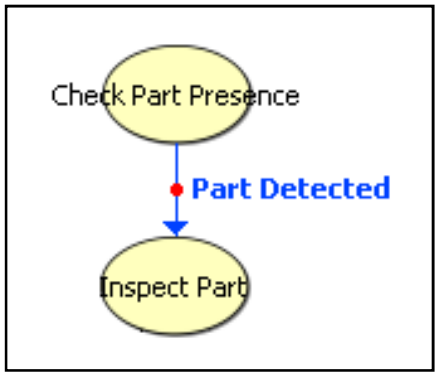
Vision Builder AI State Diagram: States

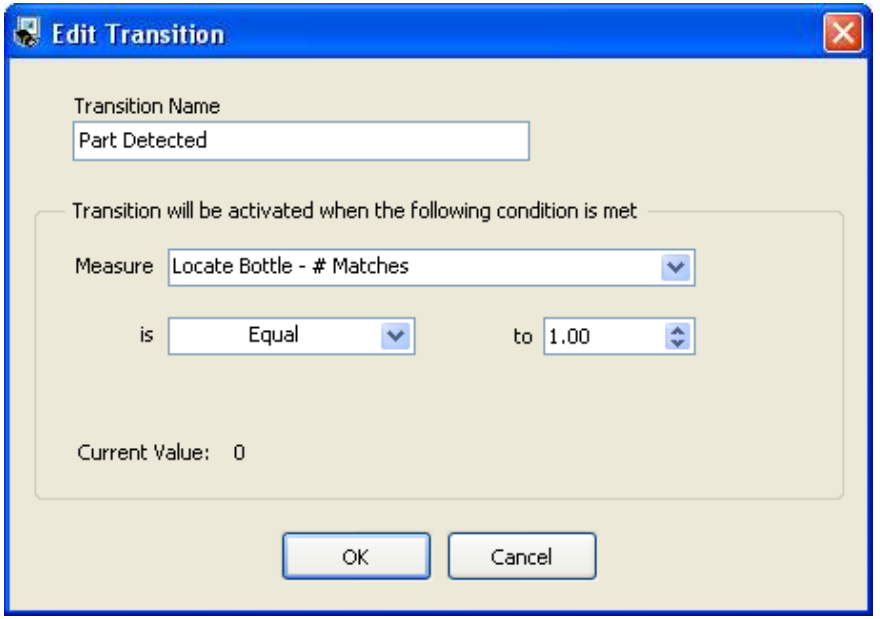
- Each state includes a set of inspection steps executed sequentially
- Any inspection step can be used in any state



Vision Builder AI State Diagram: Transitions

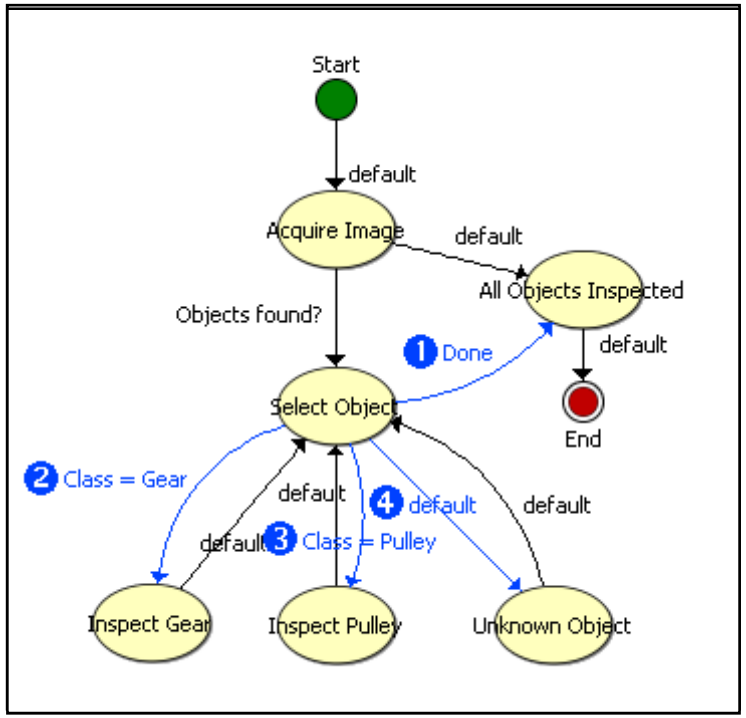
- State execution is governed by transitions
- Transition conditions are evaluated to determine the next state
- Transition conditions are based on inspection step results

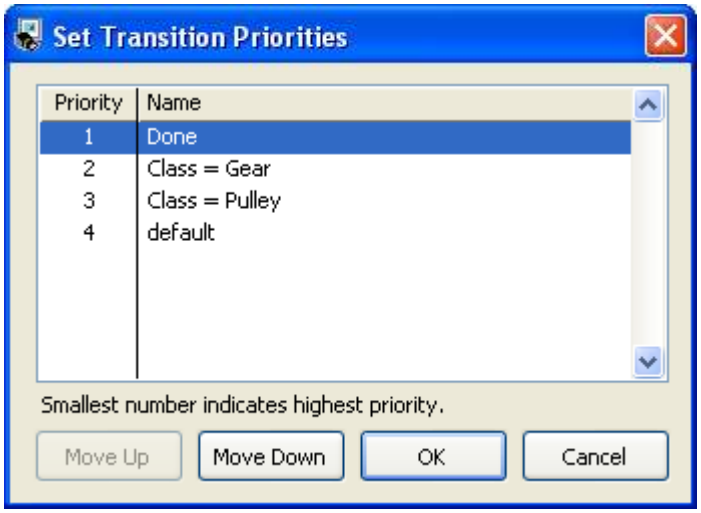




Vision Builder AI State Diagram: Transitions

- Every state has a default transition (always TRUE)
- When multiple transitions originate from the same state, conditions are evaluated according to user-defined priorities

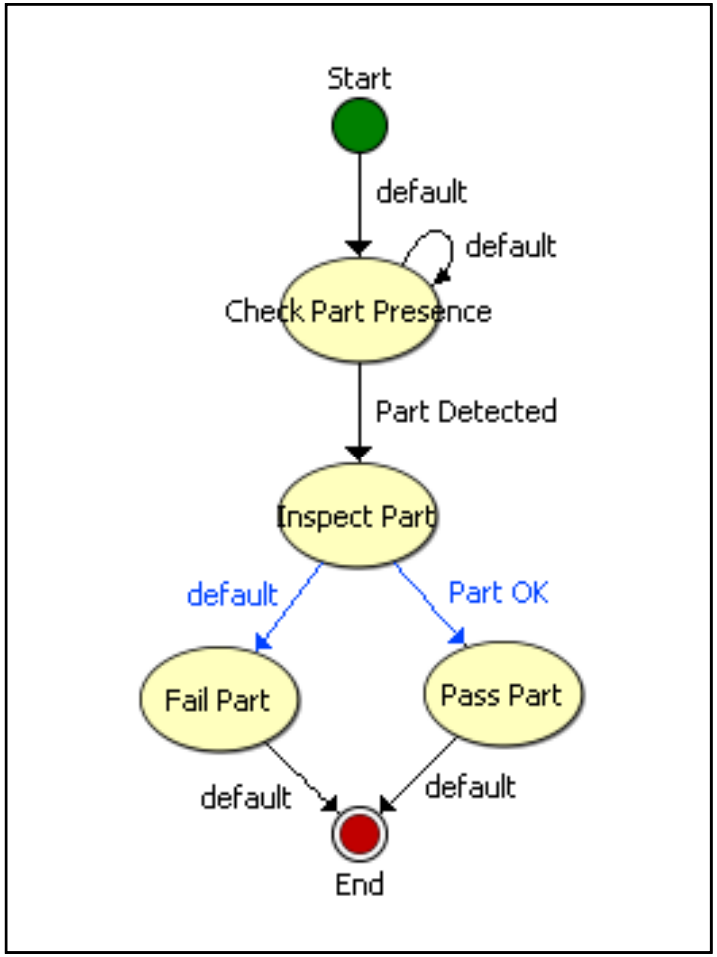




Basic State Diagram Techniques

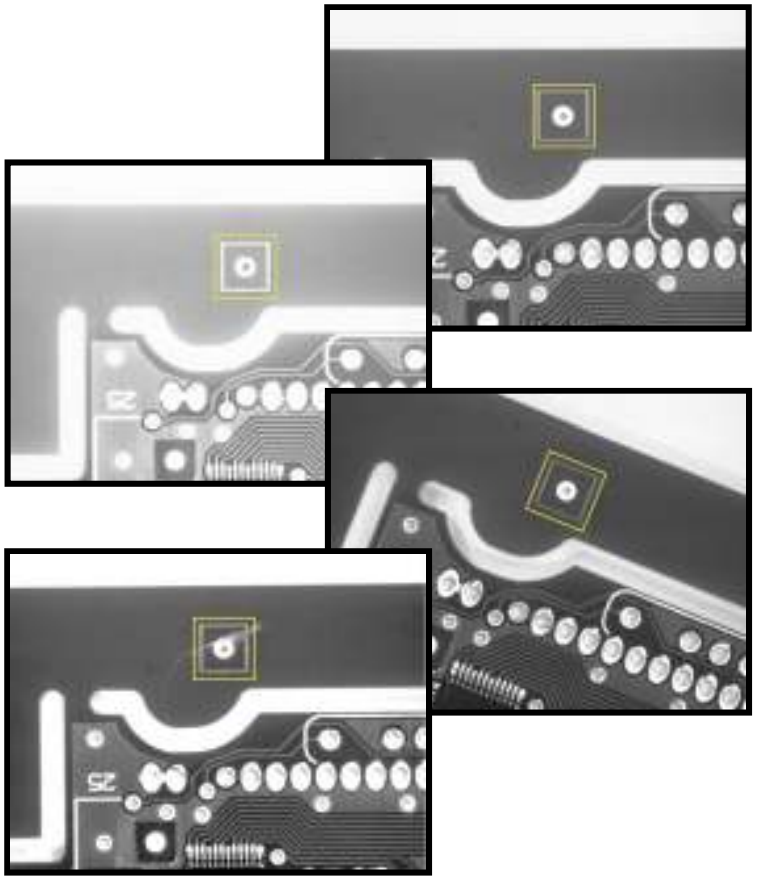
- Looping—Acquire an image and check for the presence of a part until a part is detected

- Branching—If the condition for the Part OK transition is met, execute the steps in the Pass Part state. Otherwise, execute the steps in the Fail Part state



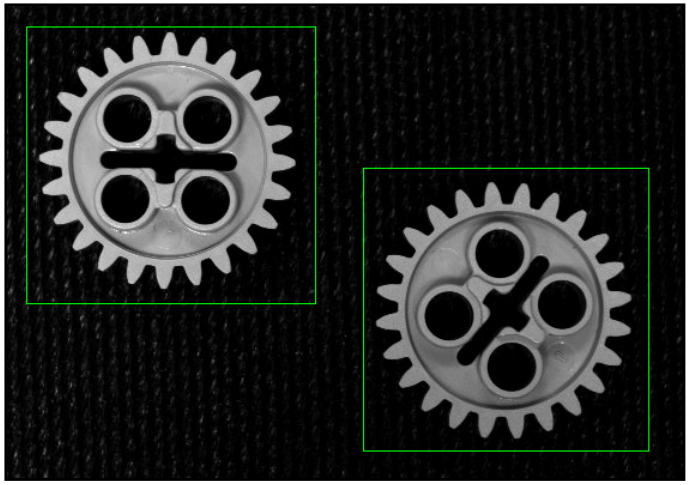
Pattern Matching

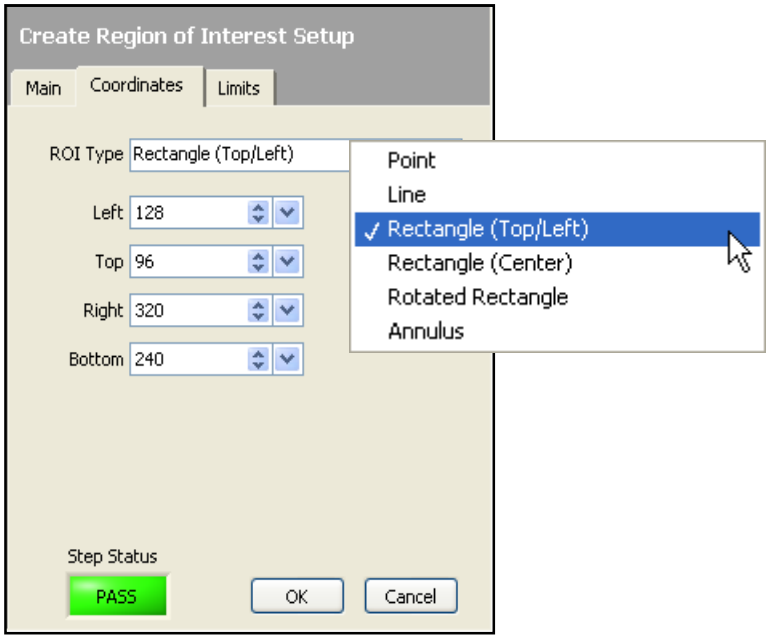
- Locate patterns very quickly
- Resistant to changes in
  - Lighting
  - Rotation
  - Focus



Create Region of Interest

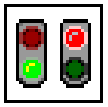
- Region of interest (ROI) can be a Point, Line, Rectangle, Rotated Rectangle, or Annulus
- ROI coordinates can be constants, previous measurements, or global variables
- Examples:
  - Create an ROI around each found object
  - Create an ROI to analyze an image according to a fixed scanning pattern
  - Create an ROI of an exact size and shape

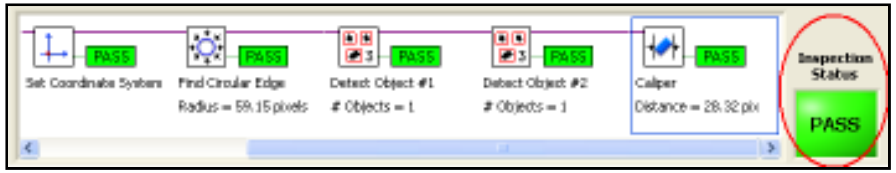


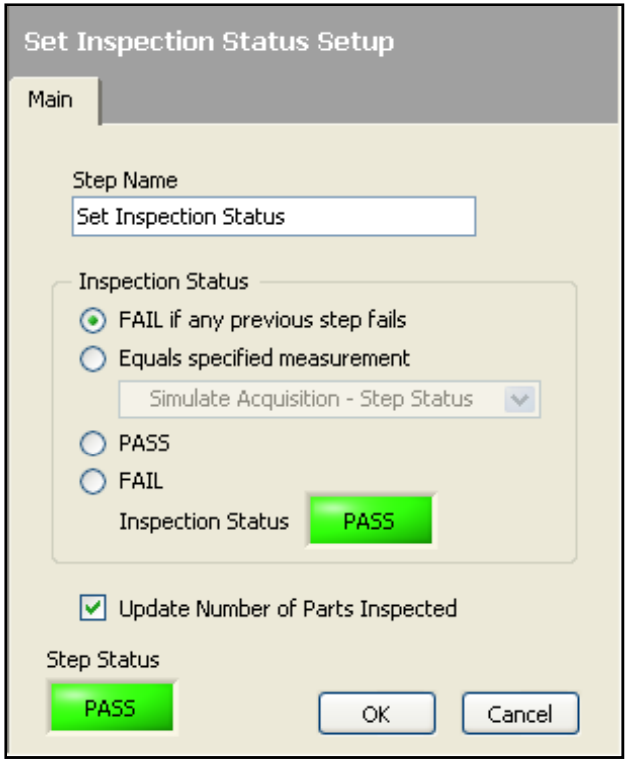


Inspection Status

- Set Inspection Status step allows you to specify how and when the Inspection Status is set
- Set Inspection Status may update the inspection statistics

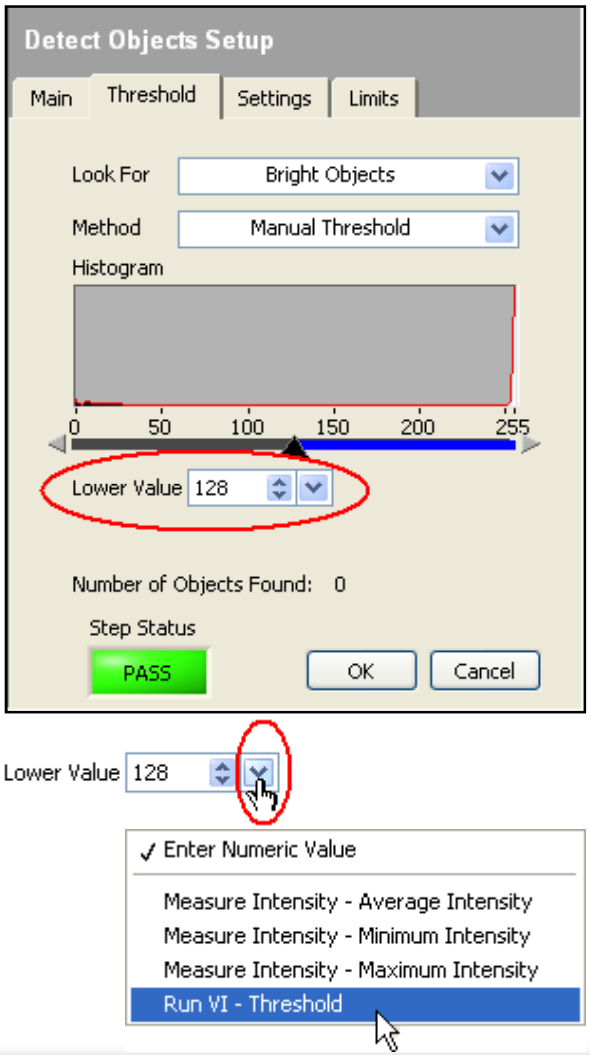






Accessing Inspection Measurements

- Vision Builder AI steps return measurement results
- Measurements from previous inspection steps can be accessed using drop-down list or configuration tree controls
- These controls allow a constant or previous measurement for the value of the control
- Measurements are local to a state

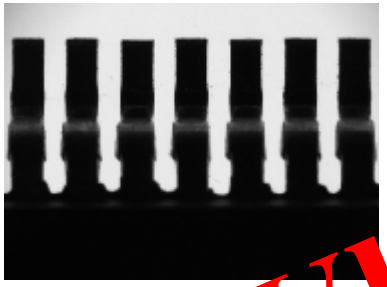


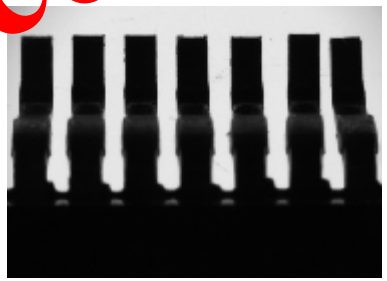
Branching and Decision Making

Instructor Demo

Iterating Between Patterns

IC inspection





What is needed?

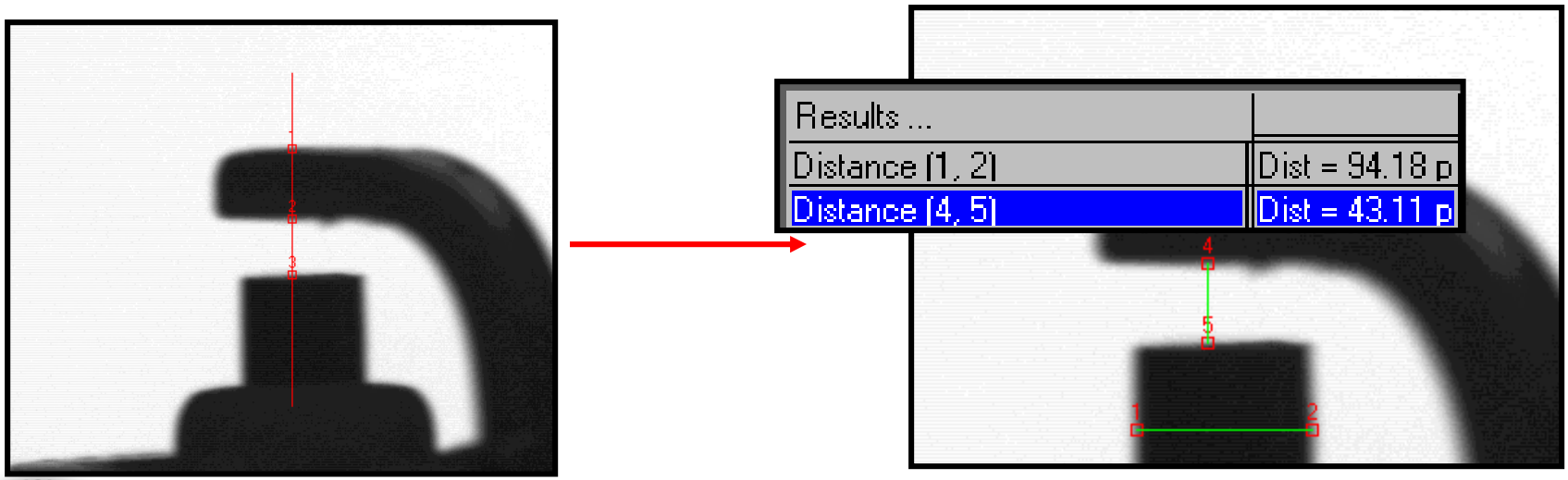
Number of pins?

Gap between pins?

How to repeat inspection for every pin?

Edge Detection and Gauging

- Find the edges of objects along any line in an image
- Use edge positions for alignment and gauging
- Subpixel accuracy
- Measure angles



Global Variables

- Global variables make measurements available to steps located in different states

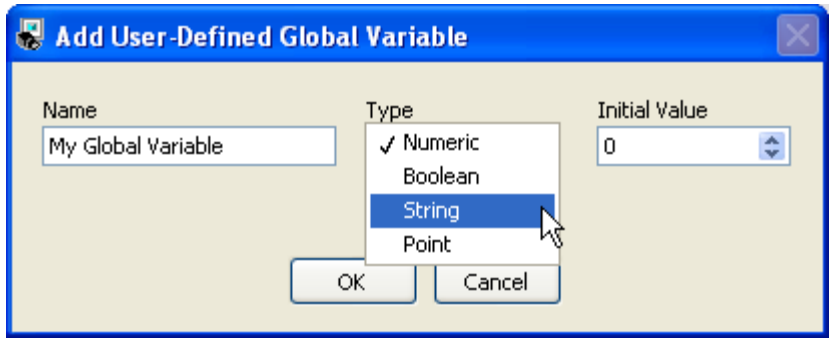
- Two types of global variables:
  - System global variable (Read Only)
  - User-defined global variable (Read/Write)—Numeric, Boolean, String, or Point

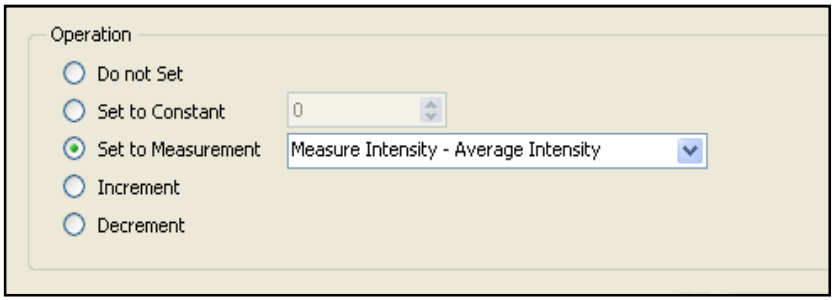
System Global Variables

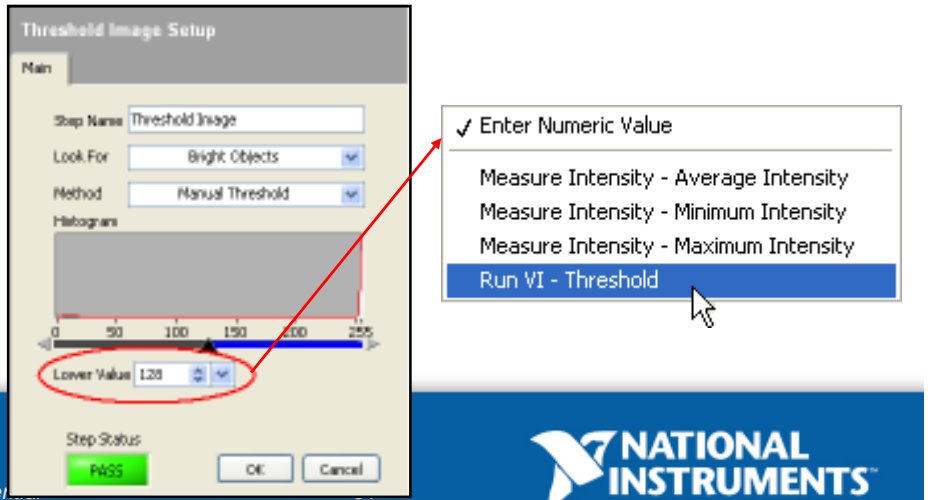
Name	Type	Value
Device Name	String	HELIOS
IP Address	String	130.164.35.4
Device Start Date	String	7/15/2006
Device Start Time	String	2:34:35 PM
Current Date	String	7/15/2006
Current Time	String	4:06:20 PM
Inspection Name	String	Untitled Inspection 1
Inspection Start Date	String	7/15/2006
Inspection Start Time	String	2:38:24 PM
Inspection Iteration Counter	Numeric	0
Active Time (s.)	Numeric	0
Idle Time (s.)	Numeric	0
Inspection Rate (parts/s.)	Numeric	0
Inspection Status	Boolean	Pass
# Pass	Numeric	0
# Fail	Numeric	0
# Parts Inspected	Numeric	0
Yield (%)		

Using Global Variables

- Define the global variable using the Global Variable Manager.
- Set the value of the Global Variable using the Set Global Variable Step 
- Select the global variable as the value for a step control located in a different state.

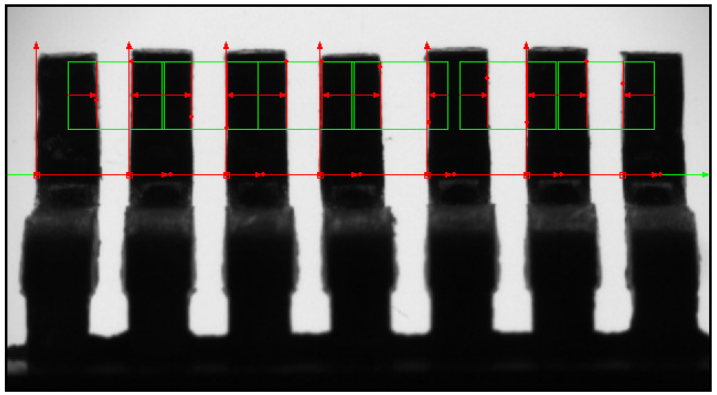


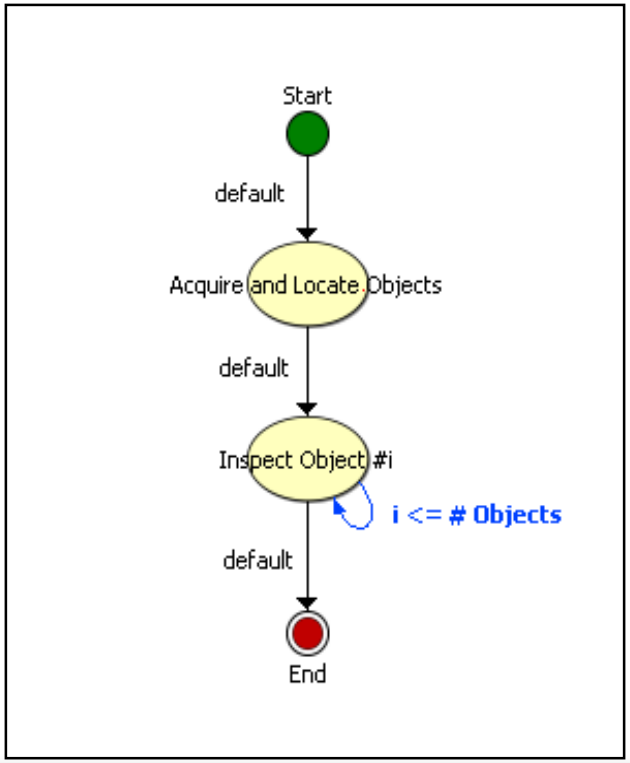




Iterations

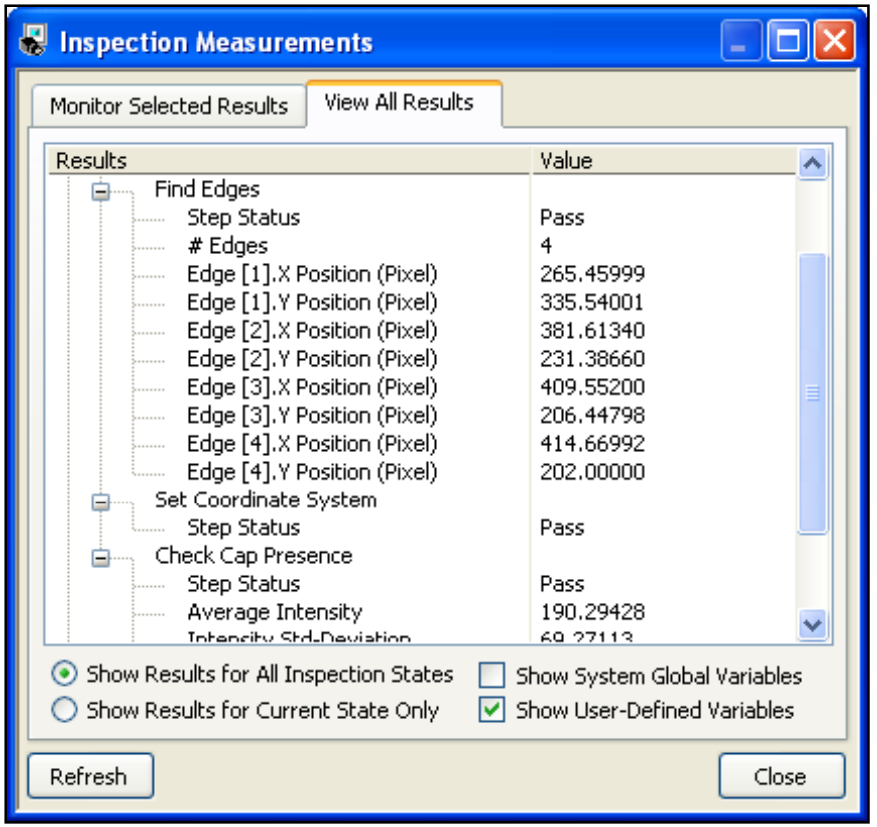
- Iterating allows you to implement FOR loops in the state diagram
- Use a global variable as the loop counter
- Use the Set Global Variable Step to increment or decrement the loop counter
- Examples:
  - Repeat an algorithm a fixed number or times or for each found objects
  - Poll an I/O line to synchronize with an external event
  - Wait for an image acquisition to complete before beginning the inspection



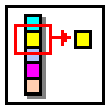


Index Measurements

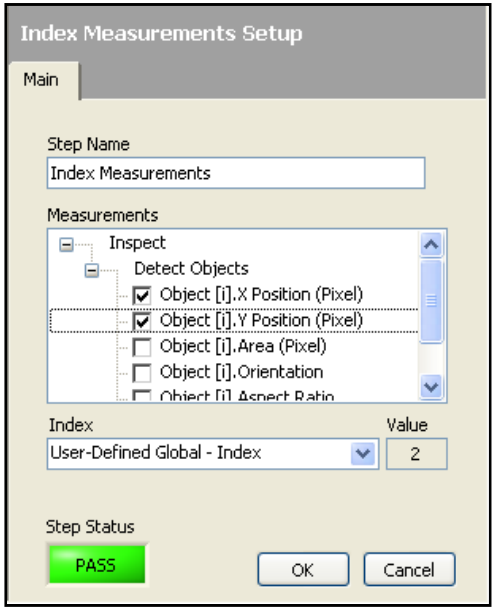
- Some steps create measurements related to multiple found objects
- Indexing allows random access to individual object results
- Examples:
  - Compute statistics about objects found in an image
  - Create a region on interest around each object found in an image and analyze the object

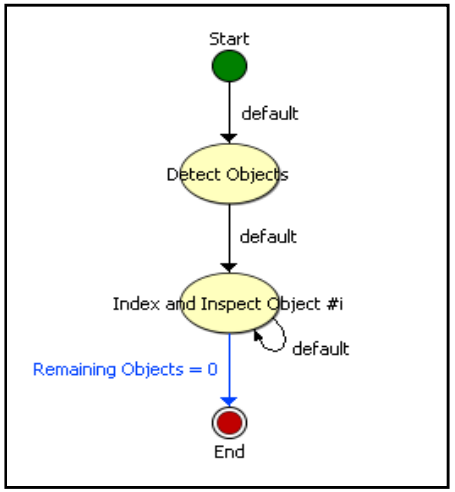


Using Index Measurements



- Index Measurements step allows you to access individual measurements from multiple measurement results.
- Create indexed measurements that can be used in future inspection steps
- Indexes can be constants, previous measurements, or global variables
- Index Measurements step returns the number of objects remaining

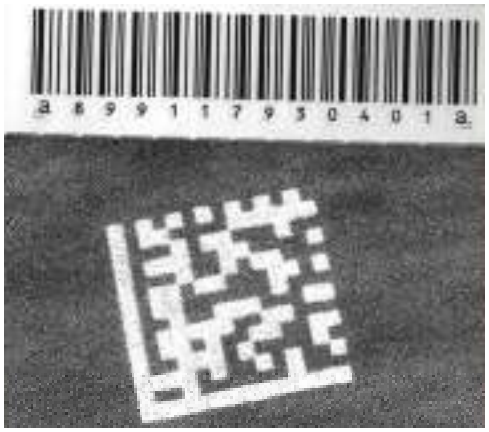


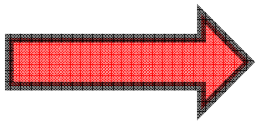


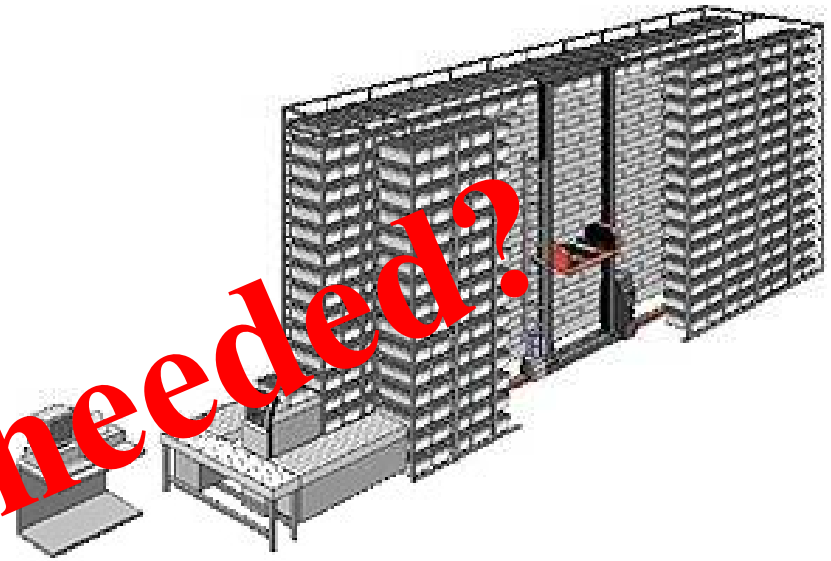
Looping and Global Variables

Instructor Demo

ASRS Integration







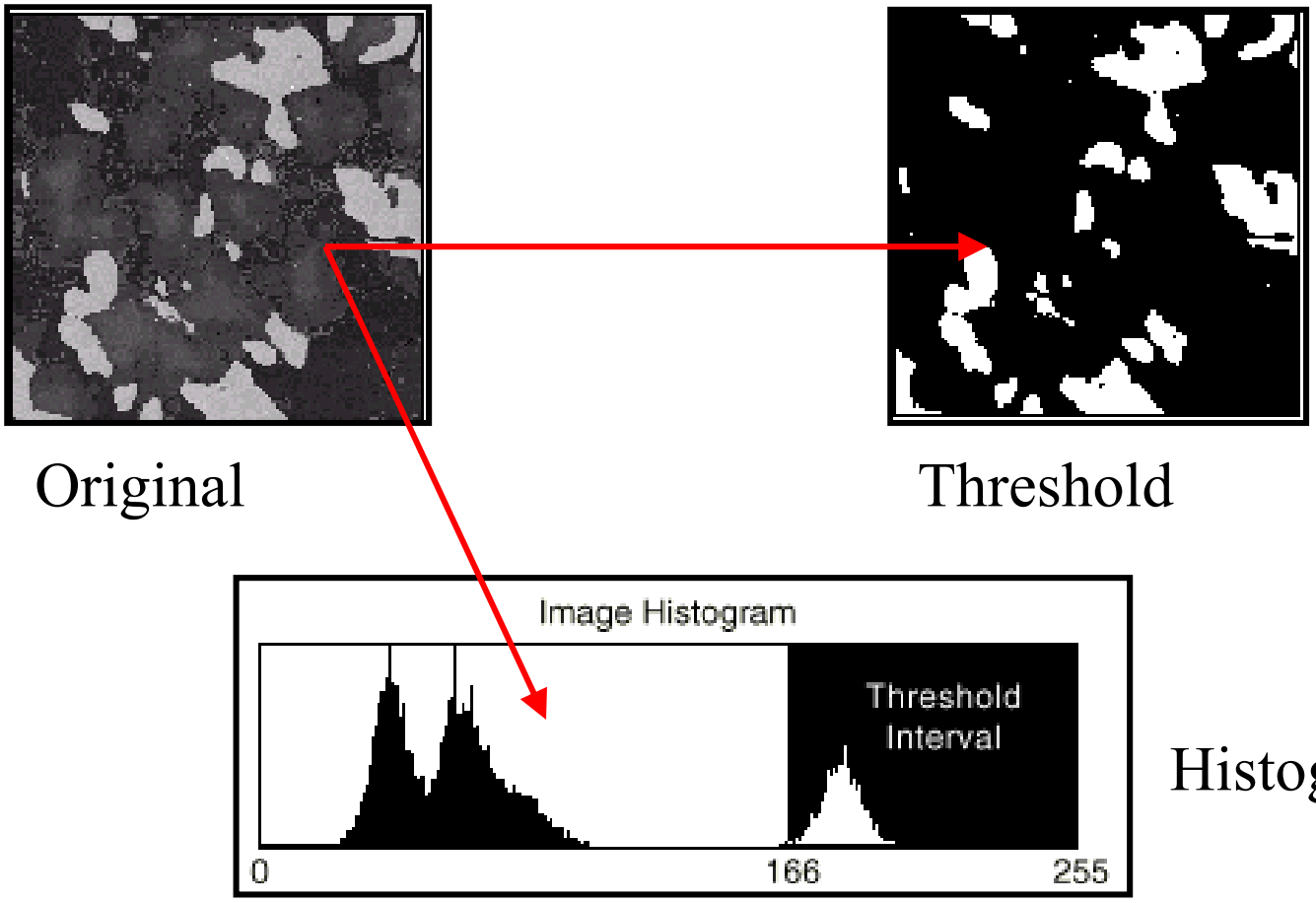
What is needed?

Barcode Reading
OCR

Automatic Storage Retrieval System Based on Product ID

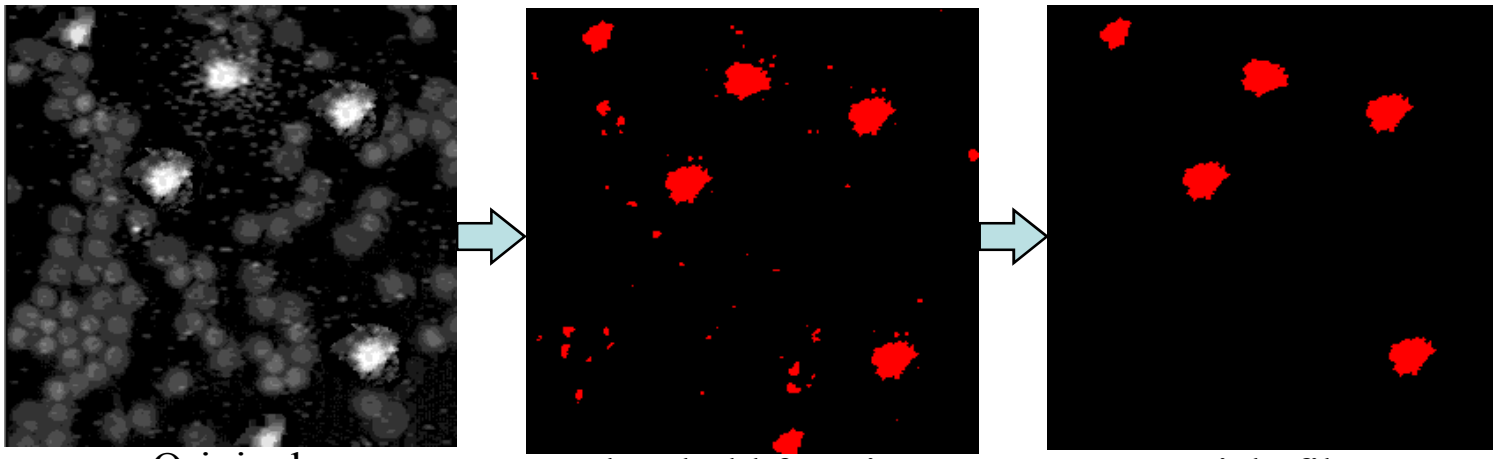
Communication with other automation products

Histograms and Thresholds



Particle Analysis

- Threshold
- Particle filter
- Particle analysis (More than 50 parameters available for analysis)
  - Quantity
  - Size and location
  - Area and circularity



Original | Threshold function | Particle filter

Optical Character Recognition and Barcodes

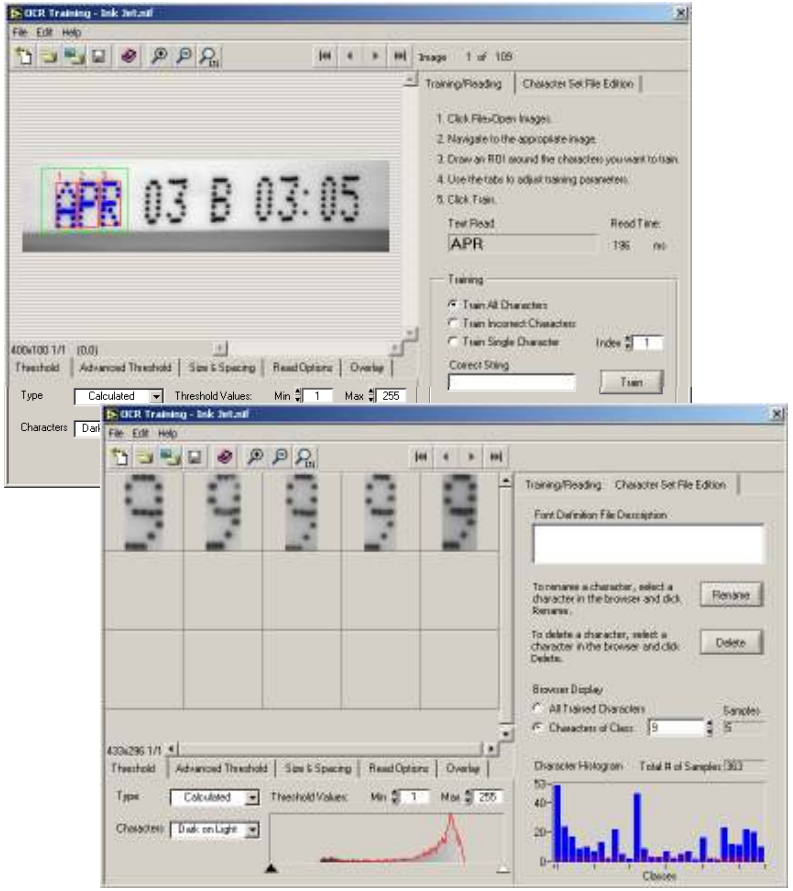
- Trainable OCR

  Trainable engine to learn a wide variety of fonts and symbols

- Barcodes

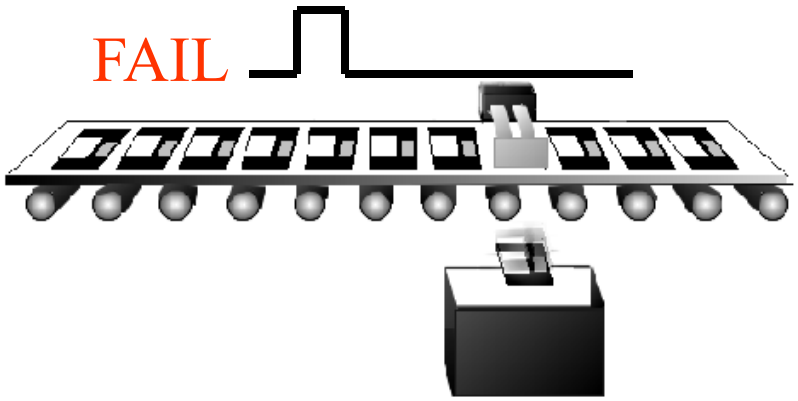
  Numerous 1D and 2D barcode formats supported

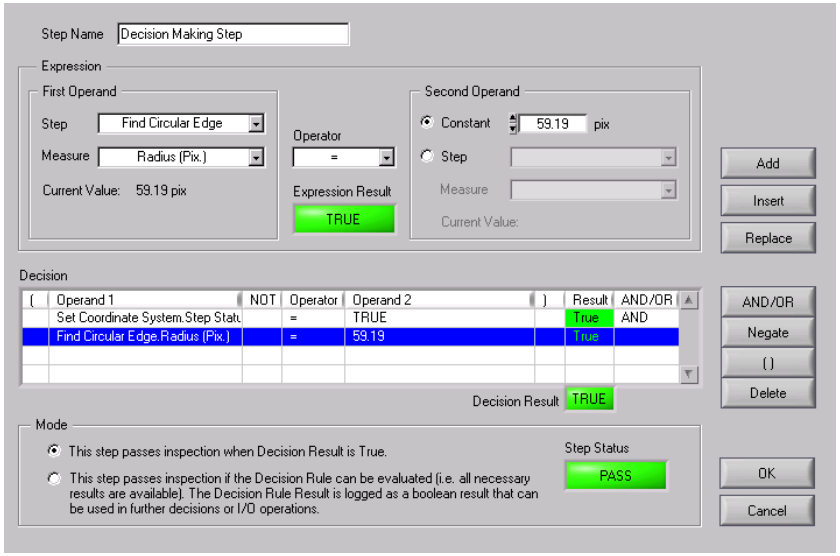
- New:
  - QR/micro QR
  - Pharma code
  - Limited RSS



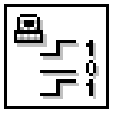
Decision Making and Digital I/O

- Set limits for each inspection step
- Set global limits by combining results from several inspection steps
- Map decisions and other parameters to serial port and digital I/O lines

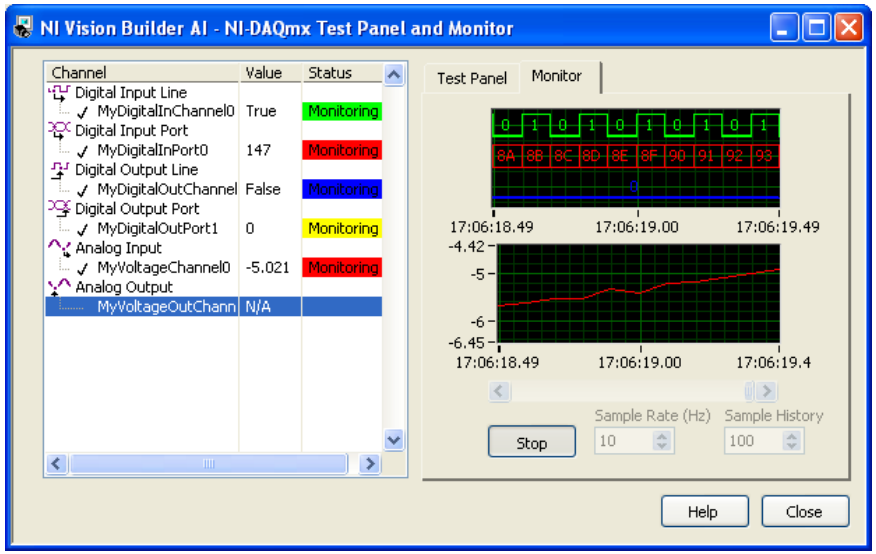




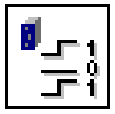
NI-DAQmx I/O Step

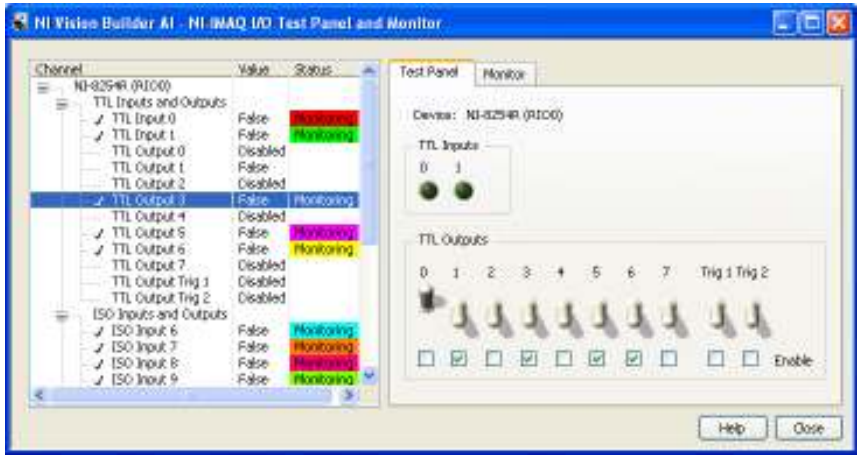


- Updated NI-DAQmx I/O step supports all devices supported by NI-DAQmx
- Read/write values or measurements to digital and analog I/O lines and digital ports
- Test and monitor I/O lines using the NI-DAQmx Test Panel and Monitor



NI-IMAQ I/O Step

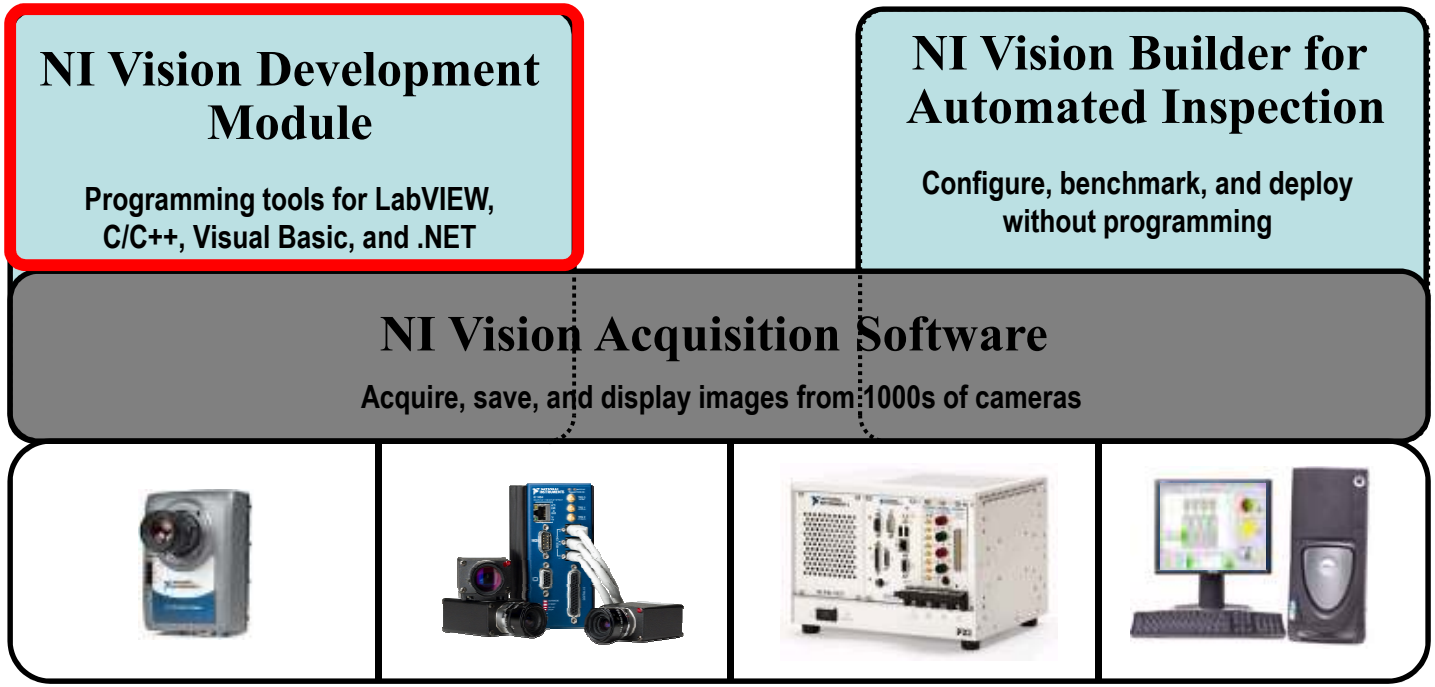
- NI-IMAQ I/O step supports NI CVS-1450 Series, NI PCI-8254R, NI PCIe-8255R devices & Smart Camera 
- Static Input and Output step
  - Read/write values and measurements to/from TTL and opto-isolated digital lines
  - Read product select port
  - Detect input lines changes
- NI-IMAQ I/O Pulse step
  - Single-shot pulse generation
  - Re-armed pulse generation
- NI-IMAQ I/O Test Panel and Monitor



Reading Characters and Numbers with OCR

Instructor Demo

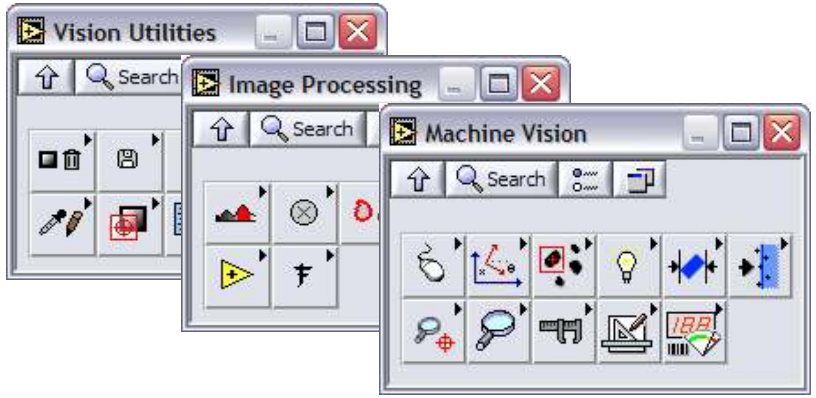
NI Vision Platform



The NI Vision Product Family

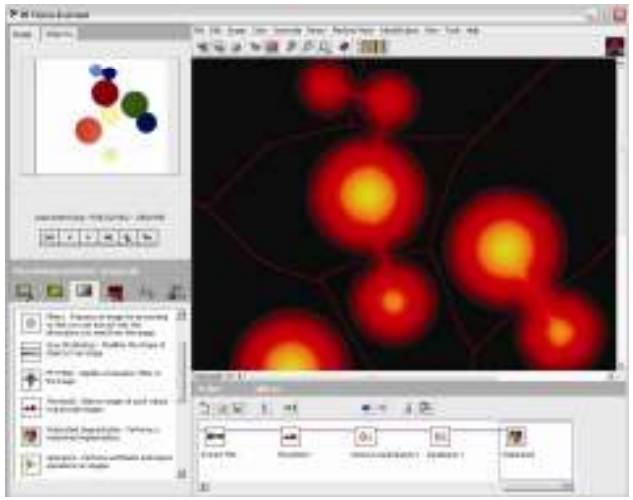
Vision Development Module

Programming tools for LabVIEW, C/C++, Visual Basic, and .NET



- **Vision Development Module** features:
  - Hundreds of image processing functions including pattern and geometric matching, OCR, barcode readers, object classification, and particle analysis
  - Tools to enhance images, check for presence, locate features, identify objects, and gauge parts
  - Fast application prototyping and code generation with Vision Assistant

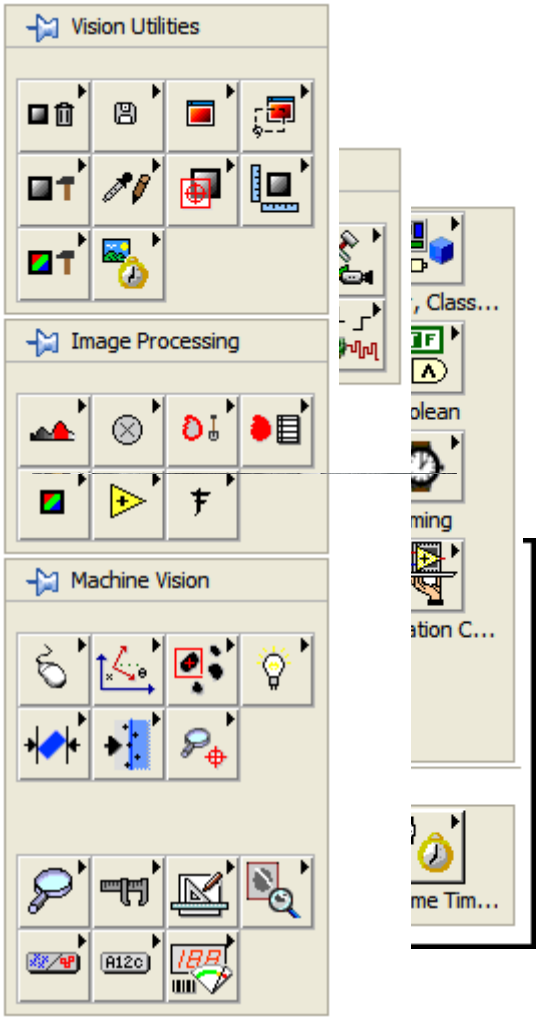
The NI Vision Product Family



- **Vision Assistant** gives you the ability to:
  - Create complex custom algorithms
  - Generate a LabVIEW VI or C/VB program from your image processing script
  - Prototype vision systems and experiment with different image processing functions
  - Maintain your original image in the reference window while storing several images for processing in the image browser

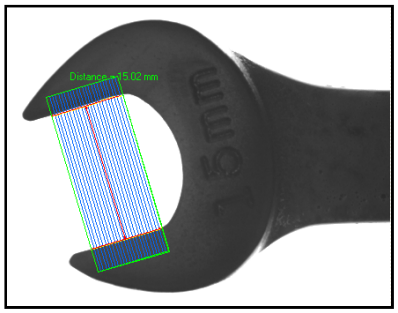
Development Software

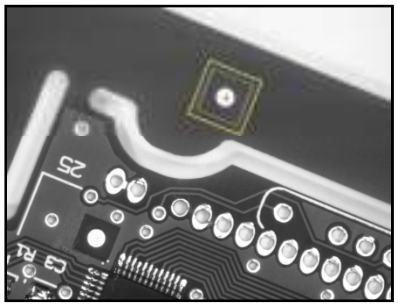
- LabVIEW Real-Time Module
- NI-IMAQ Driver
- NI Vision Development Module
- Other LabVIEW Modules and Toolkits: Control Design and Simulation Module, and more

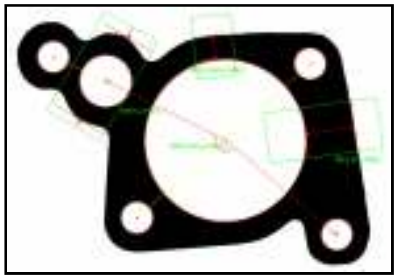


NI Vision Algorithms

- Enhance Image
  - Image Calibration
  - Image Filters
- Locate Features
  - Pattern Matching
  - Geometric Matching
  - Edge Detection
- Measure Features
  - Gauging
  - Geometry

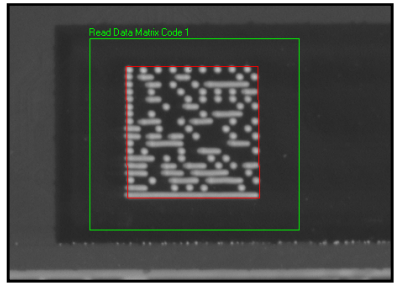






- Check for Presence
  - Intensity Measurements
  - Particle Analysis
  - Color Matching

- Identify Parts
  - Trainable OCR
  - Particle Classification
  - 1D Barcodes
  - 2D Code Readers (DataMatrix and PDF 417)

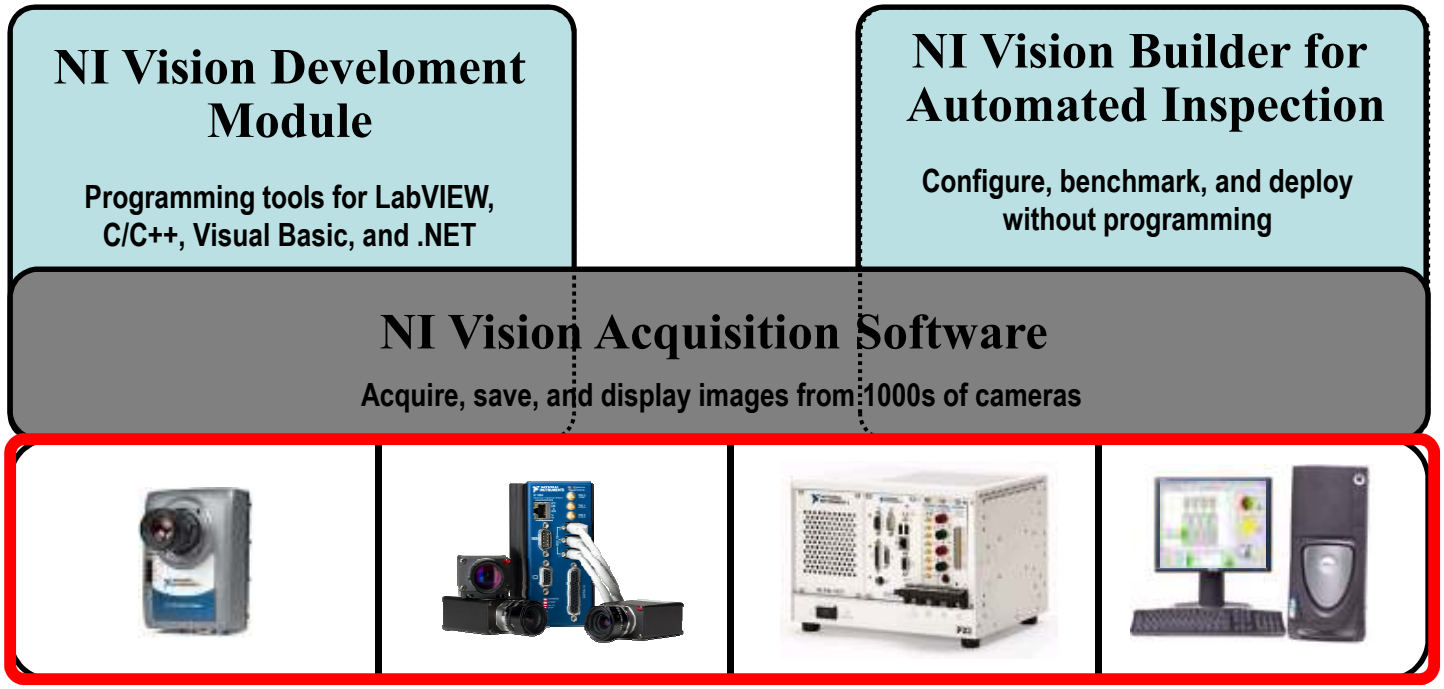


Vision Assistant LabVIEW Code Generation

Instructor Demo

Deploying Visual Inspections to Acquisition Hardware

NI Vision Platform



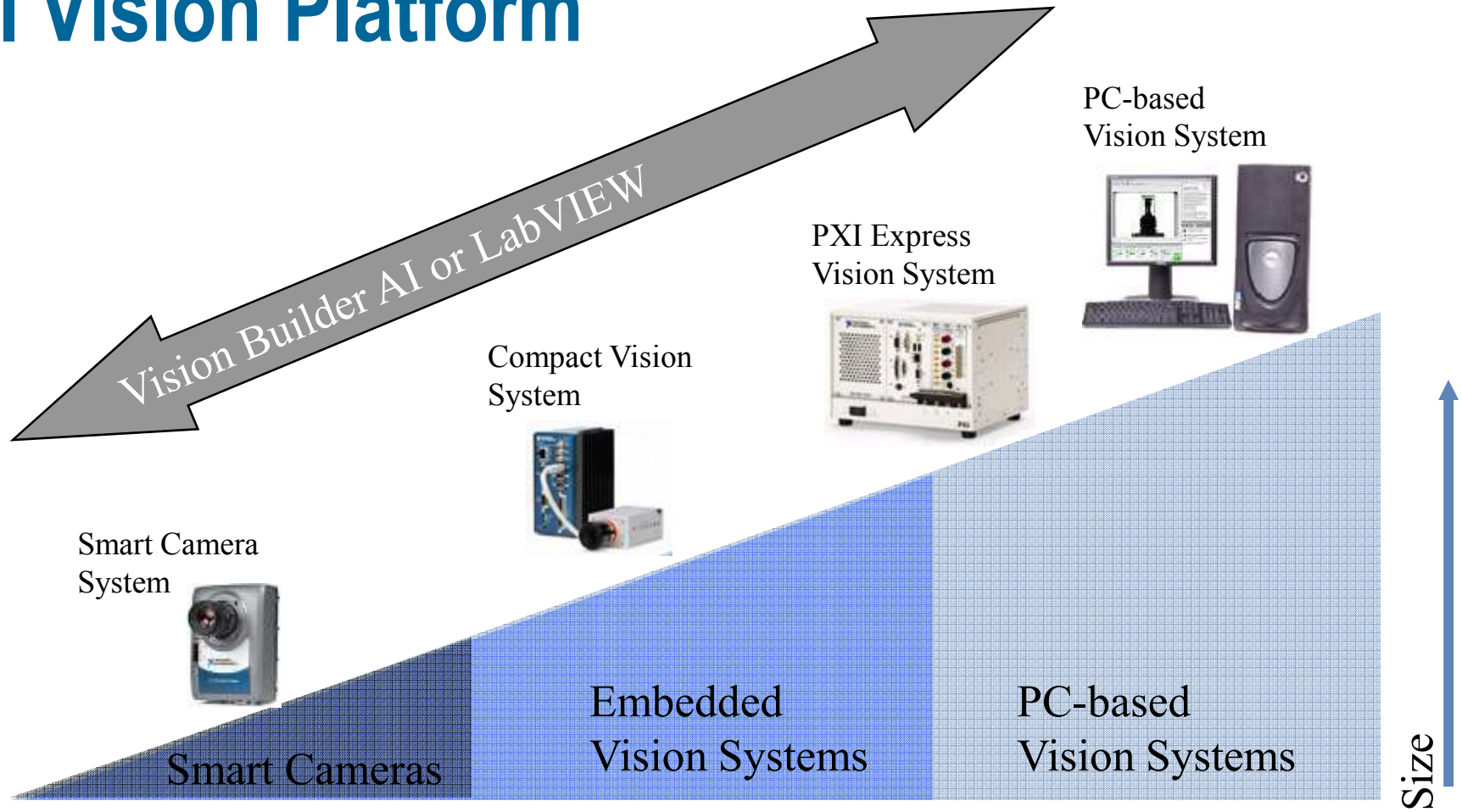
NI Image Acquisition (IMAQ) Hardware

- IMAQ devices feature:
  - Connectivity with parallel digital, analog and Camera Link devices
  - Advanced triggering and I/O capabilities
  - Up to 128 MB of onboard memory
  - Compatibility with motion control and data acquisition systems using the National Instruments RTSI bus
  - Preprocessing, which allows pixel and line scaling and region-of-interest acquisition
  - Real-time acquisition

NI Vision Hardware

- Frame grabber boards
  - Camera Link
  - IEEE 1394 and GigE
  - Standard and non-standard analog cameras
  - Parallel Digital
- Compact Vision Systems
- Smart Camera

NI Vision Platform



NI Vision Platform

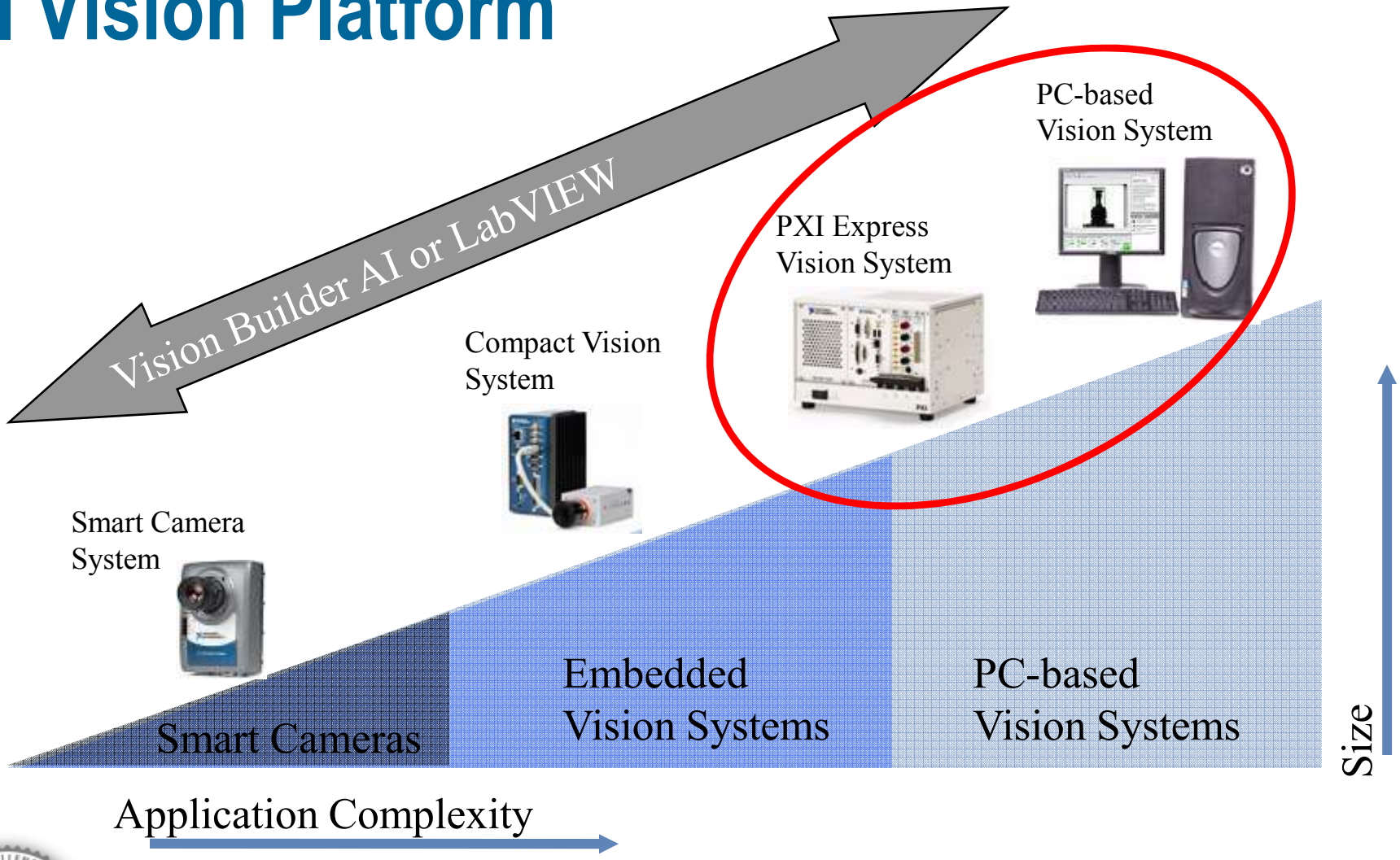
- Camera Link
  - NI PCIe-1429 (Full)
  - NI PCIe-1430 (Dual Base)
  - NI PCIe-1427 (Base)
  - NI PCI/PXI-1428 (Base/Medium)
  - NI PCI-1426 (Base)
- IEEE 1394
  - NI PCI/PXI-8252 (1394.a)
  - NI PCI-8254R (1394.a)
  - NI PCIe-8255R (1394.a & 1394.b)
- GigE Vision
  - NI PCIe-8231
- Analog
  - NI PCI-1410 (4-ch mono.)
  - NI PXI-1409 (4-ch mono.)
  - NI PCI/PXI-1411 (4-ch color/mono.)
  - NI PCI-1405 (1-ch color/mono.)
- Parallel Digital
  - NI PCI-1422 (RS422, LVDS)
  - NI PCI-1424 (RS422, LVDS, TTL)
- Compact Vision Systems
  - NI CVS-1456
  - NI CVS-1455
  - NI CVS-1454
- Smart Camera
  - NI 1722/1742

An interface for every camera on any bus

NI Vision Acquisition Software




NI Vision Platform

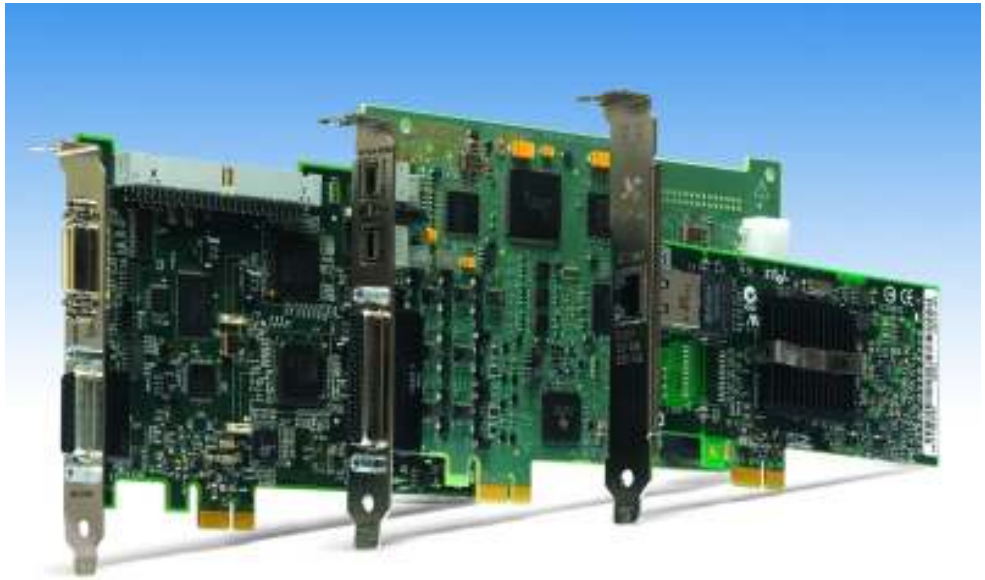


Machine Vision Hardware-PC

- Analog and Digital image acquisition devices for PCI, PCIe and PXI
- Vision Acquisition software that simplifies configuration and maintenance
- Analog devices for monochrome and color; multichannel and nonstandard formats
- Factory-calibrated hardware with real-time and embedded machine vision capabilities
- Digital devices for parallel digital, Camera Link, and IEEE 1394 (FireWire)
- Best performance and the most flexibility for the price!!

PCI Express Frame Grabbers

- Increased throughput with PCIe Cards
  - PCIe-1427 – x1 PCIe support for CameraLink
  - PCIe-8255 – x1 PCIe support for 1394 cameras
  - PCIe-8231 – x1 PCIe Gigabit Ethernet board

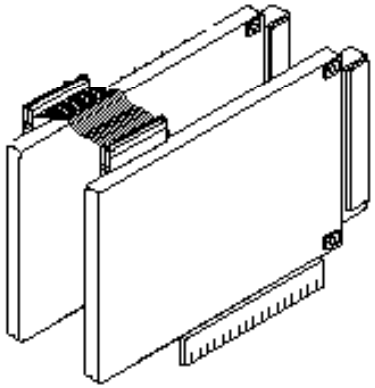


Synchronizing Vision, Motion and DAQ

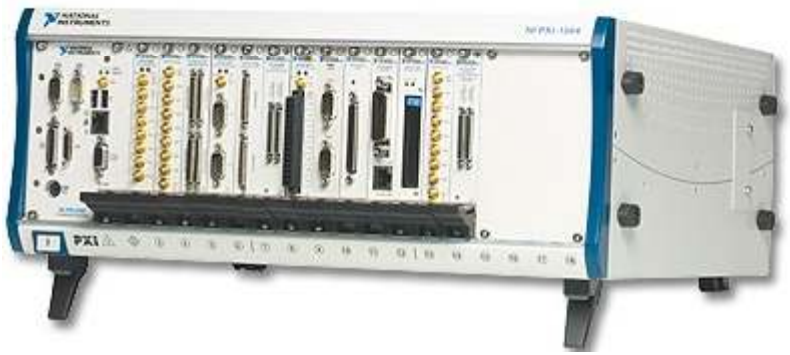
- PCI/PXI boards:
  - Motion control
  - Image acquisition
  - Digital I/O

Jaws of death Video!

- Vision/Motion Integration



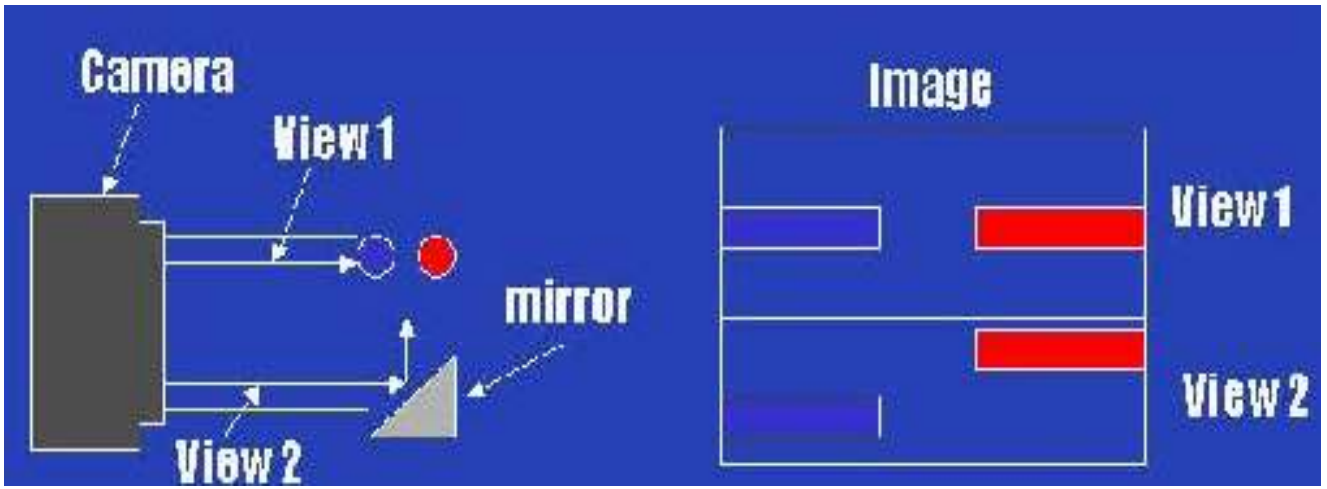
NO external cabling
NO host bus bandwidth consumption



10MHz time base
Eight-line trigger bus

Synchronizing Vision, Motion and DAQ

Aligning Optoelectric Devices



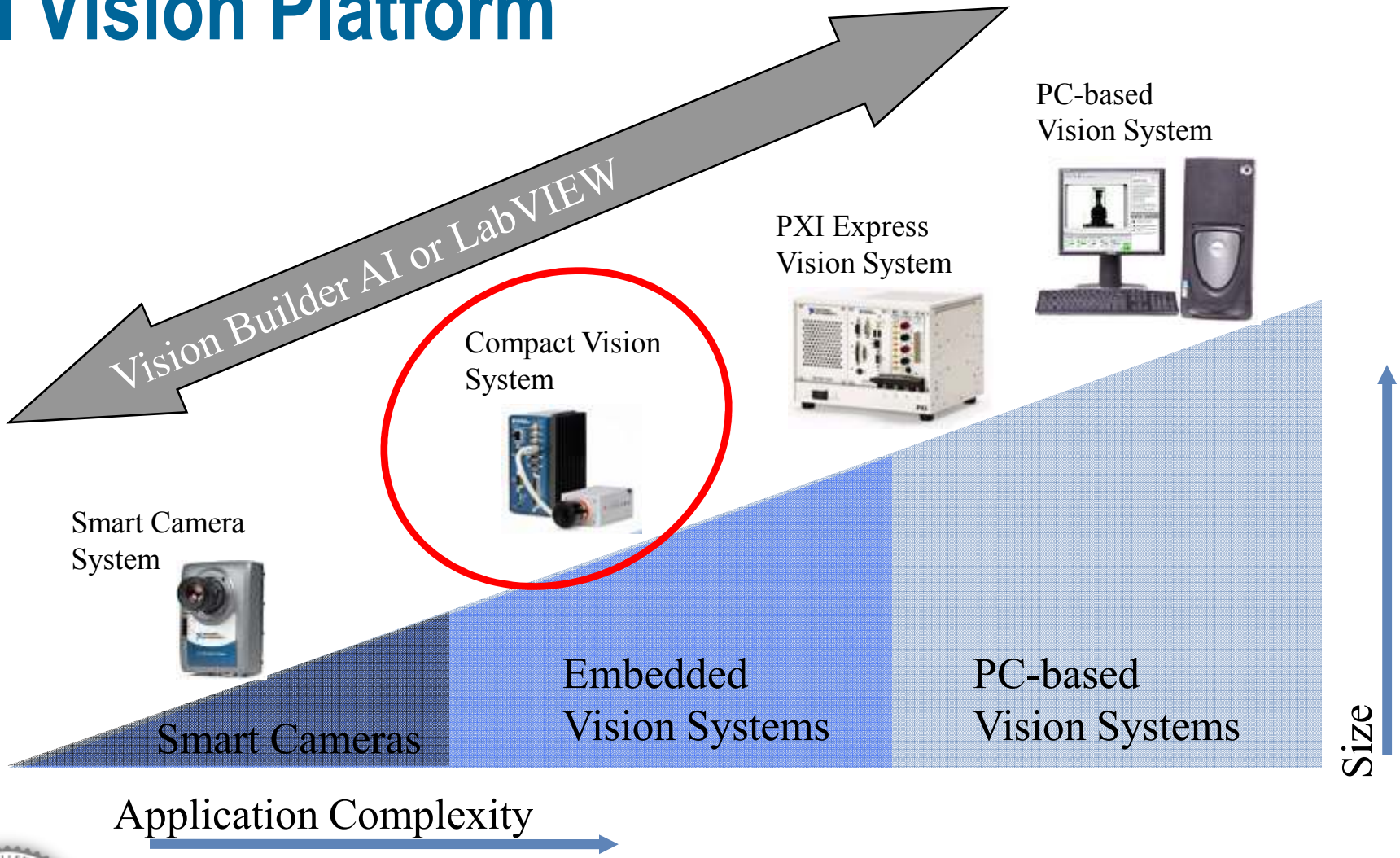
VISION + MOTION

Coarse alignment:
General alignment which has accuracy in the micron range

MOTION + DAQ

Precise alignment:
Alignment which has accuracy in the nanometer range

NI Vision Platform



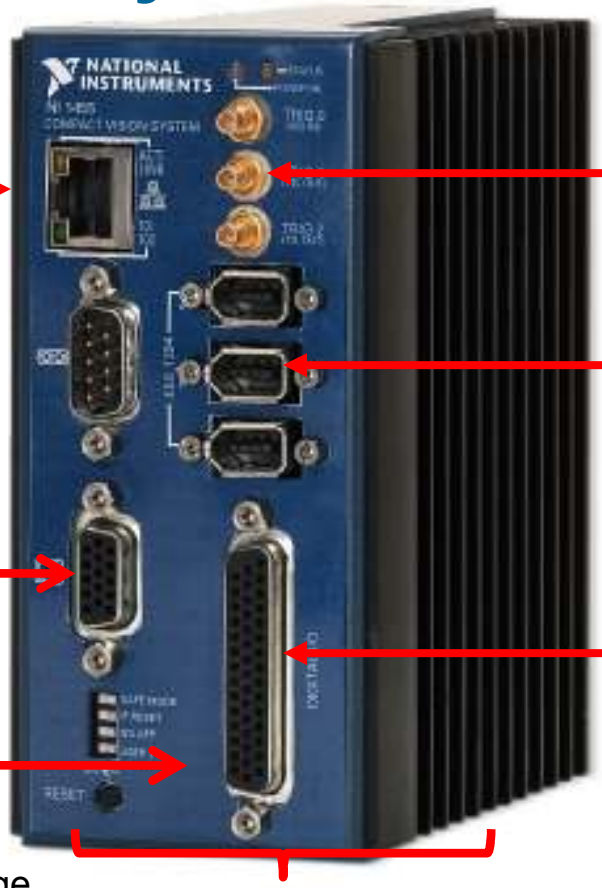
Compact Vision System

- Embedded high-performance processor for increased inspection speed
- 3 FireWire camera inputs
- Integrate with other devices through Ethernet, serial, and digital I/O
- Configure with NI Vision Builder

  for Automated Inspection, or program with NI LabVIEW and

  Vision Development Module

Compact Vision System



Ethernet
10/100 BaseT

Serial port
RS-232

VGA video out
Real-time output
Overlays supported
Up to 2,000 by 2,000 resolution

Industrial Ruggedness
No fan or external vents
Shock resistant
0-55˚C operating temperature range

Easy connect digital I/O
1 isolated input
2 TTL pulse outputs

IEEE 1394 ports
3 Ports
Shared 400 Mbps
Up to 16 cameras
Up to 100 f/s

Additional digital I/O
15DI/14DO
LabVIEW FPGA technology
Product select lines
Pulse generators
Watchdog timer

Processor Performance
Up to 1,623 MIPS
Nonvolatile storage
Up 256MB

Software Choice

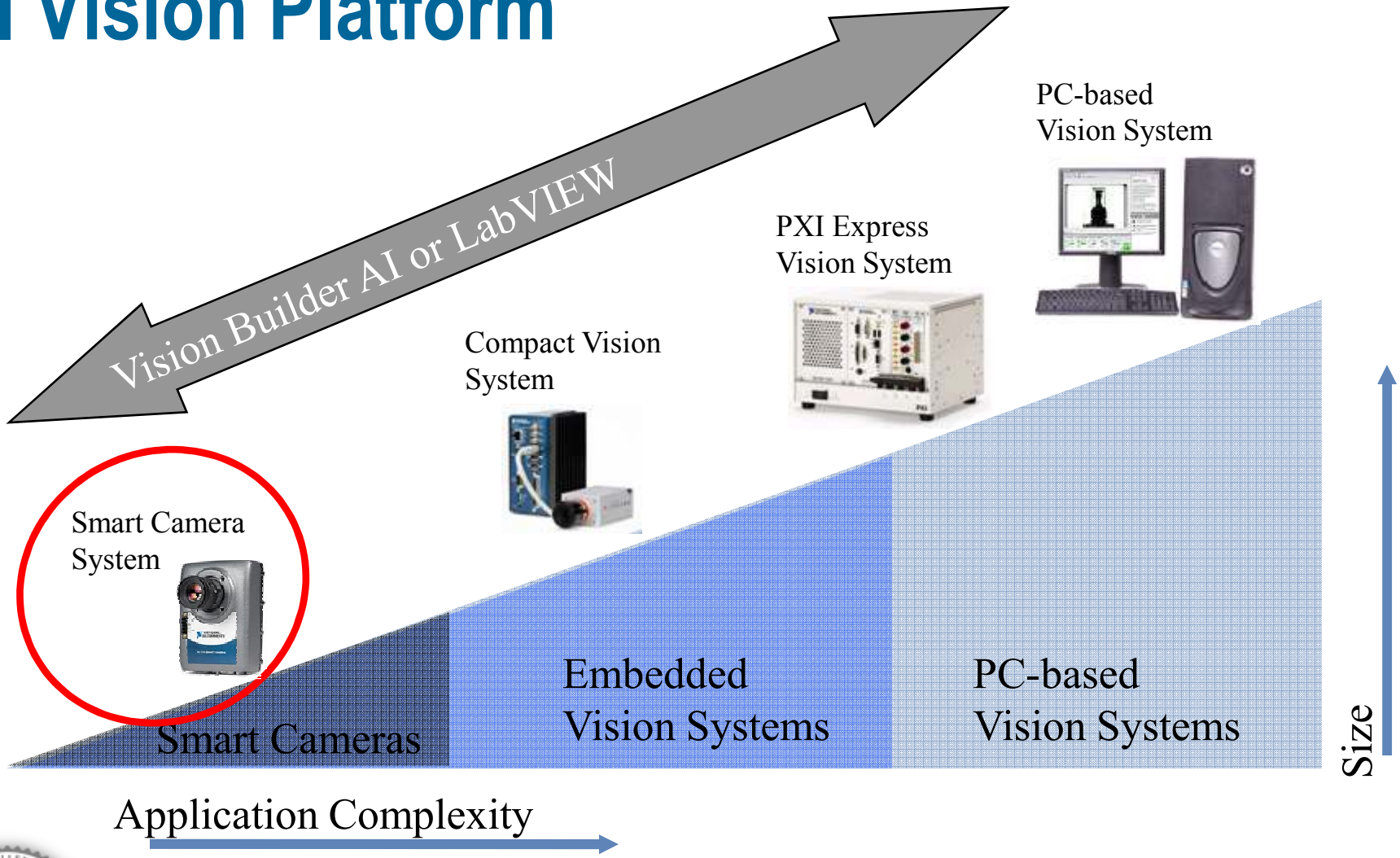
Interactive Configuration with Vision Builder for Automated Inspection

Graphical Programming with LabVIEW Real-Time

LabVIEW Demo using NI Vision functions and deploy to CVS

Instructor Demo

NI Vision Platform



A Smart Camera Is…

1. An all-in-one device used to locate, identify and inspect objects
2. An vision sensor that outputs inspection results, not images
3. The fusion of an automation controller with a camera sensor
4. The most popular vision hardware for industrial end users

- High-performance processor
  - PowerPC, DSP or X86
- Built-in I/O
- Real-time OS
- Programmed or configured remotely

- Industrial camera
  - CCD or CMOS
  - Many sensor speeds
  - Many sensor resolutions
- Standard lens mount

The NI Smart Camera

- **Best price/performance ratio, plus:**
  - Encoder support
  - Direct drive LED lighting
  - Dual gigabit Ethernet ports
  - Vision Builder AI included
- **Easier to use**
  - Vision Builder AI configuration software
  - Natively integrates with NI PACs
  - Communicates with existing industrial devices (PLCs, HMIs, OPC, etc)
- **More flexible**
  - Configurable and programmable
  - Expansion I/O with cFP-180x
- **Scalable**
  - Software scales to any NI Vision System (CVS, PXI, PC)

Unique Features & Differentiation

- Price/performance ratio
- Build-in lighting control
- Encoder support
- Dual Ethernet port
  - Debug
  - I/O Extension (e.g. NI cFP-1804)
- Deterministic Ethernet (EtherCAT) option

- Both programmable (LV) & configurable (VB AI)
- Seamless Integration in NI control platform
- Part of scalable Vision platform

NI Smart Camera Family

Multiple sensors, starting with
- Monochrome VGA CCD, 60fps
- Partial scan (½, ¼) and Binning

Direct Drive Lighting Control
- Strobe generation (5V TTL, 24V)
- Current lighting controller

Powerful processing
- PowerPC 400/533 MHz

LabVIEW Vision Builder for Automated Inspection

Dual Gigabit Ethernet
- I/O extension
- Debugging

Industrial I/O
- Opto isolated 2-in & 2-out
- RS232
- Encoder support

NI Smart Cameras

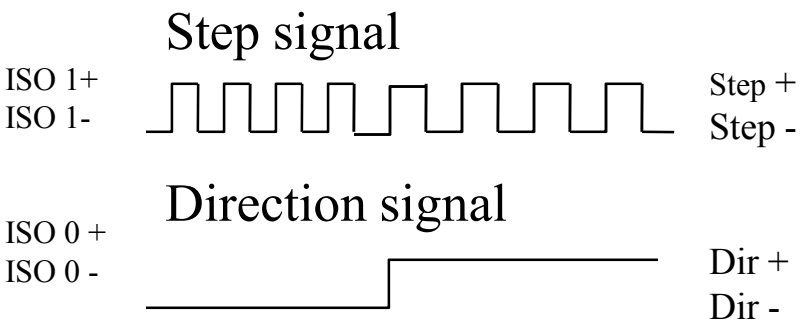
	Processor	Lighting Control	Encoder Support	Price
NI-1722	PPC 400MHz	✗	✗	$1999
NI-1742	PPC 533MHz	✓	✓	$2499
NI-1762	PPC 533MHz DSP 720MHz	✓	✓	$3499

Inputs/Outputs

- 2 opto-isolated input lines
  - Sinking/sourcing, 24 V
  - Camera trigger input
  - Product selection, learn input signal
- 2 opto-isolated output lines
  - Sinking/sourcing, 24 V, 100 mA
  - Connect to PLCs, drive solenoids, valves, relays…

Input/Outputs

- Isolated outputs pulse generation
  - Single-shot pulse—Drive ejection mechanism
  - Pulse train—Basic stepper motor control, PWM output
- Quadrature encoder input
  - Delay trigger or output pulse by given number of encoder counts
  - Read the absolute position of a motion axis



Direct Drive Lighting Control

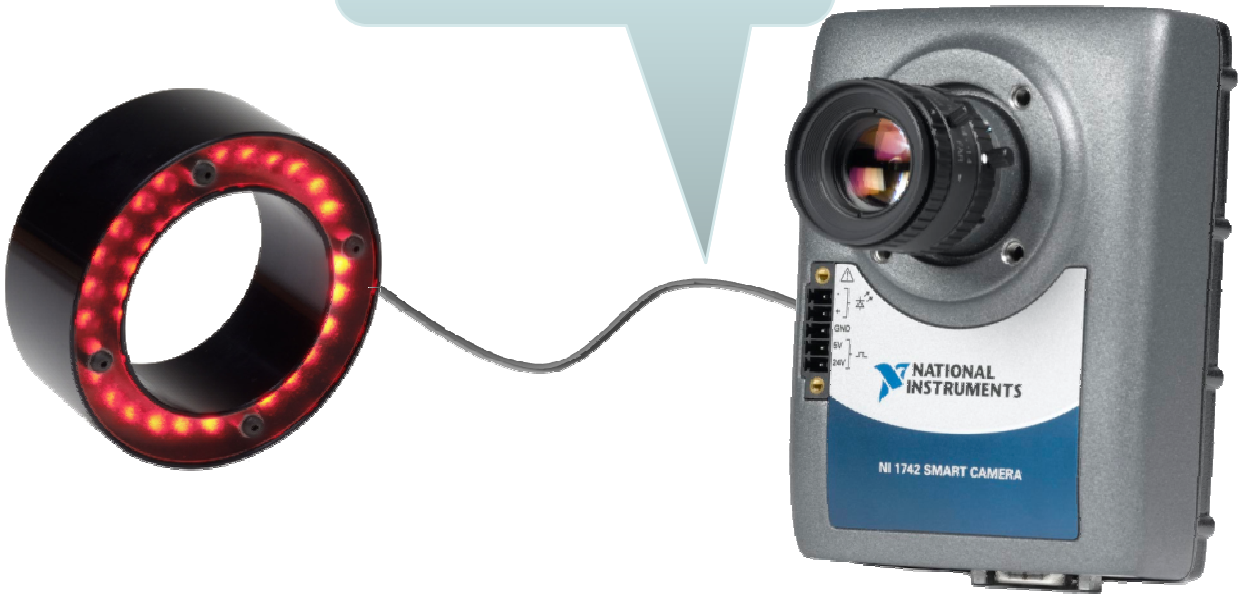
Strobe generation
- 5V TTL
- 24V

Power Supply

Lighting Controller

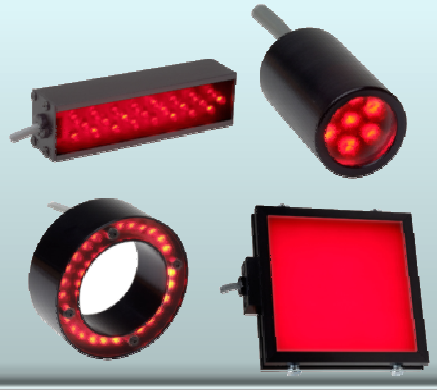
Direct Drive Lighting Control

Direct Drive
- Max 1A strobe
- Max 500 mA continuous



Lighting Control – NI 1742

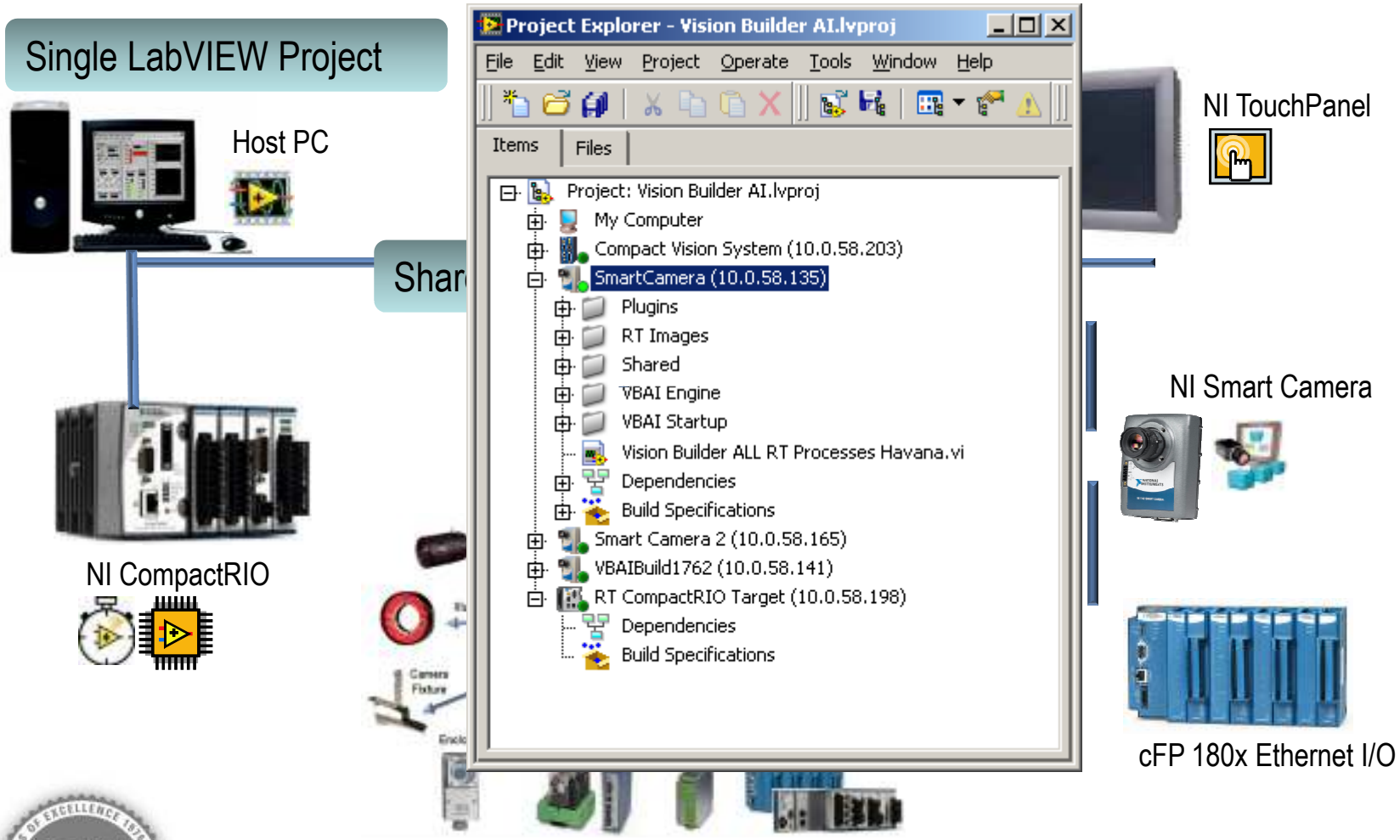
NI Lights



3rd Party Lights

- Max. 1A strobe
- Max. 500mA DC

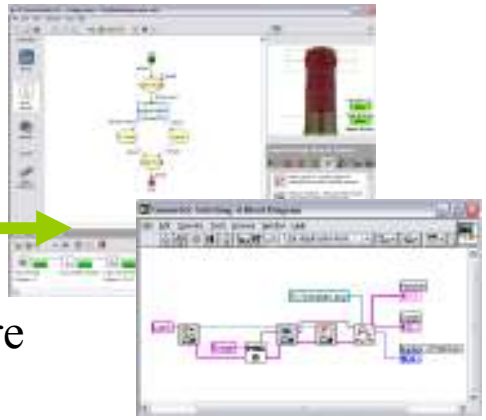
NI Industrial Platform



Completing the Package

Lens

Illumination



Software

Camera Fixture

Operator Interface

Ethernet Expansion I/O

Power Supply

I/O Breakout

CVS/Smart Camera Demo

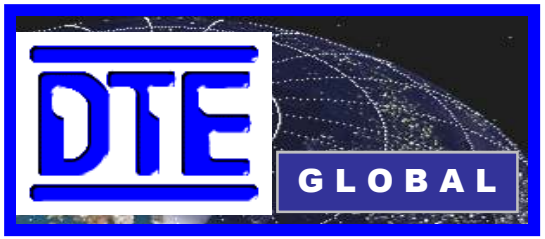
Demo

The Vision Ecosystem

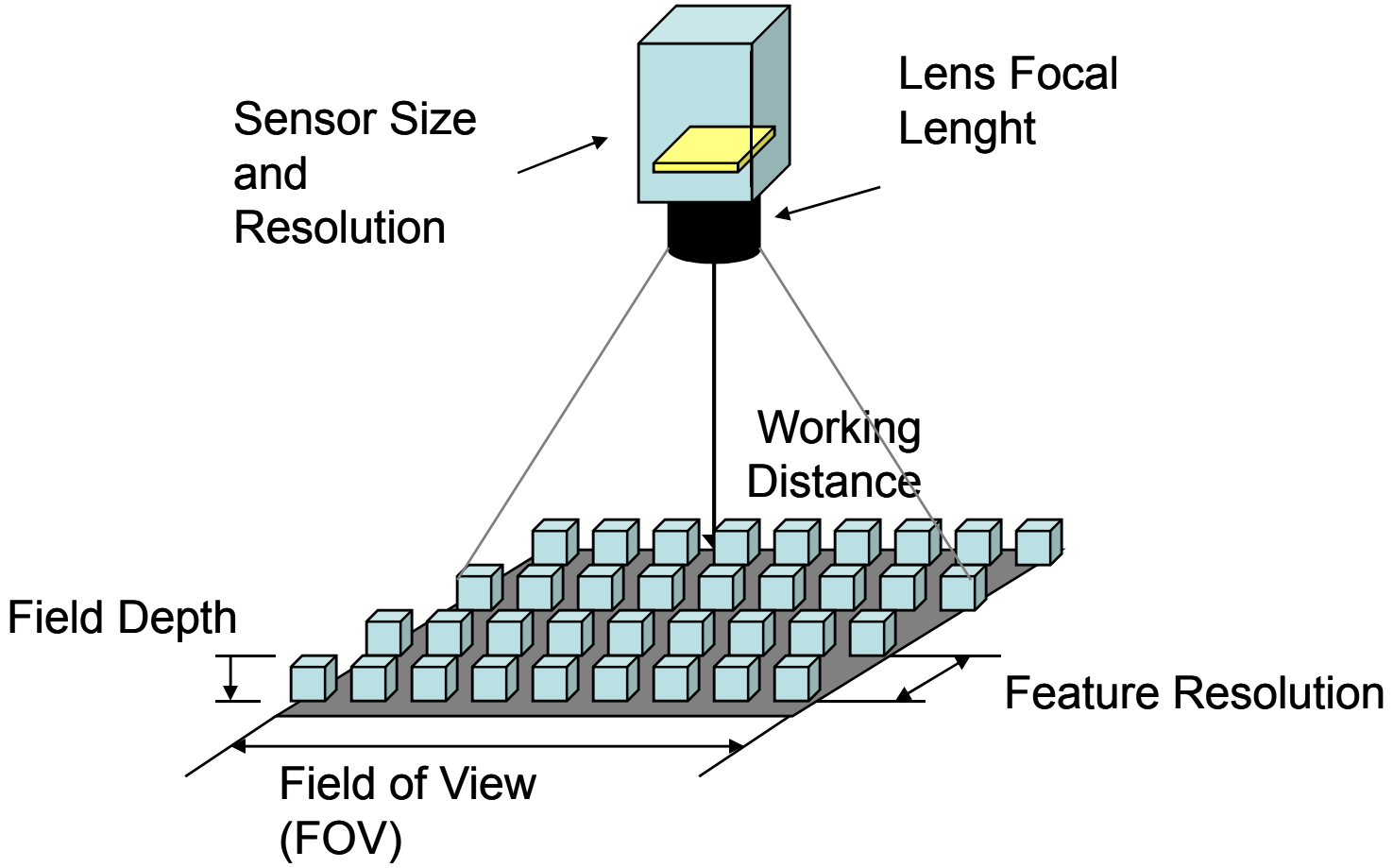
Vision Fundamentals

Concepts:

- Vision System Parameters
- Lighting Techniques
- Type of Cameras

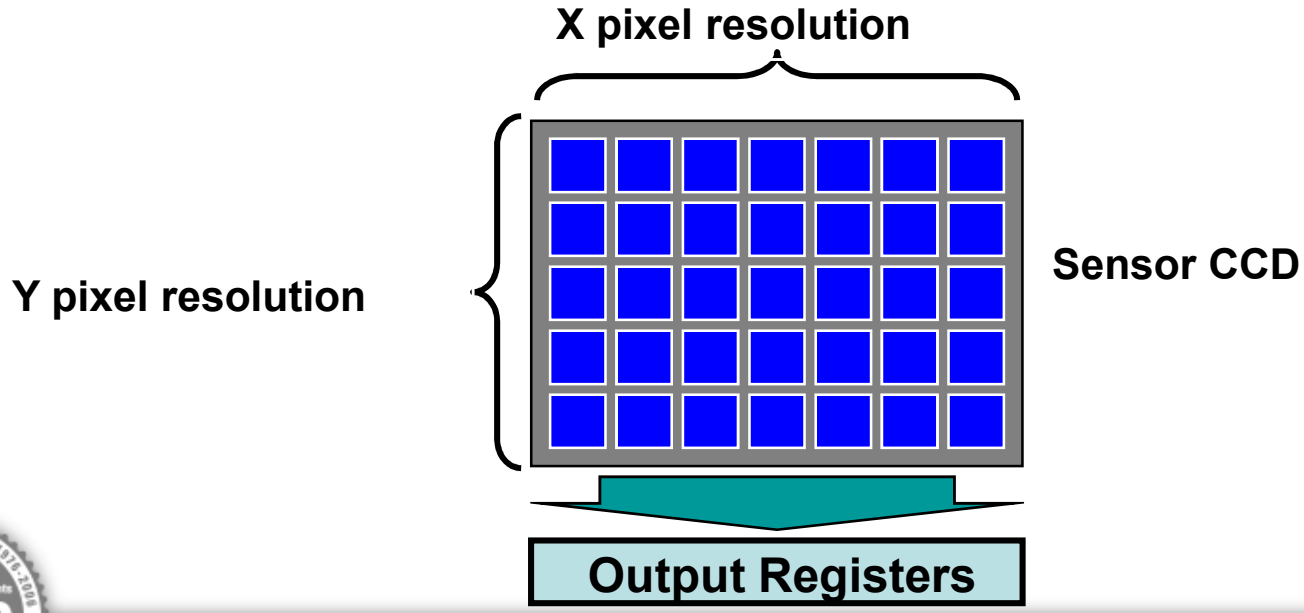


Fundamental Parameters



Sensors “Charge Coupled Device” (CCD)

- Sense Light Intensity
- Present information via registers

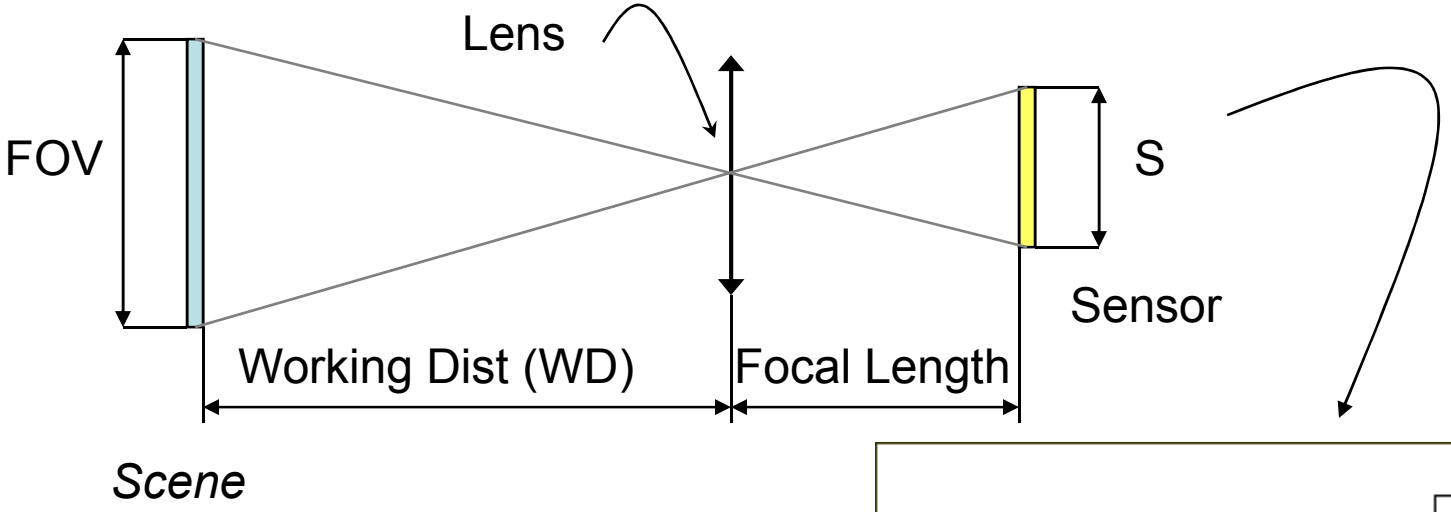


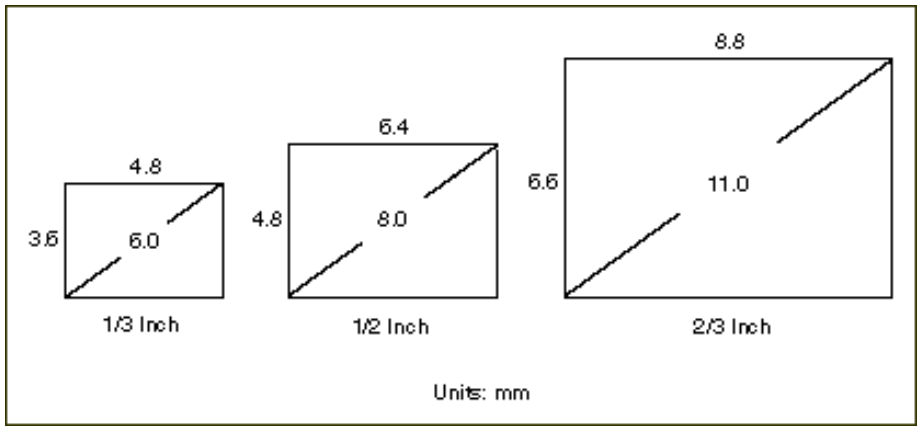
Camera Sensors

- Camera sensor resolution, is the number of columns and rows of CCD pixels
- *Sensor resolution= (FOV / resolution)* x *2*

Number of CCD Pixels	FOV	Resolution
640 x 480	**60 mm**	**0.185 mm**
768 x 572	**60 mm**	**0.156 mm**
1281 x 1072	**60 mm**	**0.093 mm**
2048 x 2048	**60 mm**	**0.058 mm**
4000 x 2624	**60 mm**	**0.030 mm**

Sensor Size





Focal Length = S x WD / FOV

Types of Lighting

Type	Feature	Advantage	Disadvantage
Ring	**Light encircles the camera length**	**Even Illumination**	**Can produce a circular glare**
Strobe	**Flash**	**Reduces motion blur**	**May have to apply artificial gain to avoid dark images**
Backlighting	**Objet placed between camera and light source**	**Useful for form evaluation**	**Curved objects can diffract light**

Diffused Lighting

- Some objects reflect light due to their surface texture or curvature
- You can use diffused lighting to eliminate glare

Backlighting

- Creates a sharp contrast that makes finding edges and measuring distances easy

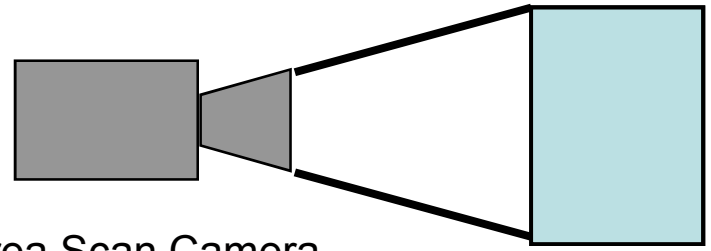
Camera Choice

1. Type of scan
2. CCD technology
3. Type of image processing

Type of Scan

Area Scan:

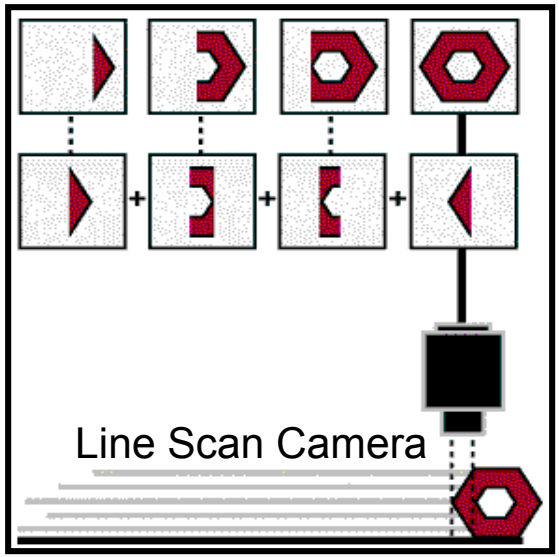
- Scans an area of pixels
- Inexpensive
- More popular



Area Scan Camera

Line Scan:

- Scans one line of pixels at a time
- Processing required to build image
- Applicable for big objects in movement, or rotary cylinders

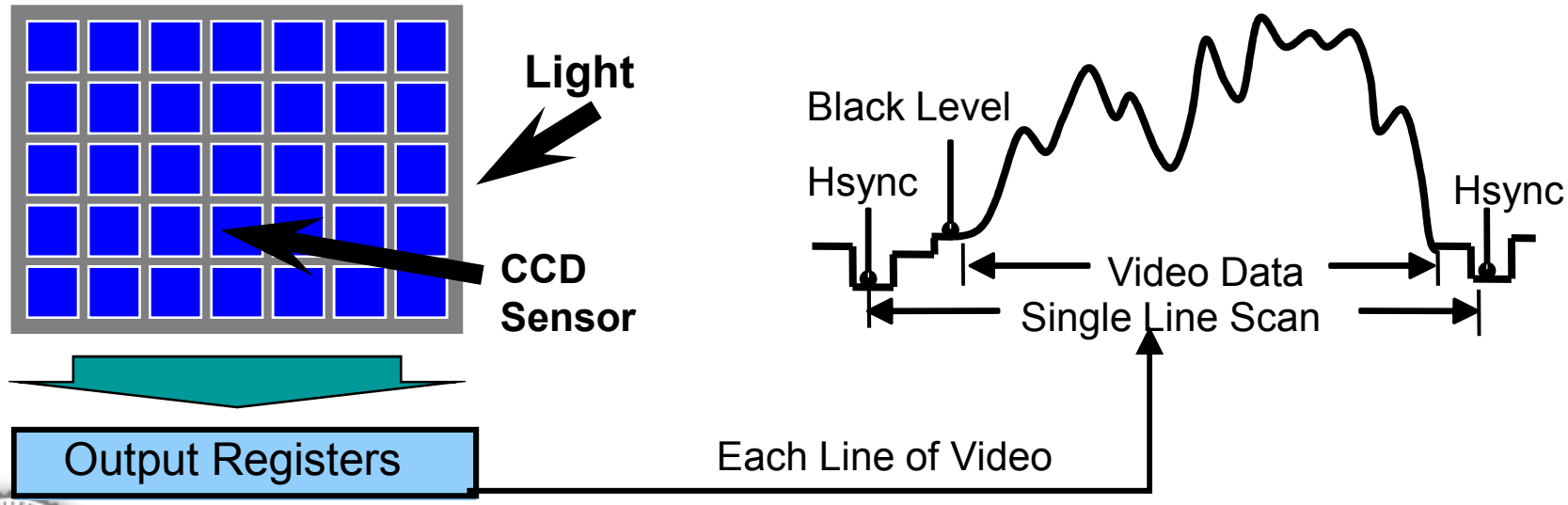


CCD Technology

- Infrared or Ultraviolet Cameras
  - Identifies not apparent aspects in the visible spectrum
  - Standard video output

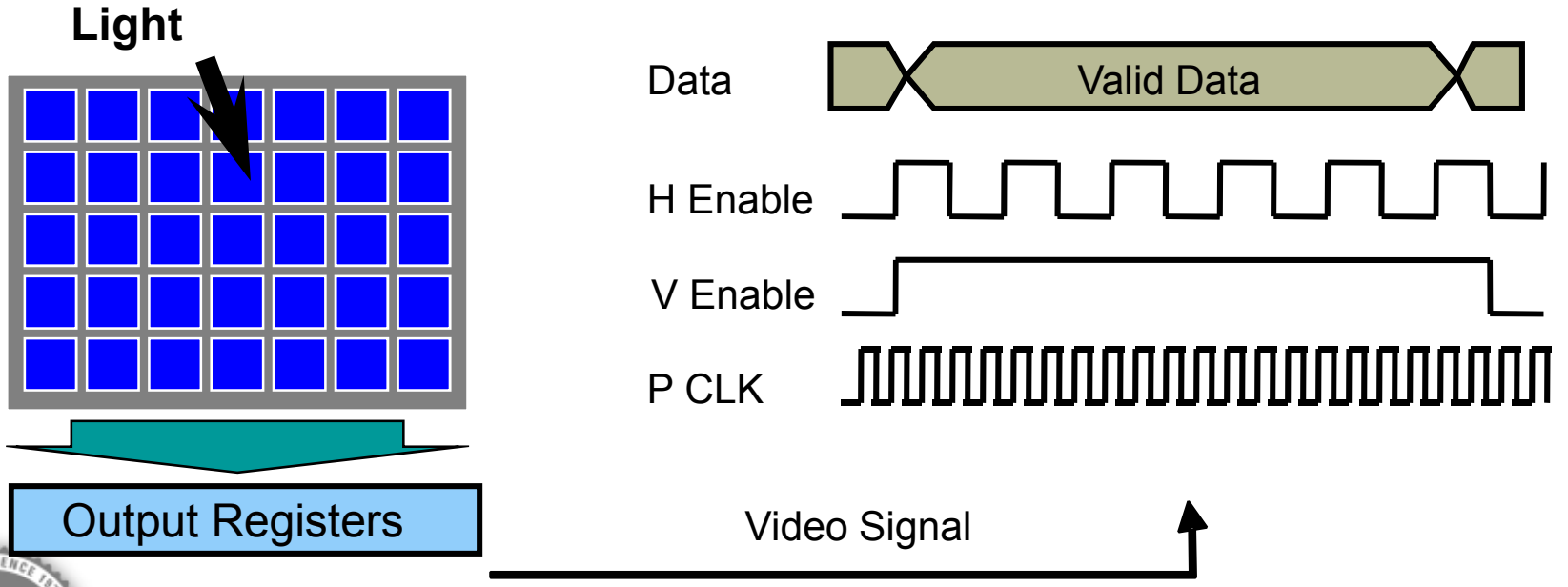
Analog Cameras

- Output video signals as variable voltage level
- Established technology
- Most common type of camera



Camera Formats: Digital

- Digitizer housed inside the camera
- High image quality and pixel depth
- Large image sizes and high frame rates



Analog vs. Digital

- Analog Cameras
  - Established technology
  - Simple cabling
  - Low cost
  - Potentially poor image quality
- Digital Cameras
  - High speed, high pixel depth, and large image sizes
  - Programmable controls
  - Less image noise
  - Expensive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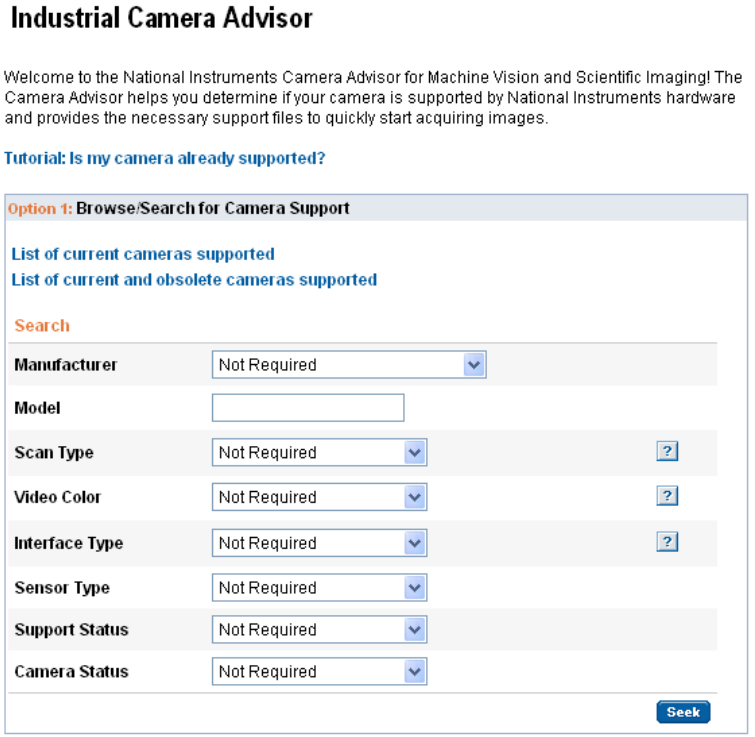
La automatización al alcance de todos
NADIE MAS PUEDE OFRECERLE UN PAQUETE DE SOLUCIONES
TAN INNOVADORAS Y ACCESIBLES PARA:
Protección de su valioso inventario o proceso:
Reaccione a tiempo
Supervise continuamente las condiciones de su inventario o proceso crítico.
Identifique fácilmente sus puntos de riesgo o de mejora
Telemetría Inalámbrica Celular
Reporte a su computadora por internet
Reducción de sus costos
Mejore el desempeño de sus bombas y compresores
Alargue su vida útil
Incremente la calidad y confiabilidad del servicio
Minimice sus costos directos!
Familia HIDROMATIC
Ahorro de Energía
Utilice sólo la energía que su proceso requiera
Corte de sus recibos el pago excesivo por demanda máxima!
Variadores de Velocidad
Arrancadores Suaves
Monitoreo de Demanda
DTE GLOBAL, S.A de C.V.
Periférico de la Juventud #8329, Fracc. Bahias, C.P. 31125, Chihuahua, Chih. (614) 455-8855 y 455-8844
www.dtesite.com e-mail: ventas@dtesite.com

Camera Comparison

- Analog Cameras
  - Standardized
  - Low cost
  - Simple connectivity
- Digital Cameras
  - Greater spatial resolution
  - Faster data rates
  - Greater pixel depth
  - Greater noise immunity
  - Various standards



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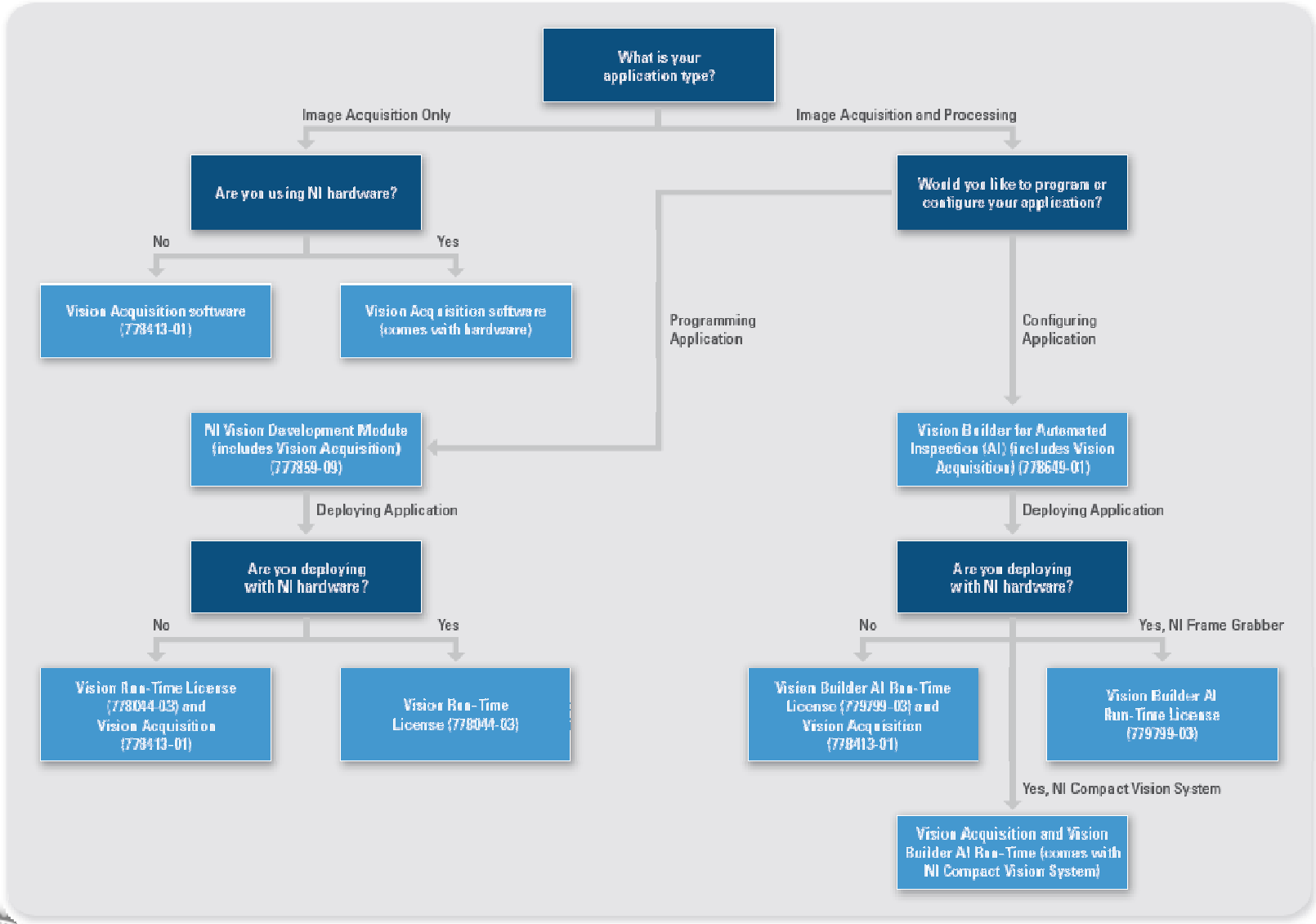
What is your application type?
Image Acquisition Only
Image Acquisition and Processing
Are you using NI hardware?
No
Yes
Vision Acquisition software (778413-01)
Vision Acquisition software (comes with hardware)
Would you like to program or configure your application?
Programming Application
Configuring Application
NI Vision Development Module (includes Vision Acquisition) (777859-09)
Vision Builder for Automated Inspection (AI) (includes Vision Acquisition) (778649-01)
Deploying Application
Deploying Application
Are you deploying with NI hardware?
Are you deploying with NI hardware?
No
Yes
No
Yes, NI Frame Grabber
Vision Run-Time License (778044-03) and Vision Acquisition (778413-01)
Vision Run-Time License (778044-03)
Vision Builder AI Run-Time License (779799-03) and Vision Acquisition (778413-01)
Vision Builder AI Run-Time License (779799-03)
Yes, NI Compact Vision System
Vision Acquisition and Vision Builder AI Run-Time (comes with NI Compact Vision System)

Low Total Cost of Ownership

- Development
  - Single API for all development (from R&D to the factory)
  - Fastest time to vision
- Deployment
  - CVS deployment – FREE
  - PC-based deployment - $295
  - Platform independent deployment
- Support
  - WW network of system integrators
  - 200 worldwide application engineers

Leveraged Benefits of NI Approach

- Over 900 R&D Engineers – New products
- Invest over 16% in R&D – New technologies
- 85 Field Sales Engineers in the US – Local presence
- 100s Application Engineers WW – Support
- Consulting Engineers – Feasibility
- Strategic 3rd Party Vendor Partnerships – Complete product
- Over 500 System Integrators – Complete solution
- Over 25 years of industry experience – Comfort

Vision Services and Support

- Services to meet the needs of the application lifecycle
- Technical Support
  - Web support resources
  - Applications engineers worldwide
  - Premier Support
- Software Maintenance Services
  - IMAQ Vision Software Subscription Program
  - NI Developer Suite
  - NI Factory Installation Services for PXI/SCXI
- Professional Services—Feasibility, consulting, system integration through our Alliance Program members

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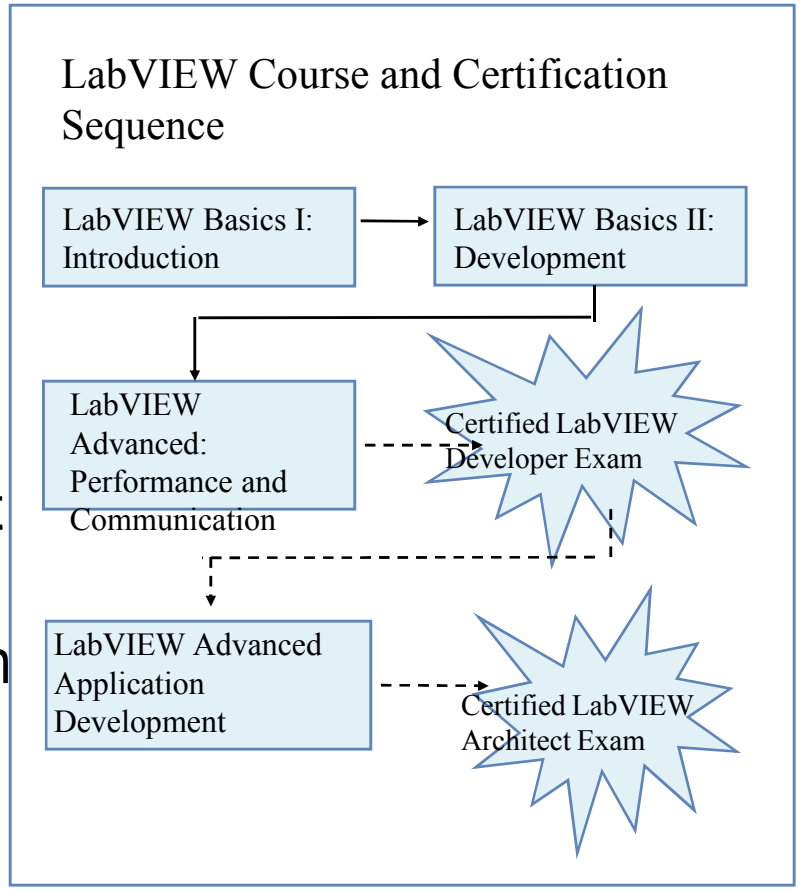
Vision Training and Software Certification

- **Instructor-led classroom training**
  - Machine Vision and Image Processing
  - Basic to Advanced LabVIEW courses, such as:
    - LabVIEW Basics I: Introduction
    - LabVIEW Basics II: Development
    - LabVIEW Advanced: Performance and Communication
- **Onsite training**
- **Self-paced training**
- **LabVIEW and TestStand Certification**



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Resources to Ensure Success

- Camera Advisor
- Application notes
- Customer solutions
- Evaluation software
- Example code
- Add-on products
- Technical support
- Contact our field engineers for more information