NI Vision Platform

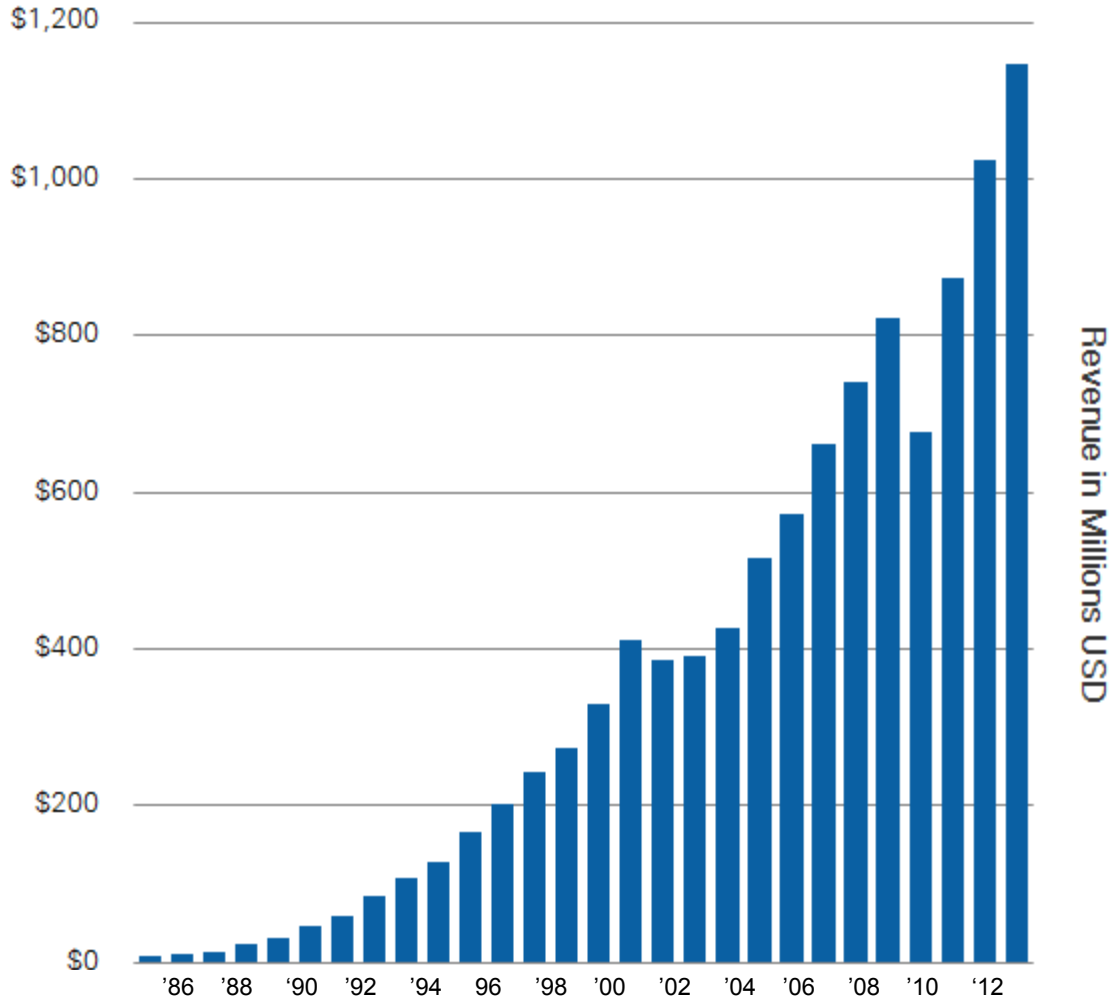
Radim ŠTEFAN

www.ni.com/vision

NATIONAL INSTRUMENTS™

National Instruments – Our Stability

- **Revenue:** $1.15B in 2012
- **Innovation:** 18% re-invested to R&D
- **Global Operations:** Approximately 7,100 employees; operations in more than 40 countries
- **Broad customer base**: More than 35,000 companies served annually
- **Diversity**: No industry >15% of revenue
- **Culture**: Ranked among top 25 companies to work for worldwide by the Great Places to Work Institute



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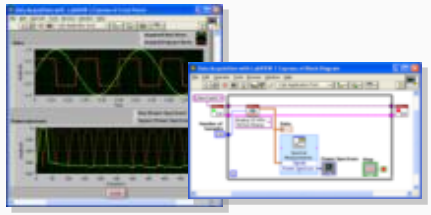
National Instruments—What We Do

NI combines graphical programming software with modular hardware, leveraging the latest technologies.

Low-Cost Modular Measurement and Control Hardware

Productive Software Development Tools



Highly Integrated Systems Platforms

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Graphical System Design

A Platform-Based Approach for Measurement and Control

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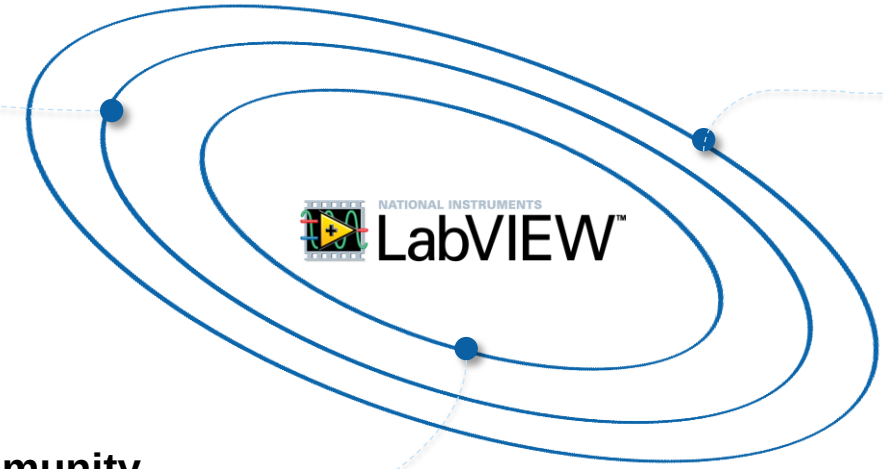
The LabVIEW Ecosystem

LabVIEW Tools Network
1,000,000+ Add-Ons Downloaded
26+ Certified Add-Ons
100+ Available Add-Ons



Partners and Solutions
700+ Alliance Partners

User Community
9,000+ Certified Users
700+ Alliance Partners
60+ Registered User Groups

Automotive and Aerospace

- Assembly verification
- Gauging and metrology
- Quality assurance
- Surface inspection for metal and glass

Food, Pharmaceuticals, Consumer Goods

- Defect detection
- High-speed sorting
- Packaging inspection
- Traceability and identification
- Web inspection for fabrics and paper

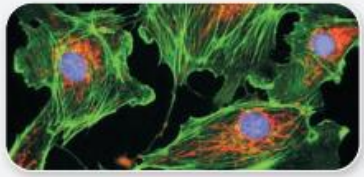
Vision-Guided Robotics

- Industrial robot guidance
- Pick and place
- Obstacle avoidance for autonomous vehicles
- Simultaneous localization and mapping

Semiconductor and Solar

- Electroluminescence
- Shunt detection
- Silicon purification
- Solar inspection for thin-film and crystalline photovoltaics
- Wafer sorting and alignment

Medical and Scientific



- Automated microscopy
- Body temperature scanning
- Eye tracking
- Fluorescence imaging
- Optical coherence tomography (OCT)

Electronics Validation

- Cell phone camera testing
- Display inspection
- Image sensor testing
- LED testing
- PCB inspection

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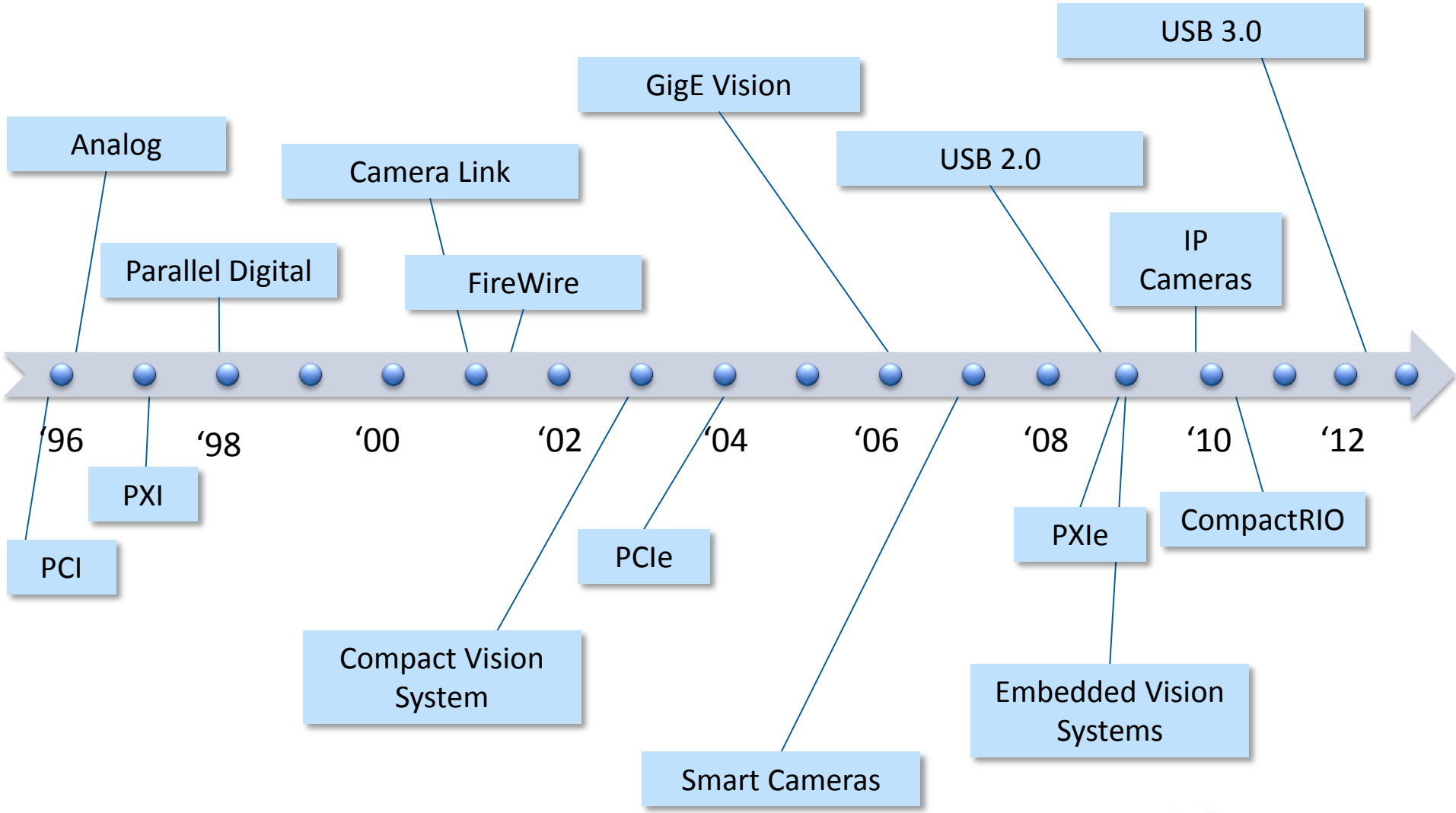
17 Years of Vision at National Instruments



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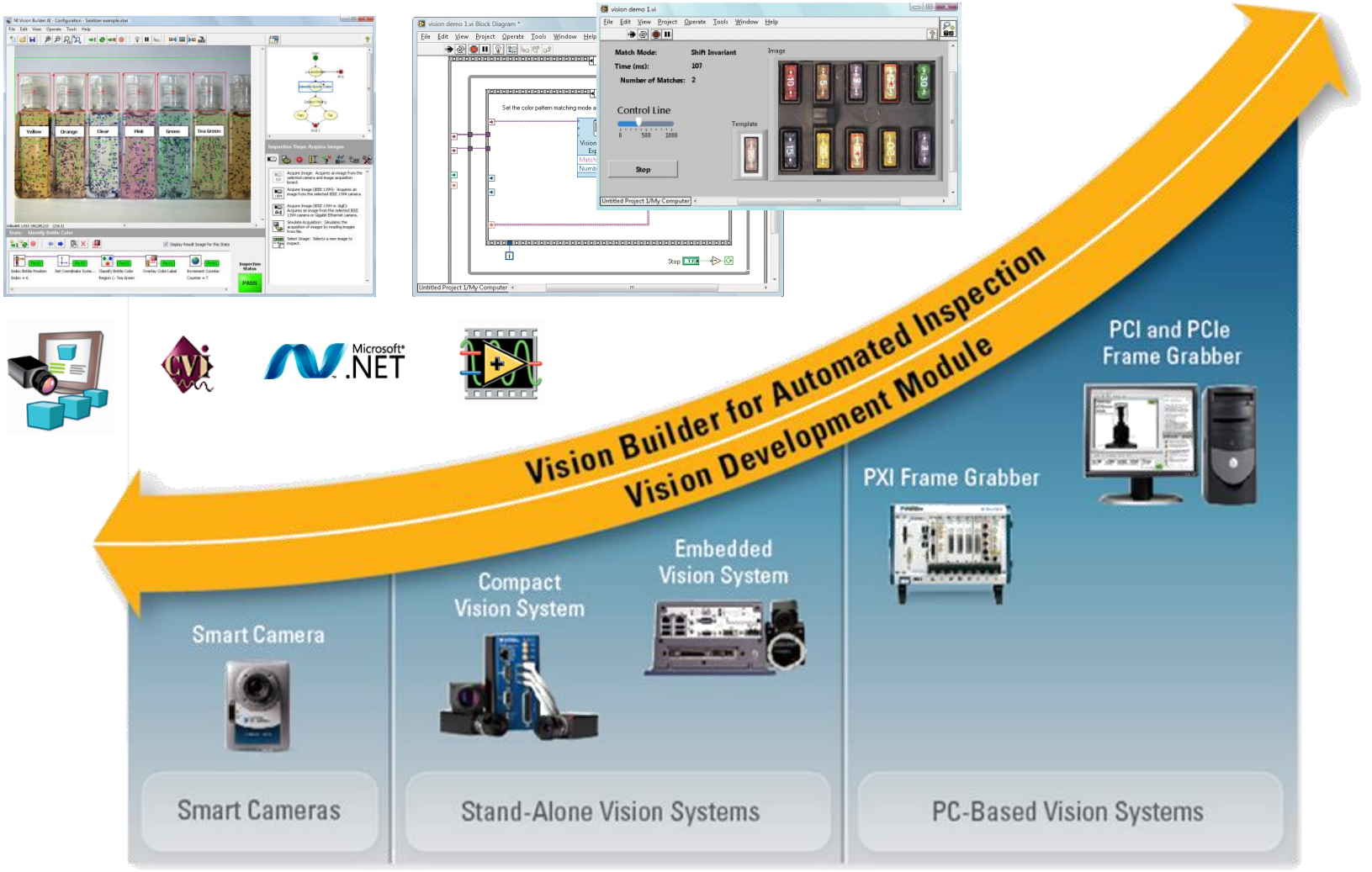
NI Vision Platform



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NI Vision Platform - Hardware

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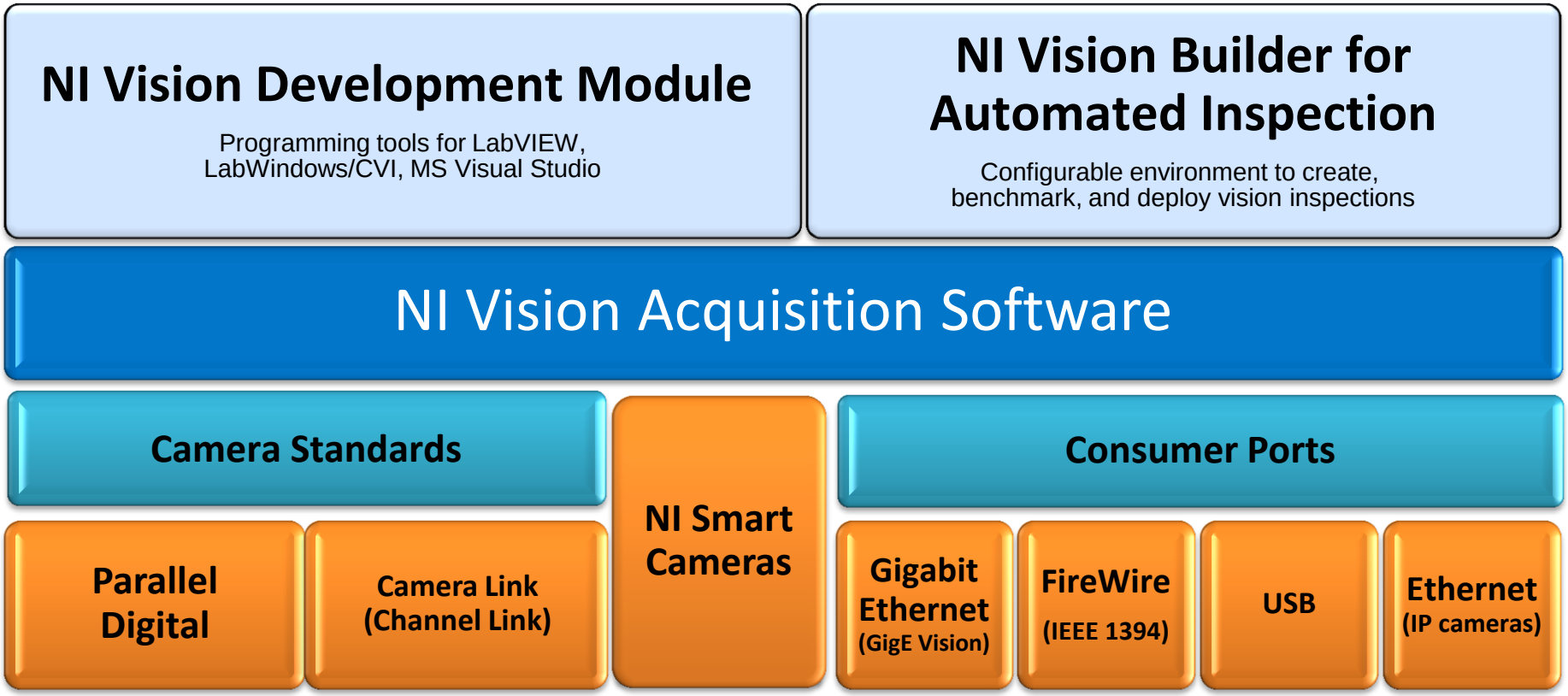
Hardware Abstraction



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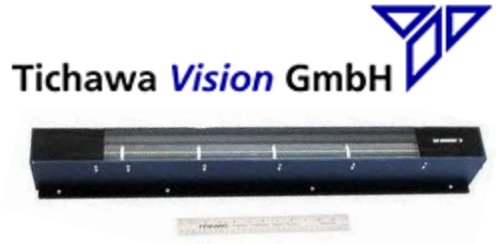
Camera Sensor & Camera Bus Support

Buses

Parallel digital

Sensors

- Line-scan
- Area scan
- Thermal/infrared
- Near infrared (NIR)
- Lasers
- Proximity sensors
- 3D laser triangulation sensors
- Contact Image Sensors (CIS)
- Etc.

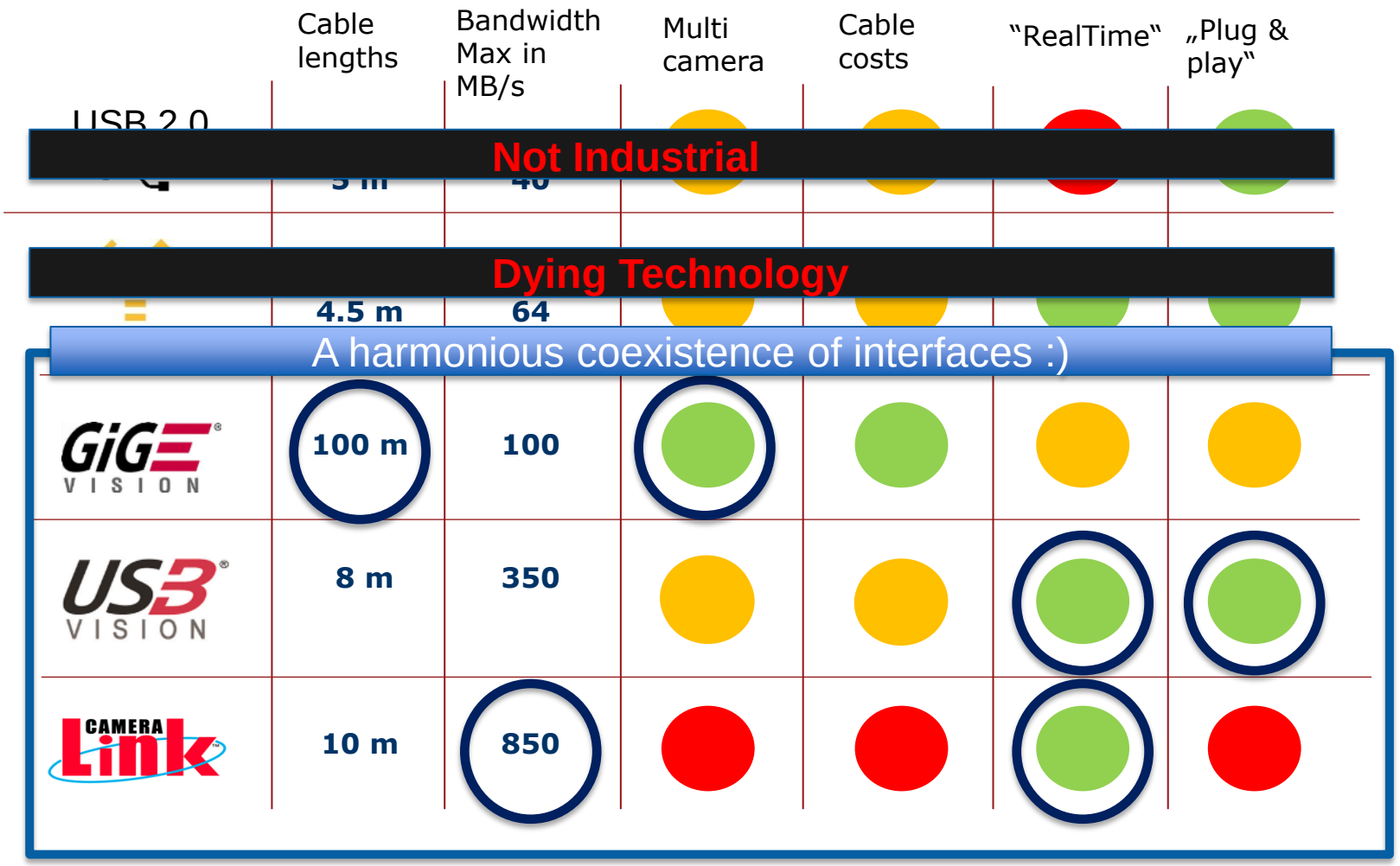


Industry Involvement

- AIA Board Member since 2004
- VDMA member

- Technical Committees
  - Camera Link
  - GigE Vision
  - Gen<i>Cam
  - Camera Link HS
  - USB3

Interface Comparison



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USB3 Vision

- USB3 Vision standardization effort started 2010.
- Version 1.0 standard released in 2013
- NI chairs the USB3 Vision standardization committee.
- Standard based on USB 3.0 specifications (SuperSpeed) and Gen<I>Cam.

- NI-IMAQdx includes native driver for USB3 Vision camera on Windows.

Smart Cameras

- 11 models
- Rugged (IP67) and small
- Integrated camera and processor
  - CCD sensors (VGA to 5 MP resolution)
  - Monochrome or Color
  - Up to 1.6 GHz processor
- Isolated digital I/O
- Direct drive lighting
- Wide range of connectivity options
  - EtherNet/IP, Modbus TCP/Serial , RS232, TCP/IP

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Compact Vision System

- Rugged, passively cooled
- Small form factor
- 1.66 GHz Atom processor
- 2 independent GigE Vision ports
  - Power over Ethernet (PoE) compliant
- 1 GigE port for network connectivity
- 2 USB ports for external data storage
- Built-in VGA port for display
- Selectable RS232/RS485 serial port
- FPGA-based industrial I/O
  - 8 Bidirectional TTL (2 MHz)
  - 8 Opto-Isolated Inputs (~200 kHz)
  - 8 Opto-Isolated Outputs (~2 kHz)
  - 1 Quadrature Encoder Input (5 MHz)

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Embedded Vision Systems

- Stand-alone real-time machine vision
- Multi-camera support
  (GigE Vision, IEEE 1394, Camera Link)
- Industrial, fanless design
- Solid-state drive
- Dual-core processor
- Reconfigurable digital I/O (TTL, isolated)
- Industrial communications options
- Built-in video output

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PC-Based Solutions

- Real-time or Windows (32-bit & 64-bit) systems
- PCI, PCI Express, PXI, PXI Express frame grabbers (cameras can also connect directly to PCs)
- Support for wide range of camera types:
  Parallel digital, IEEE 1394, CameraLink, GigE Vision, USB, IP
- PXI and PCs provide highest performance (ex. multicore)

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Integration with automation devices

- Communicate inspection results to PLCs, HMIs, and other automation devices with digital I/O, serial, and Ethernet protocols.

EtherNet

TCP/IP

Serial

RS232 Serial

Digital I/O

TTL

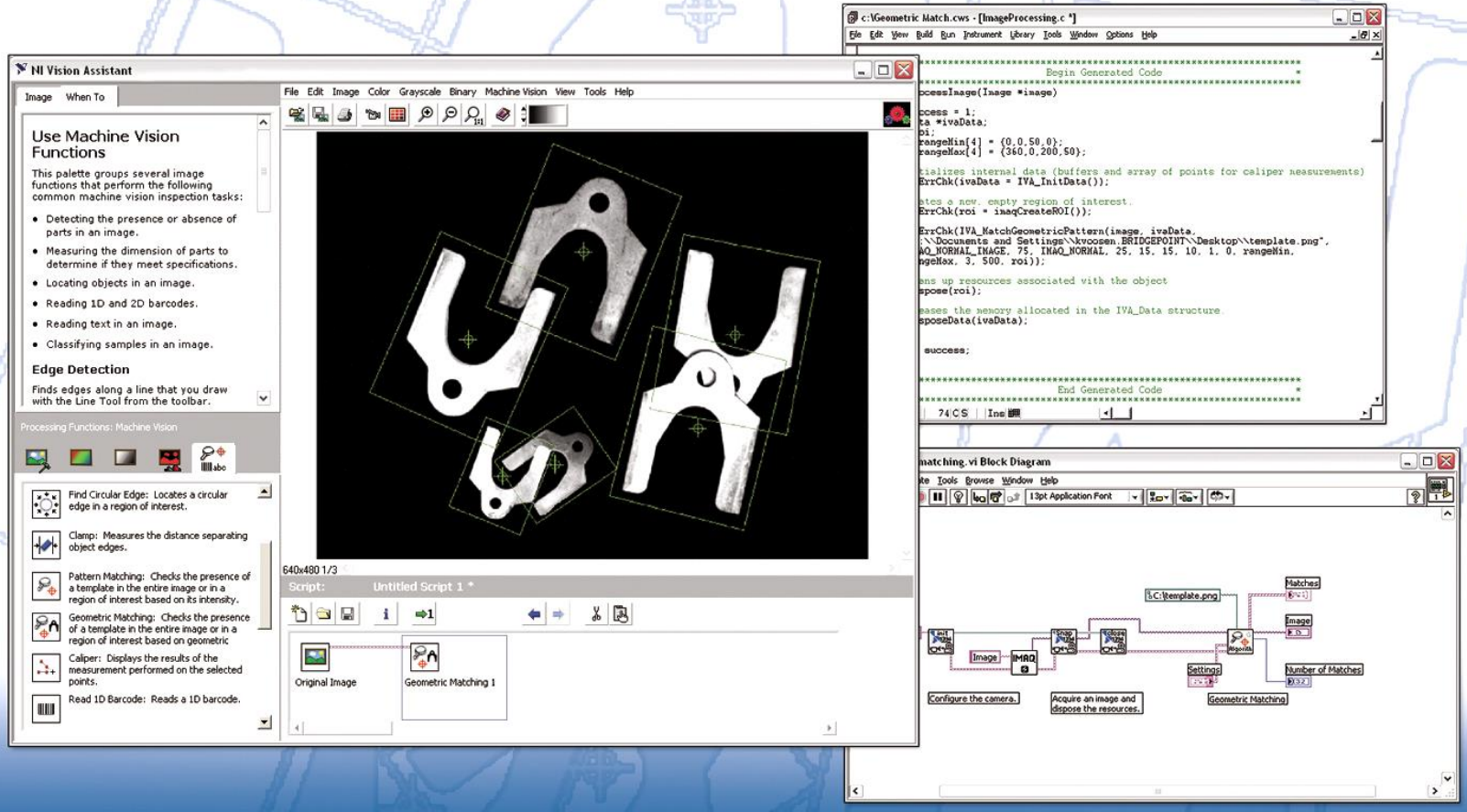
Opto-isolated

Other

IEEE 1588

Network-Shared variables

NI Vision Platform - Software



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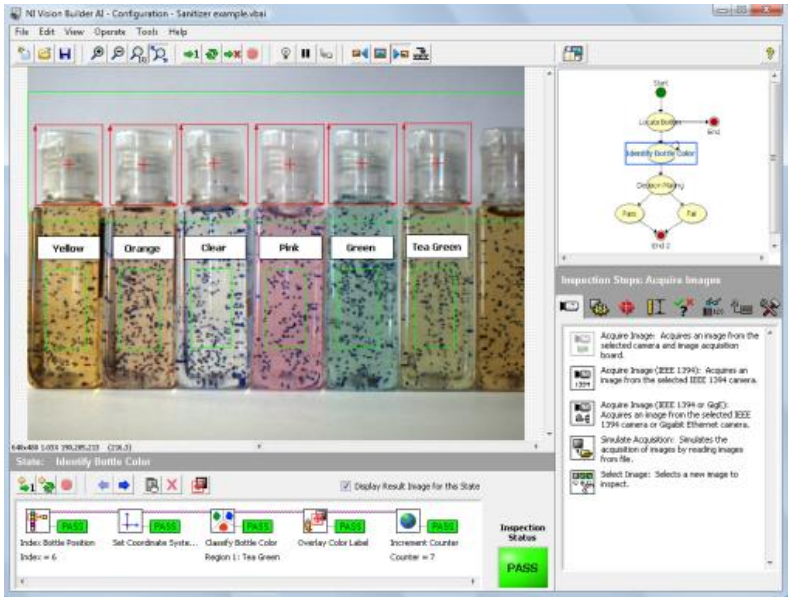
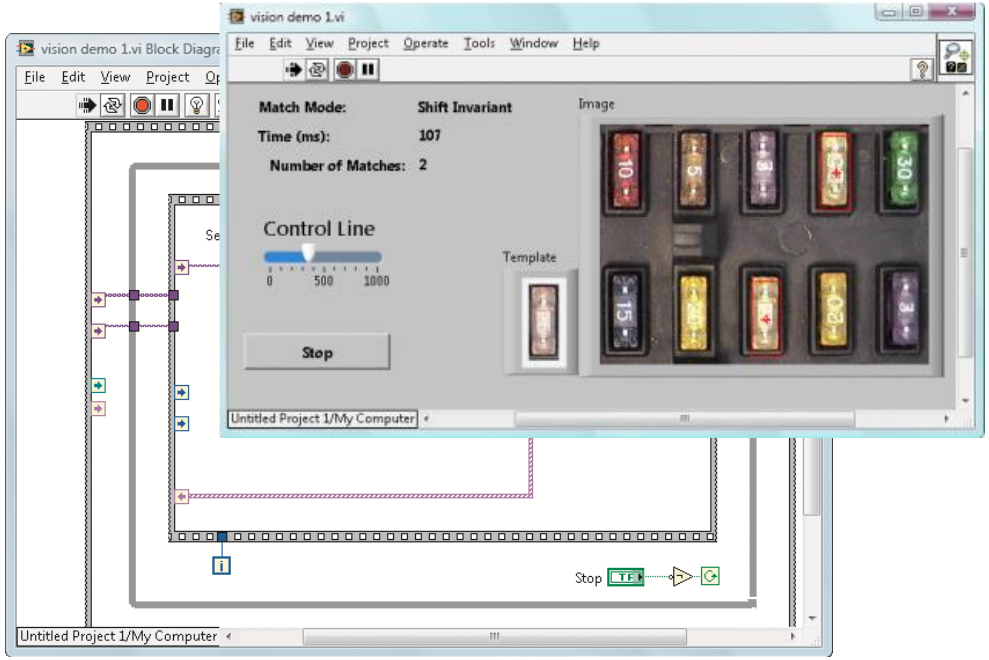
Two Ways to Create Vision Applications

- Configuration Software
- Programming Libraries





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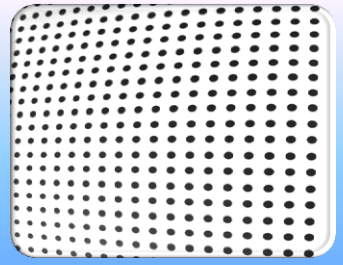
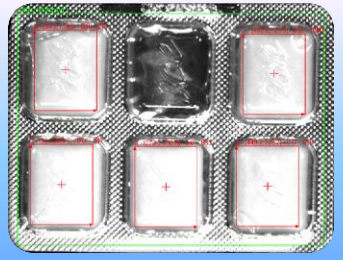
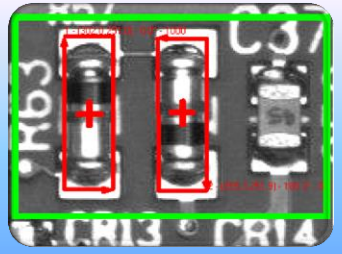
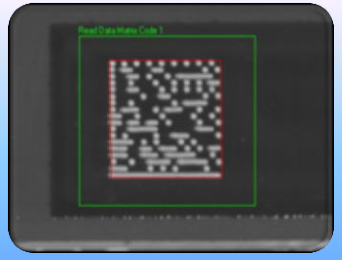
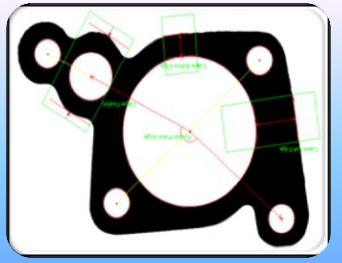
NI Vision Capabilities

Enhance

- Calibrate image
- Filter noise
- Remove distortion

Check

- Measure intensity
- Count particles
- Match colors

Locate

- Match patterns
- Match geometry
- Detect edges

Identify

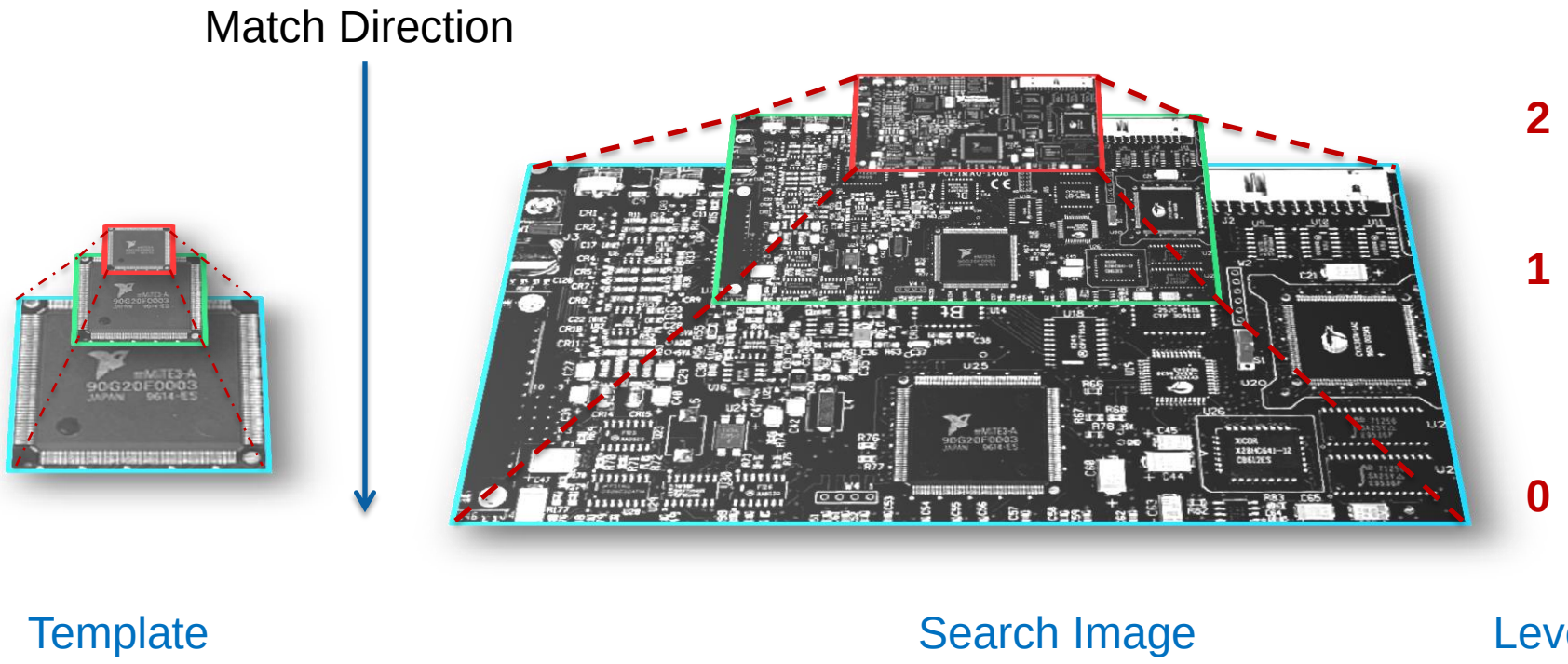
- Read text (OCR)
- Read 1D barcodes
- Read 2D codes
- Classify shapes

Measure

- Detect edges
- Measure distance
- Calculate geometry

NATIONAL INSTRUMENTS

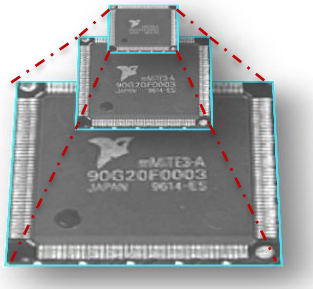
Pyramid Matching

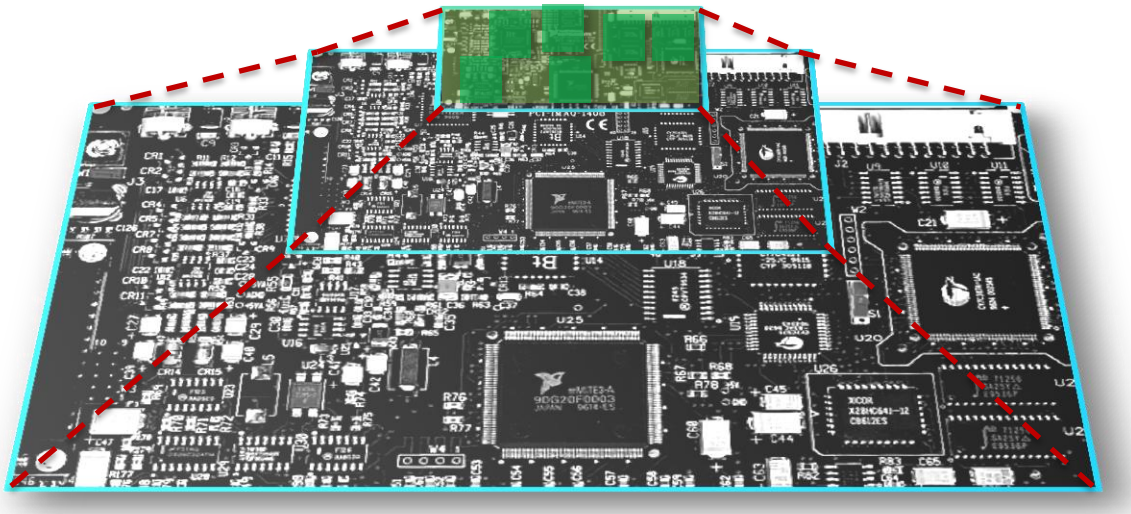


Pyramid level is same for the template and search image during matching.

Pyramid Matching – Initial Matching

All the pixel positions in higher pyramid are inspected for possible matches





2

1

0

Template

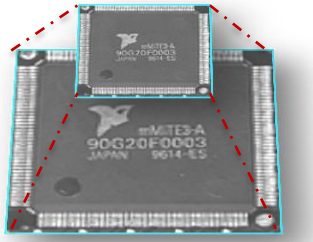
Search Image

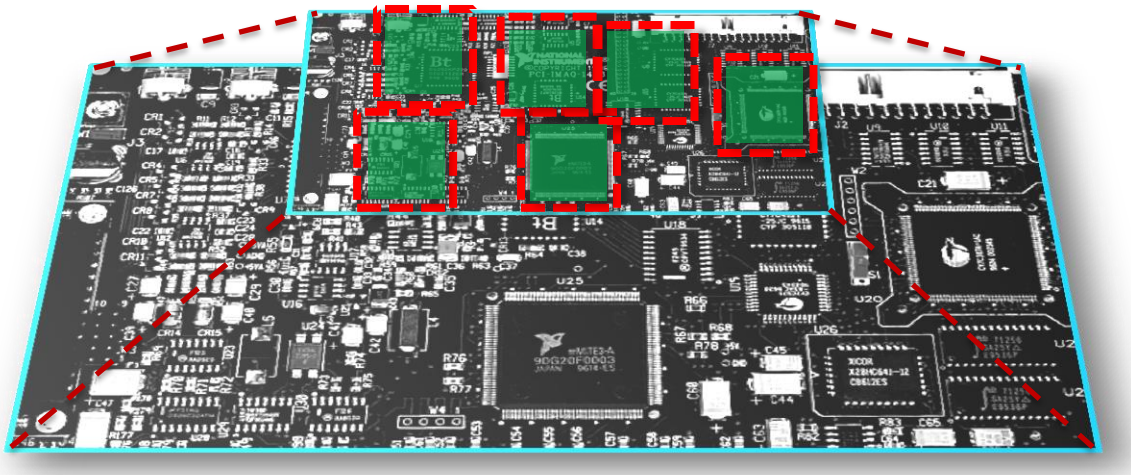
Level

NATIONAL INSTRUMENTS

Pyramid Matching – Refine Matching

Only Initial matches are inspected in Lower pyramids.





2

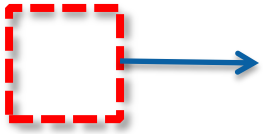
1

0

Template

Search Image

Level

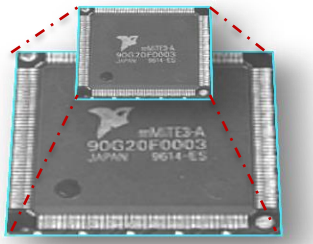


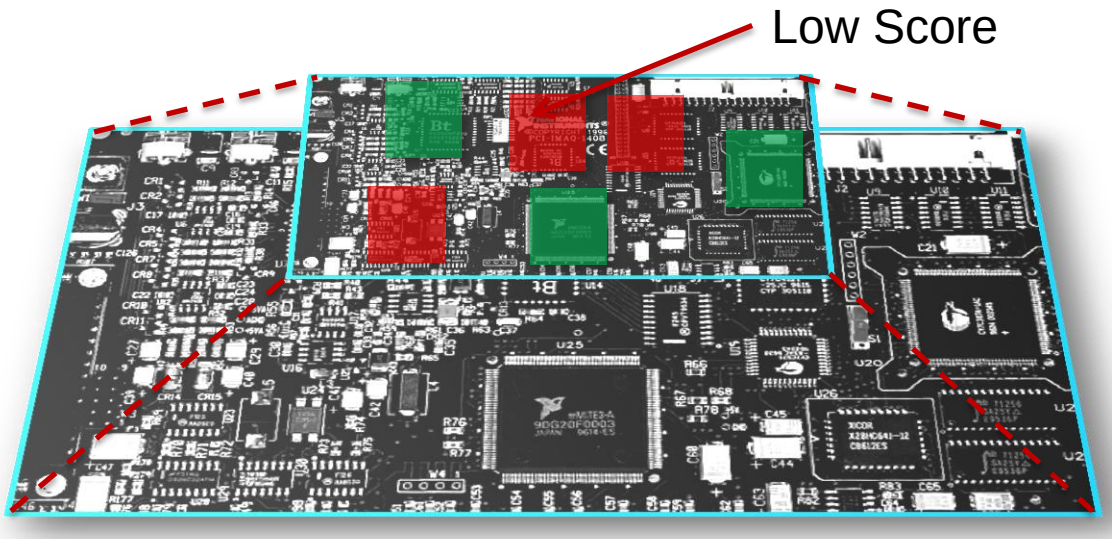
Neighborhood Search Area

NATIONAL INSTRUMENTS

Pyramid Matching – Refine Matching

Matches are **qualified based on score** on every pyramid level





Template

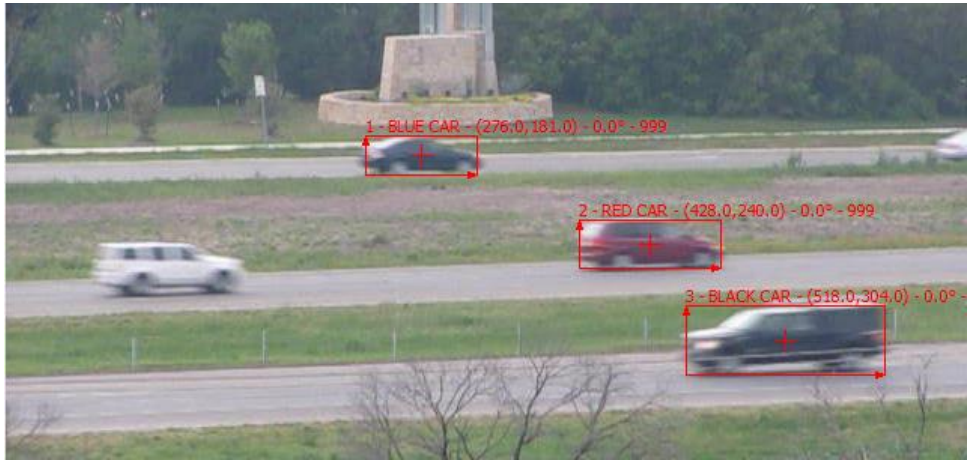
Search Image

Level

NATIONAL INSTRUMENTS

Vision Development Module: Object Tracking

- Track objects regardless of blur, noise and partial occlusion
- Invariance to gradual changes in geometric transformations such as shifting, rotation, or scaling
- Track objects in gray-scale and color images
- Multiple Object Tracking



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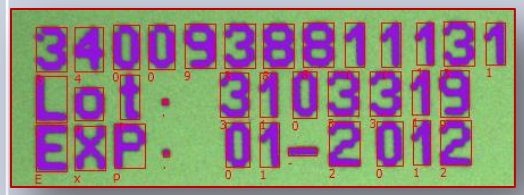
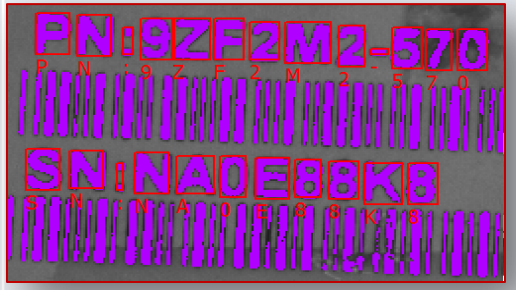
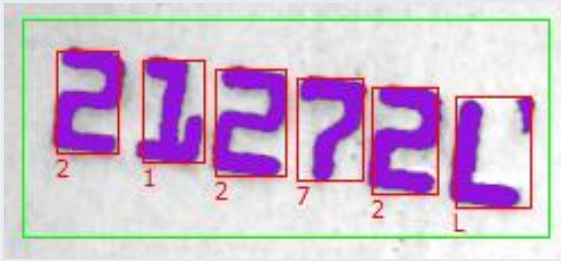
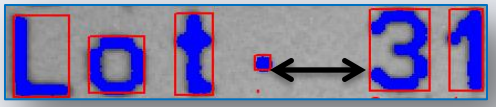
Vision Development Module: OCR

Preprocessing: Multiline Detection		**Segmentation:** Local Threshold, Color Threshold	
Noise Filtering		Character separation	
Rotation detection		Space Identification	

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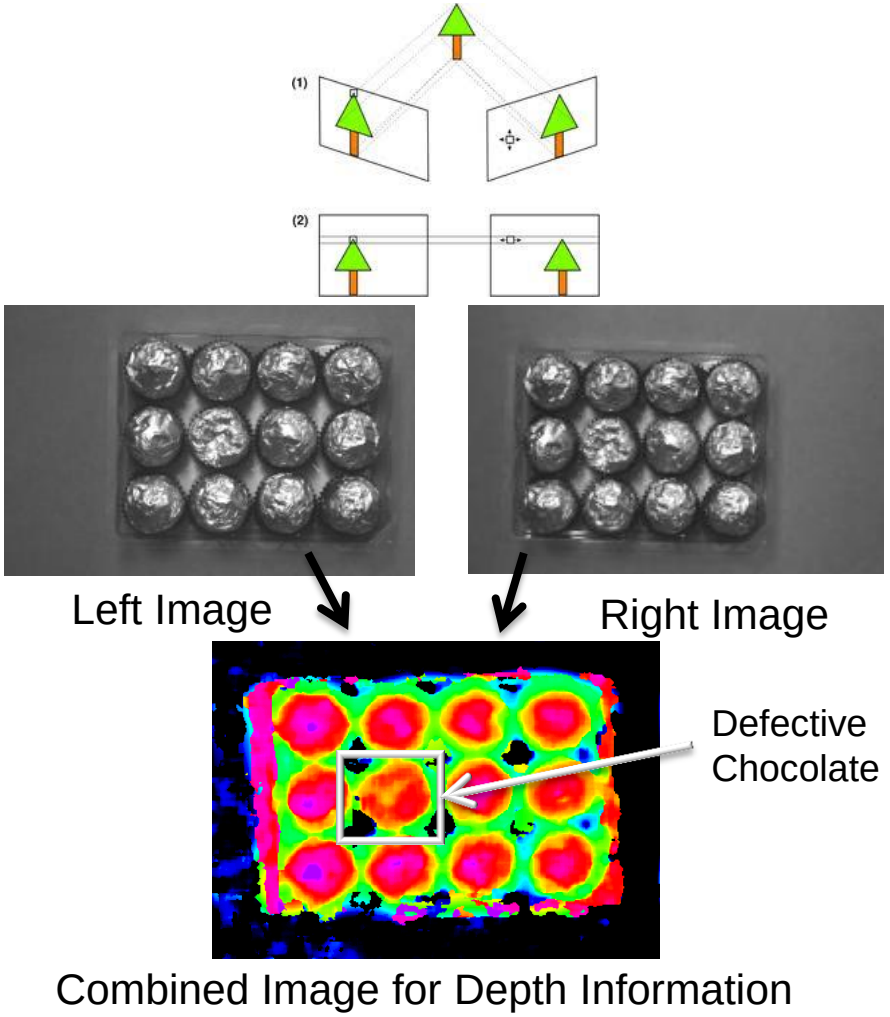
3D Binocular Stereo Vision

- New 3D Stereo Vision Features in Vision Development Module
- Calibrate cameras to analyze left and right images
- Generate depth and disparity maps (3D images)
- Suited for advanced inspection and vision guided robotics applications



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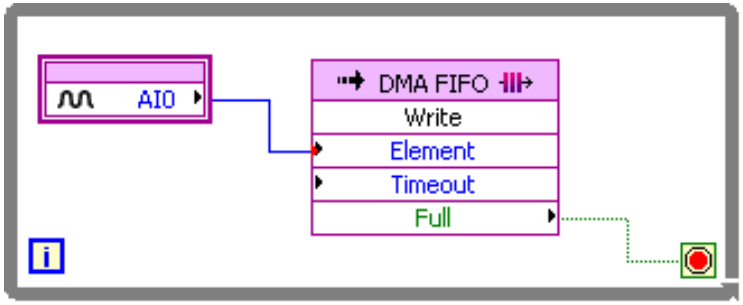
LabVIEW FPGA - Abstraction to the Pin

VHDL



LabVIEW FPGA

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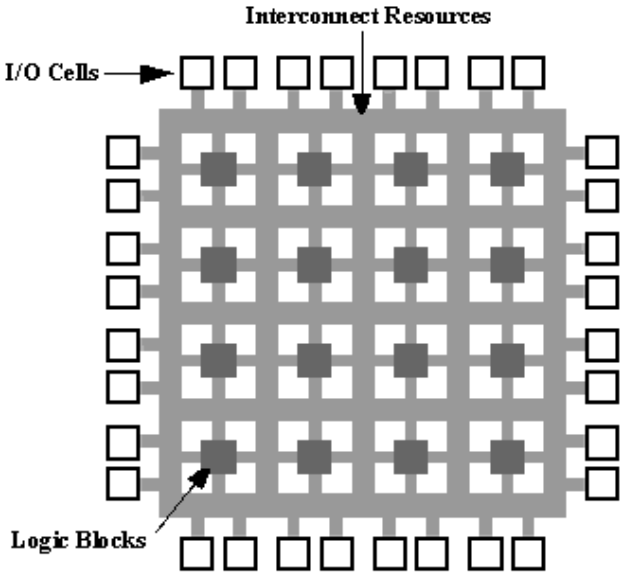
FPGAs

- Latency
- Jitter
- Compute power
- Pipelining
- Security
- Weight / Power / Heat
- Complexity
- Raw Clock Rates
- Limited Floating Point support



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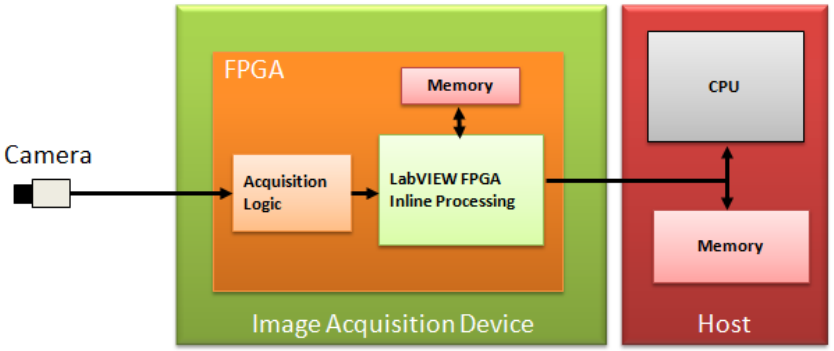
FPGA Image Processing

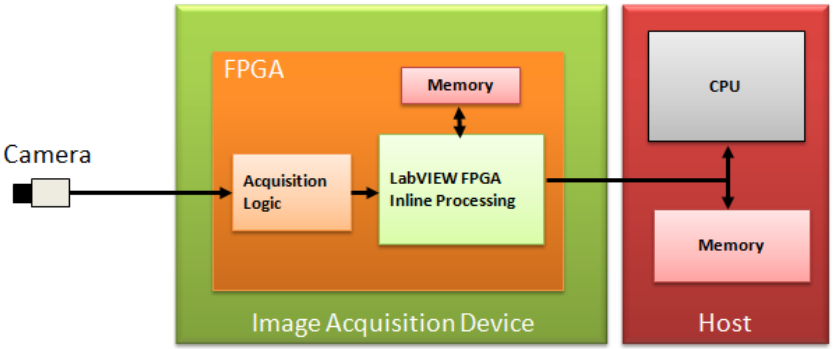
- High-speed control

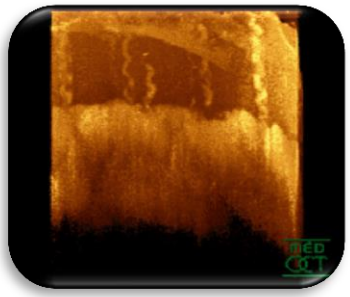


Laser Alignment & Tracking

High-Speed Sorting

- Image pre-processing





Optical Coherence Tomography

Web & Surface Inspection

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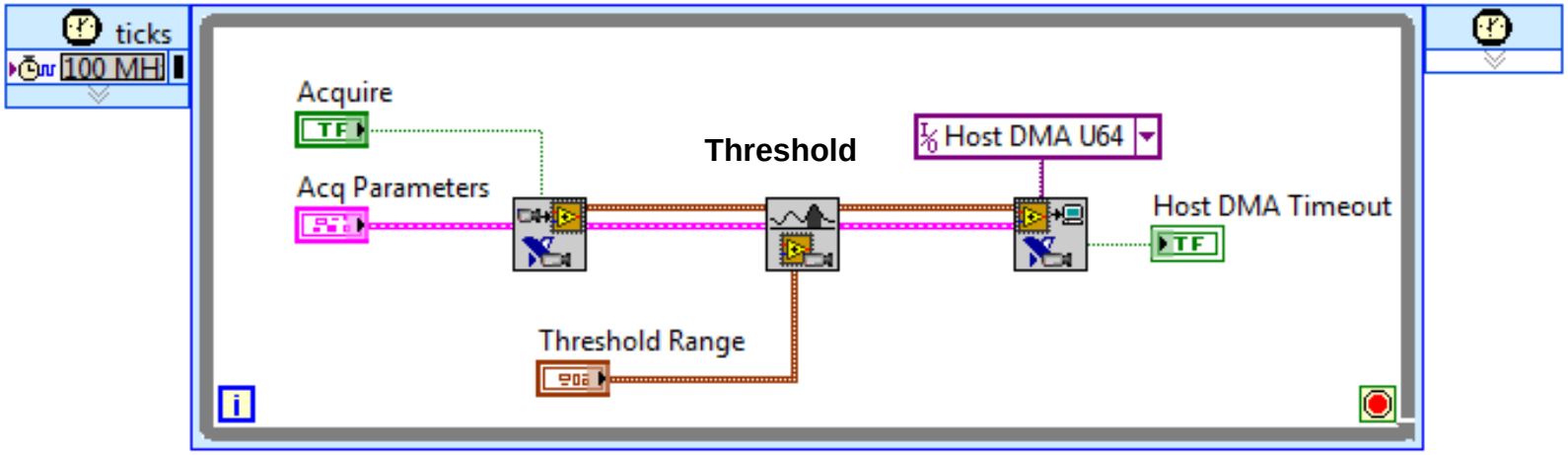
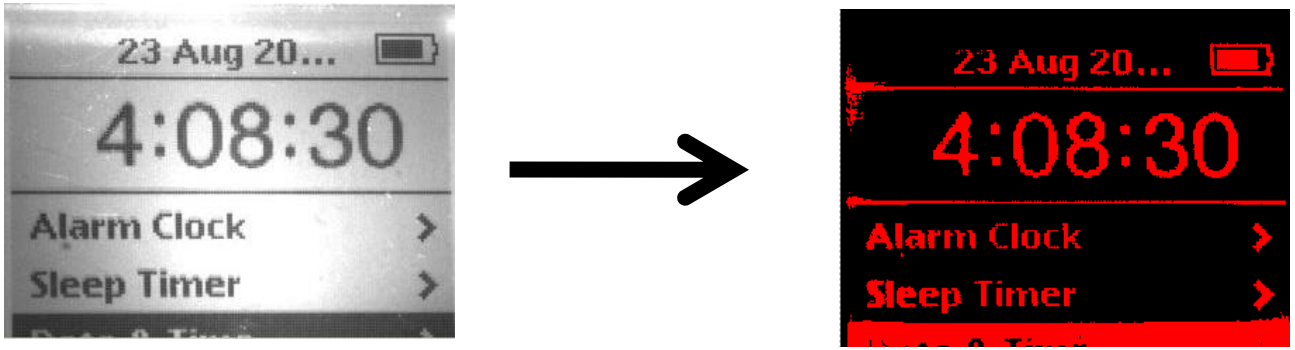
Pixel Processing Example - Threshold





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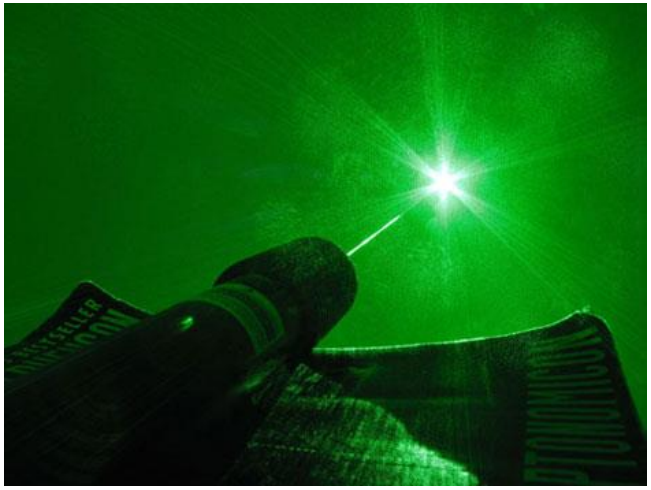
High-Speed Control

- Laser alignment/steering
  - Beam profile/position measurements
  - Low latency control output
- High-speed sorting
  - Segmentation
  - Measure parameters of contaminant
  - Trigger rejection valves
- In Air Sorting
  - Image and inspect falling product
  - Low jitter requirement for decision making and IO



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Adaptive Optics

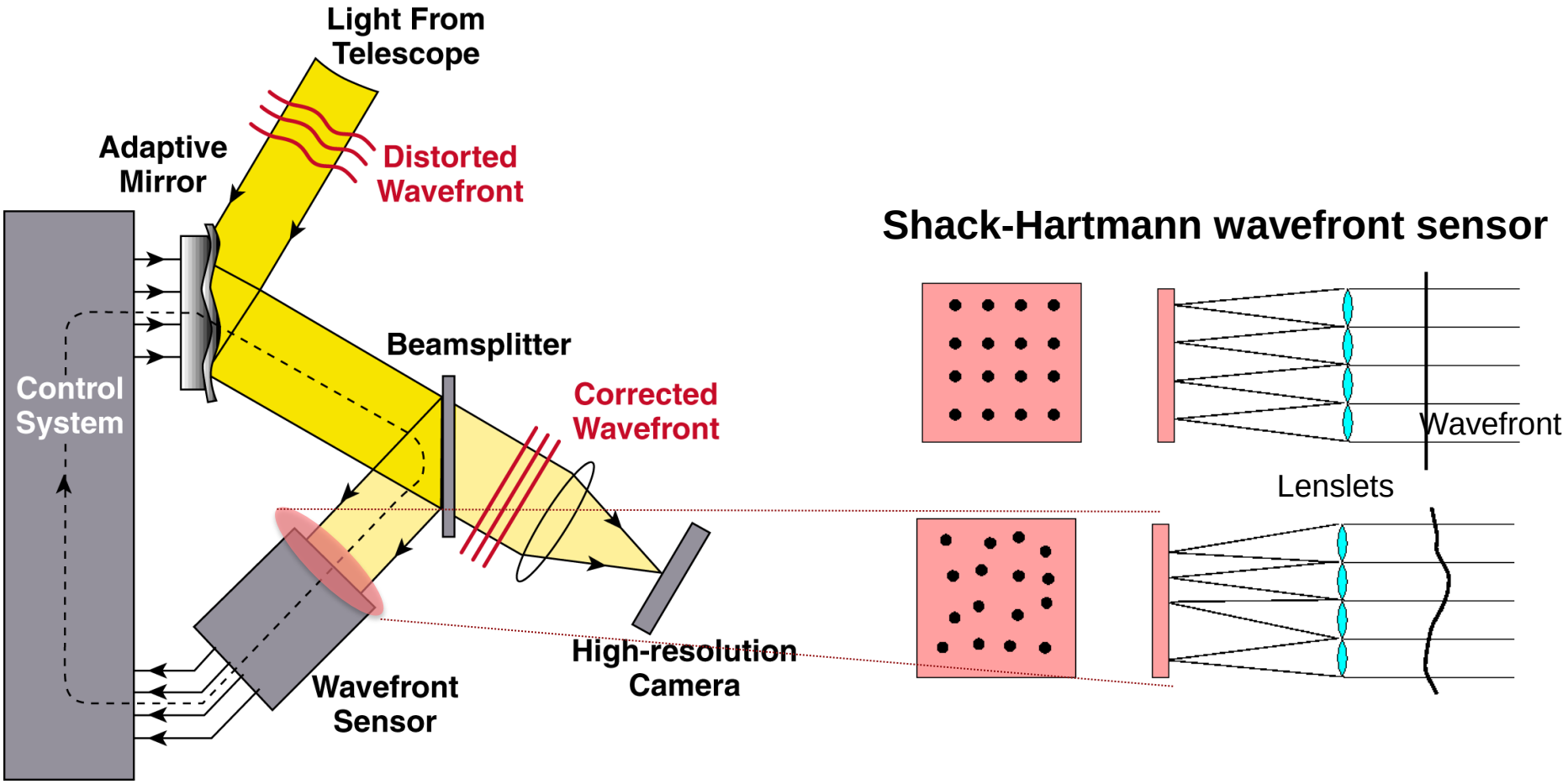

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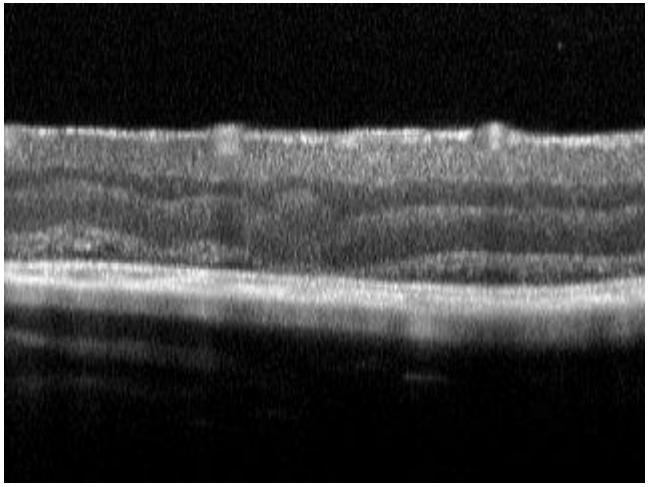
Image Pre-processing

- Optical Coherence Tomography (OCT)
  - Data scaling
  - FFT
  - Logarithmic LUT
  - Image display (host)



- Web and surface inspection
  - Flat field correction
  - Thresholding
  - Particle analysis

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Zveme Vás na NIDays 2013
největší konferenci National Instruments v České republice, 7. 11. 2013

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Registrace

NIDays 2013

Nejnovější technologie a trendy v navrhování, testování a řízení.

Datum a čas

7.11.2013, 9:00-18:00

Místo

Hotel Don Giovanni

Více informací: czech.ni.com/nidays

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