

NI Vision Platform



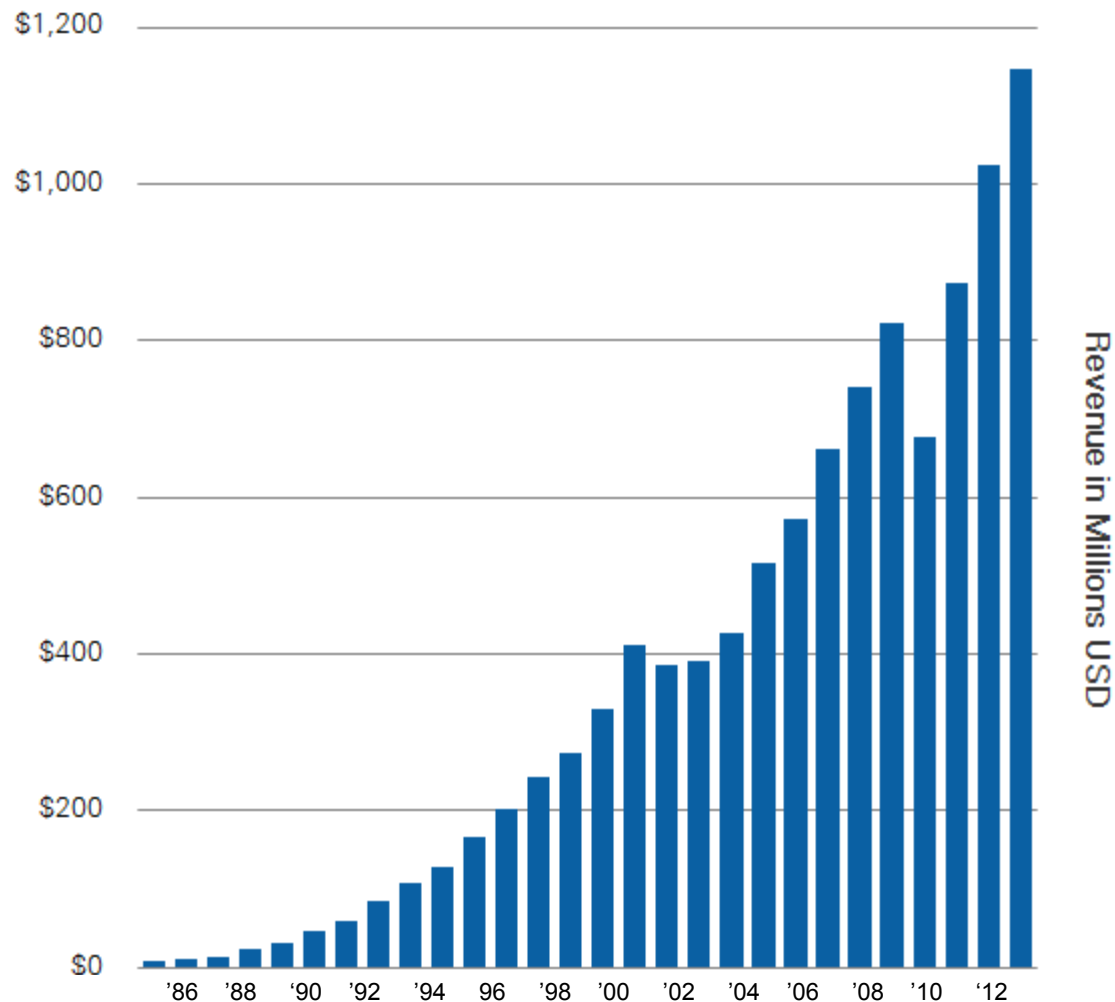
Radim ŠTEFAN

www.ni.com/vision



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



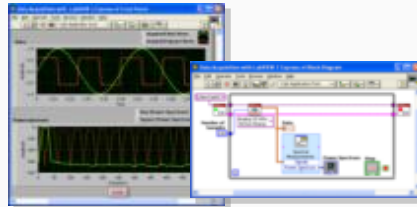
National Instruments—What We Do

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



Graphical System Design

A Platform-Based Approach for Measurement and Control



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



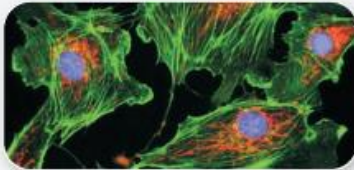
- Industrial robot guidance
- Pick and place
- Obstacle avoidance for autonomous vehicles
- Simultaneous localization and mapping

Semiconductor and Solar



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

Medical and Scientific



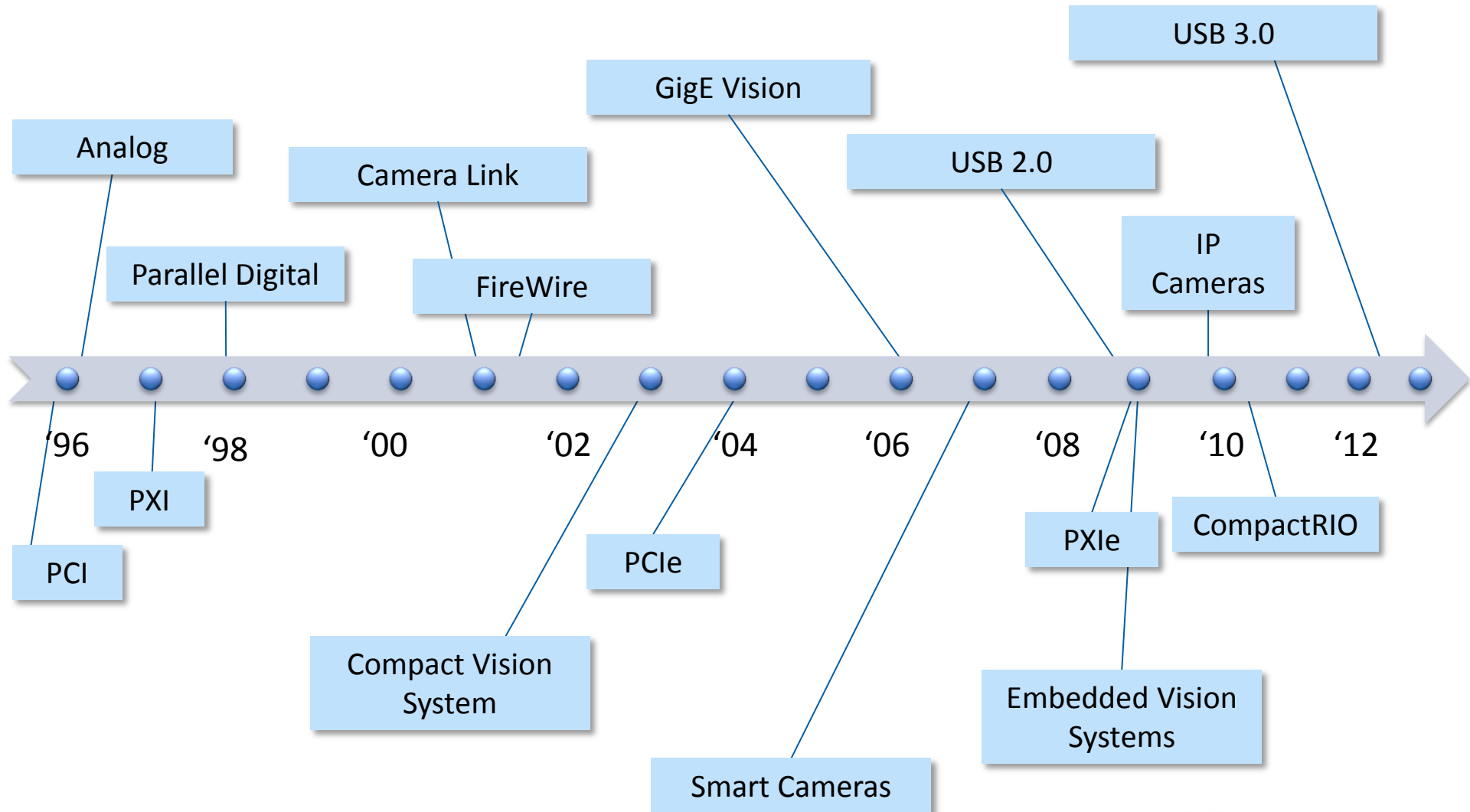
- Automated microscopy
- Body temperature scanning
- Eye tracking
- Fluorescence imaging
- Optical coherence tomography (OCT)

Electronics Validation

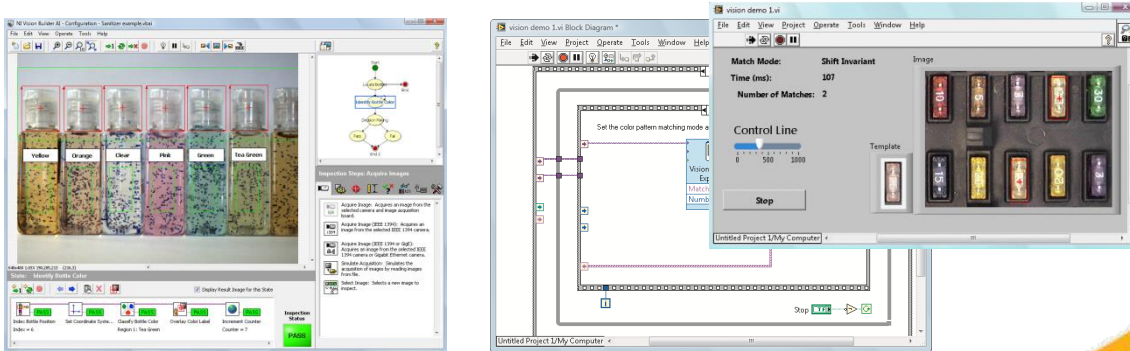


- Cell phone camera testing
- Display inspection
- Image sensor testing
- LED testing
- PCB inspection

17 Years of Vision at National Instruments



NI Vision Platform



**Vision Builder for Automated Inspection
Vision Development Module**

PCI and PCIe
Frame Grabber



PXI Frame Grabber



Embedded
Vision System



Compact
Vision System



Smart Camera



Smart Cameras

Stand-Alone Vision Systems

PC-Based Vision Systems

NI Vision Platform - Hardware



Hardware Abstraction

NI Vision Development Module

Programming tools for LabVIEW,
LabWindows/CVI, MS Visual Studio

NI Vision Builder for Automated Inspection

Configurable environment to create,
benchmark, and deploy vision inspections

NI Vision Acquisition Software

Camera Standards

Parallel
Digital

Camera Link
(Channel Link)

NI Smart
Cameras

Consumer Ports

Gigabit
Ethernet
(GigE Vision)

FireWire
(IEEE 1394)

USB

Ethernet
(IP cameras)

Camera Sensor & Camera Bus Support

Buses



FireWire



Parallel digital

Sensors

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



Tichawa *Vision* GmbH 



SICK IVP

Industry Involvement

- AIA Board Member since 2004
- VDMA member
- Technical Committees
 - Camera Link
 - GigE Vision
 - Gen<i>Cam
 - Camera Link HS
 - USB3



Interface Comparison

	Cable lengths	Bandwidth Max in MB/s	Multi camera	Cable costs	"RealTime"	"Plug & play"
USB 2.0	5 m	40	Yellow	Yellow	Red	Green
Not Industrial						
	4.5 m	64	Yellow	Yellow	Green	Green
Dying Technology						
A harmonious coexistence of interfaces :)						
GiGE VISION	100 m	100	Green	Green	Yellow	Yellow
USB VISION	8 m	350	Yellow	Yellow	Green	Green
CAMERA Link	10 m	850	Red	Red	Green	Red

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.



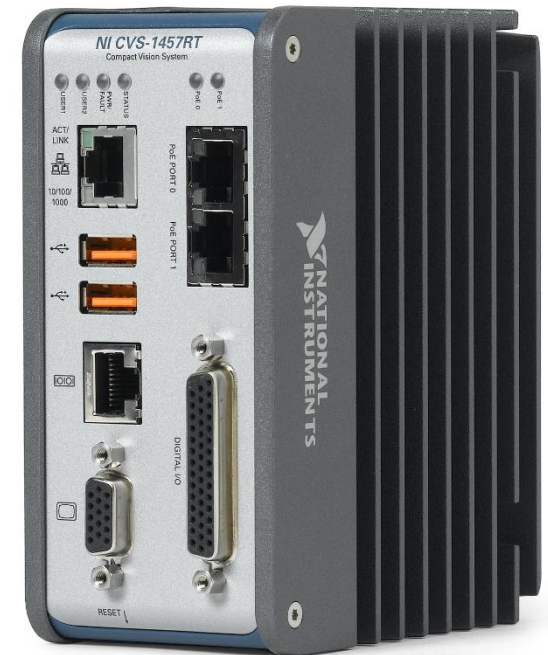
Smart Cameras

- 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



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)



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



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)



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

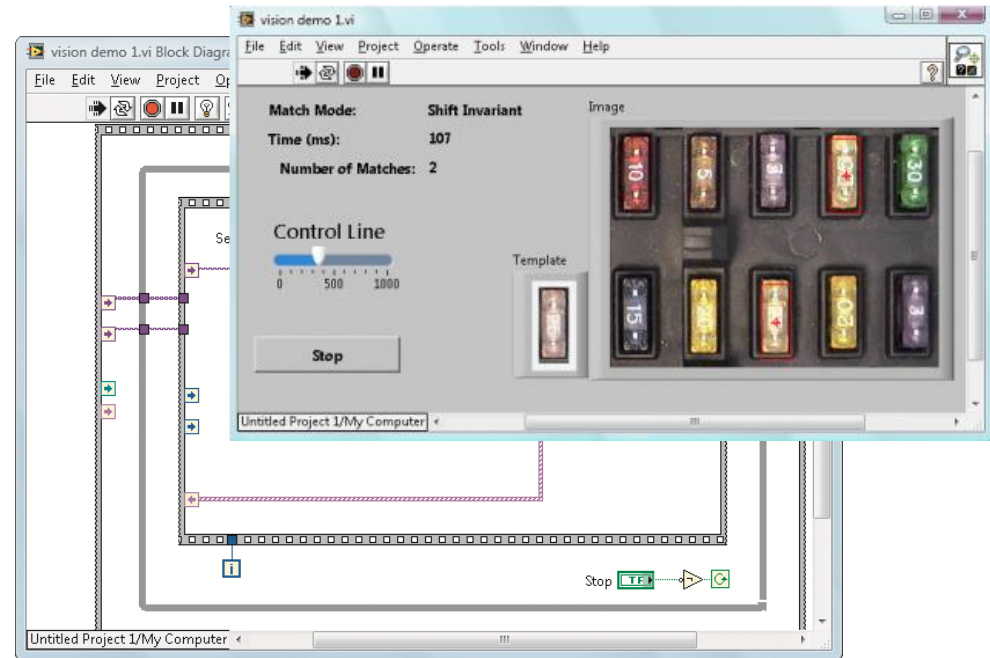
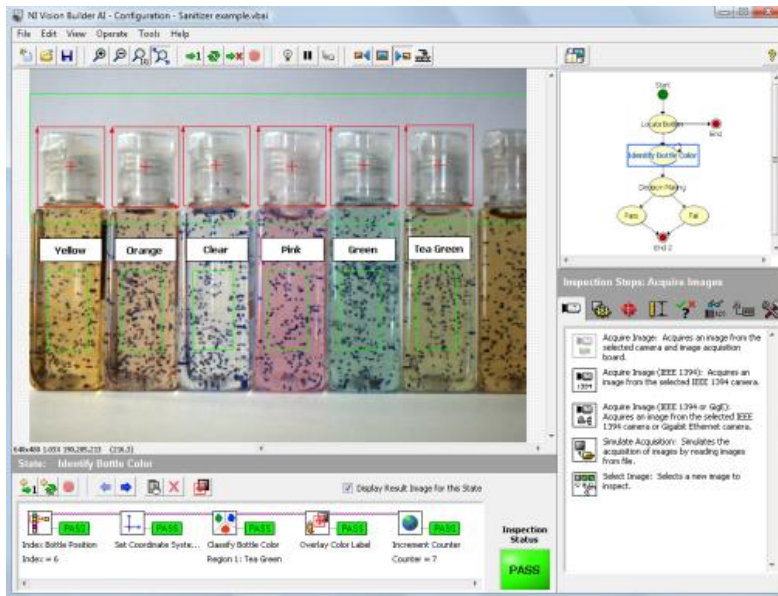
NI Vision Platform - Software

The screenshot displays the NI Vision Assistant software interface. The main window is titled "NI Vision Assistant" and contains a central image processing area showing a grayscale image of a mechanical part with several regions of interest (ROIs) marked by green boxes and crosshairs. The interface is divided into several panels:

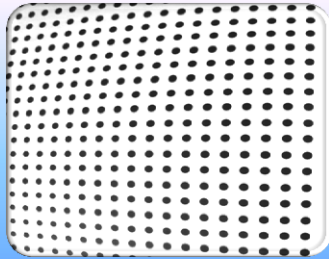
- Use Machine Vision Functions:** A list of tasks including detecting the presence or absence of parts, measuring dimensions, locating objects, reading barcodes, and classifying samples.
- Edge Detection:** A section for finding edges along a line drawn with the Line Tool.
- Processing Functions: Machine Vision:** A list of specific functions such as Find Circular Edge, Clamp, Pattern Matching, Geometric Matching, Caliper, and Read 1D Barcode.
- Script Window:** A window titled "Untitled Script 1" showing a C# script for geometric matching. The script includes comments and code for initializing data, creating ROIs, and performing the matching process.
- Block Diagram:** A "matching.vi Block Diagram" showing a flowchart of the vision process. It starts with "Configure the camera" and "Acquire an image and dispose the resources", leading to "Image" and "IMAQ I/O" blocks. The process then moves through "Geometric Matching" to "Matches" and "Number of Matches" blocks.

Two Ways to Create Vision Applications

- Configuration Software
- Programming Libraries

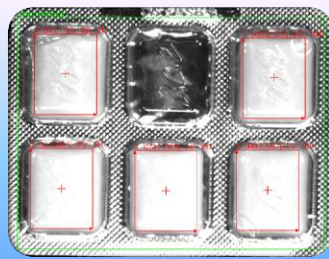


NI Vision Capabilities



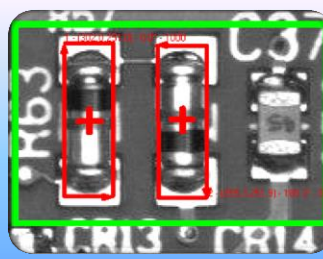
Enhance

- Calibrate image
- Filter noise
- Remove distortion



Check

- Measure intensity
- Count particles
- Match colors



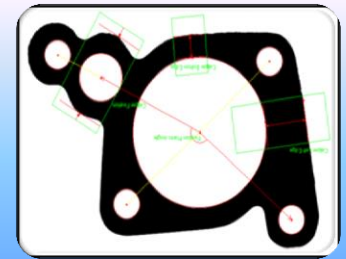
Locate

- Match patterns
- Match geometry
- Detect edges



Identify

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

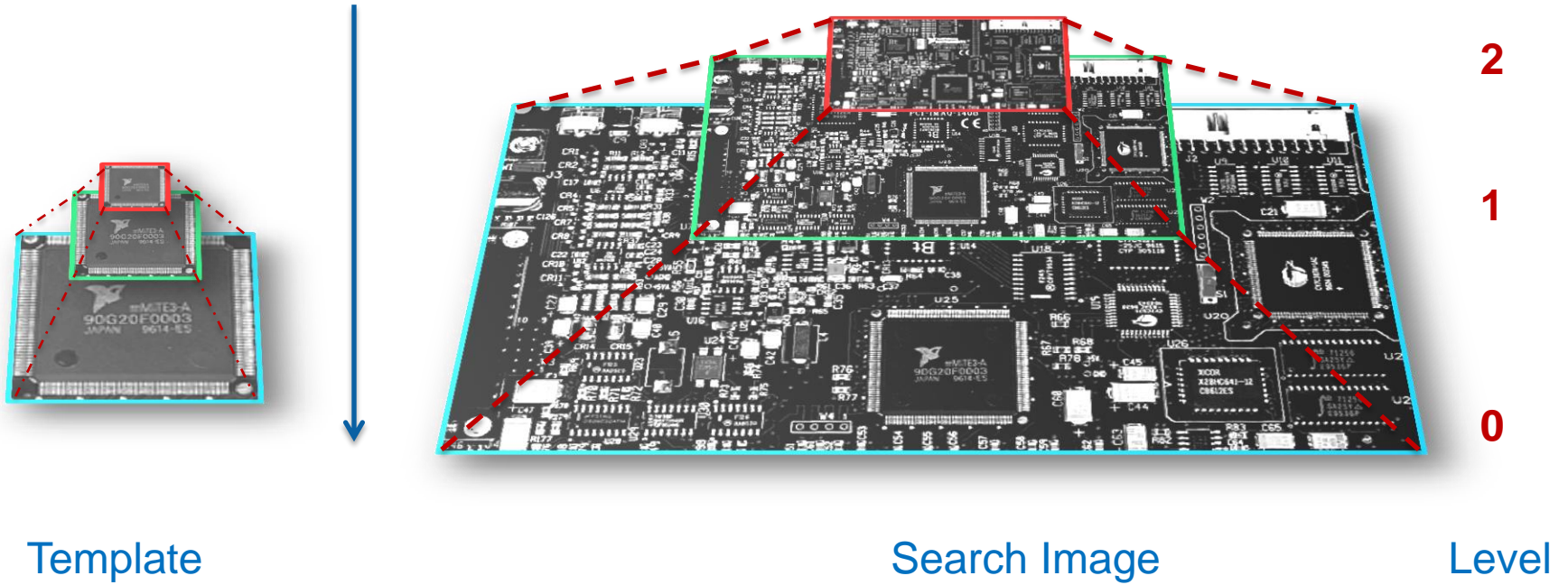


Measure

- Detect edges
- Measure distance
- Calculate geometry

Pyramid Matching

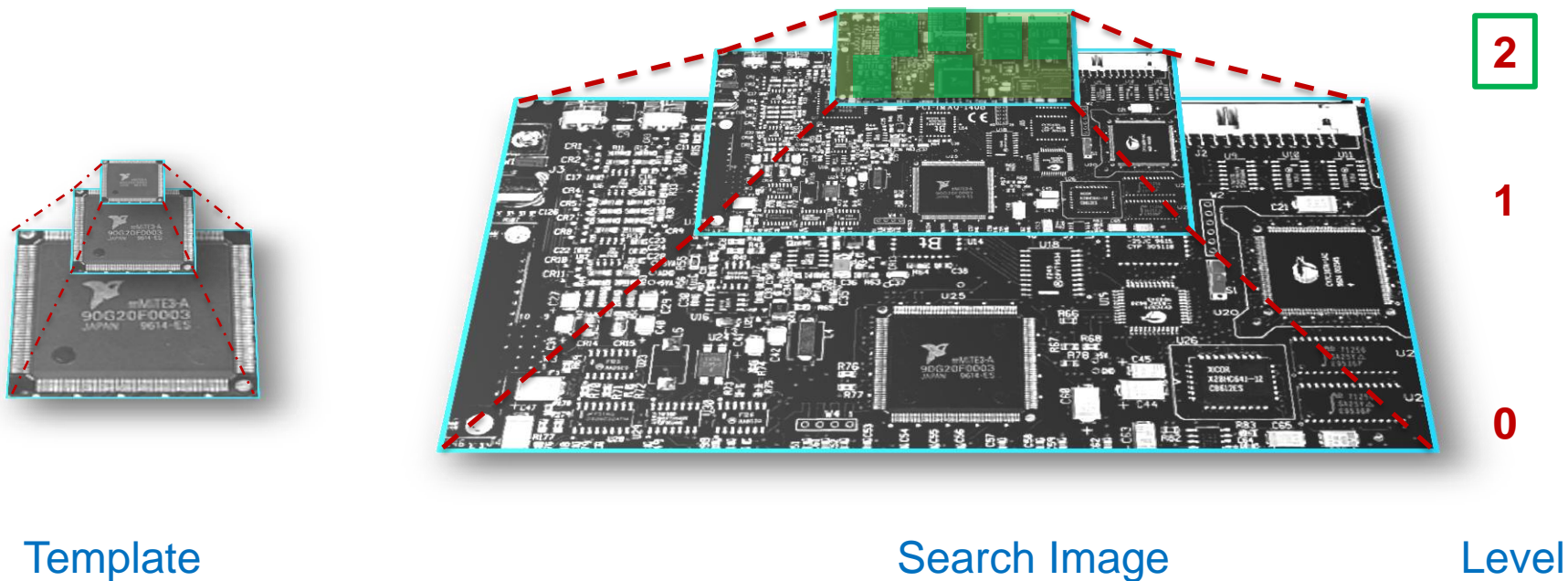
Match Direction



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

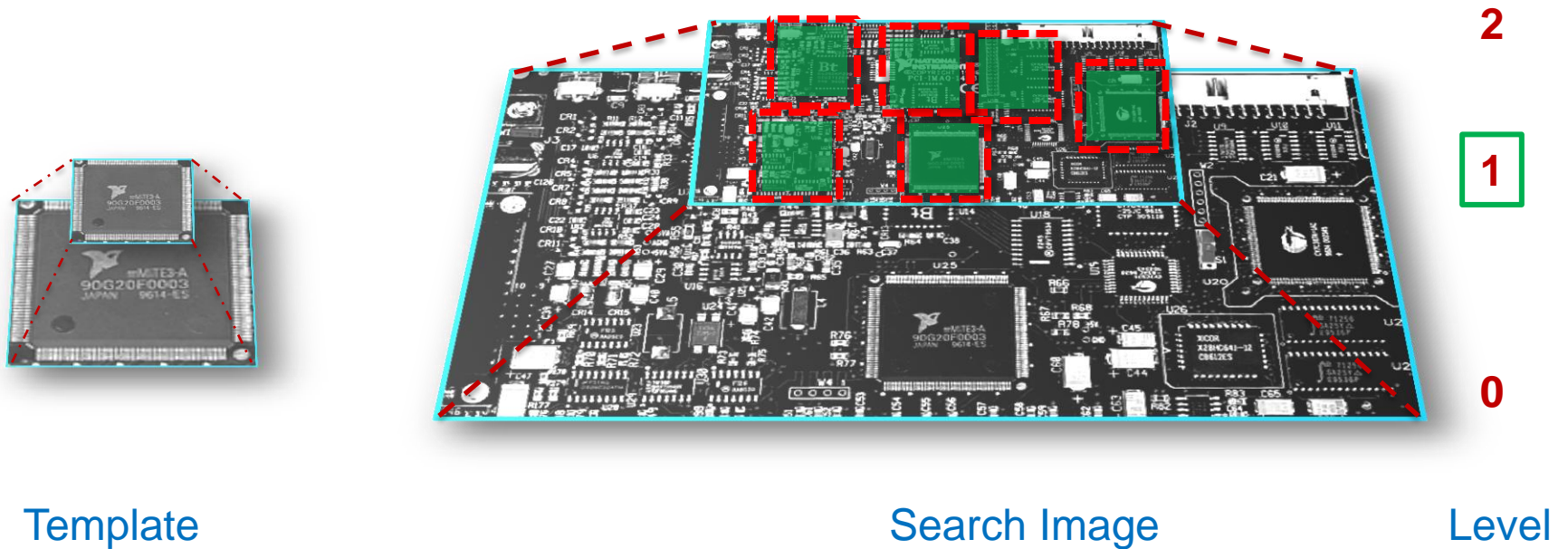
Pyramid Matching – Initial Matching

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



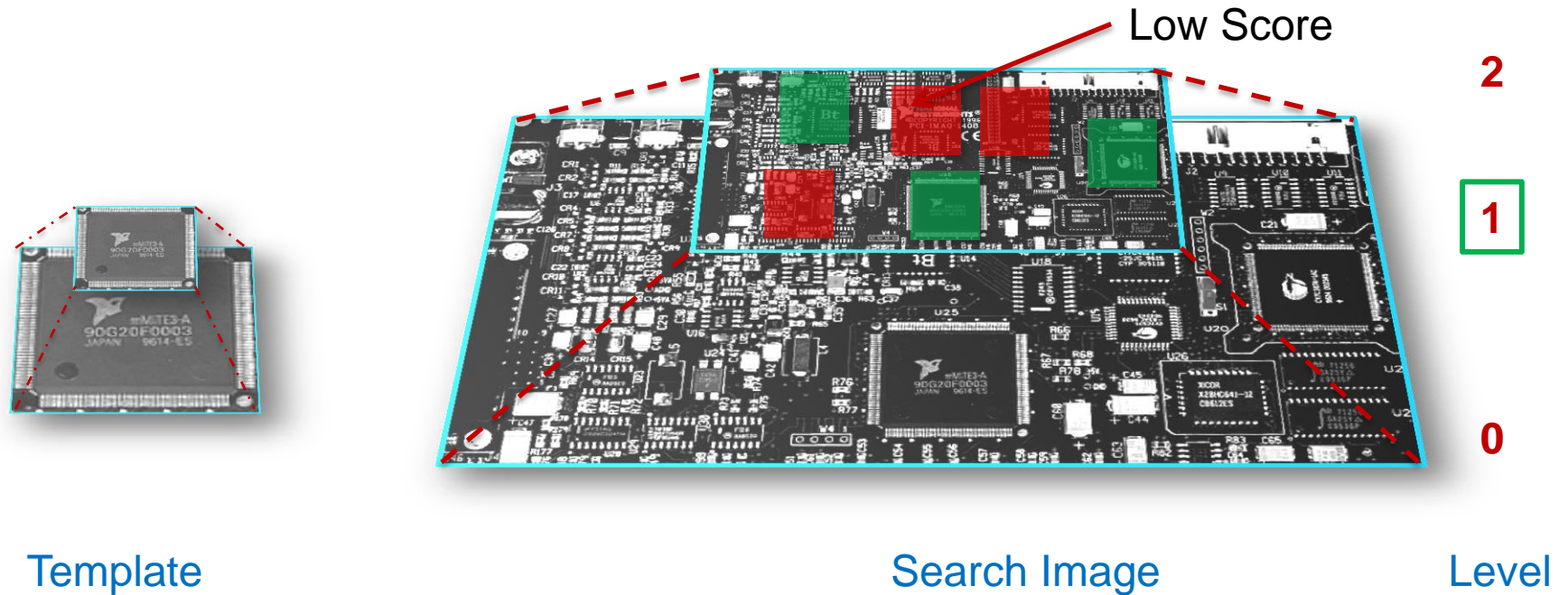
Pyramid Matching – Refine Matching

Only Initial matches are inspected in Lower pyramids.



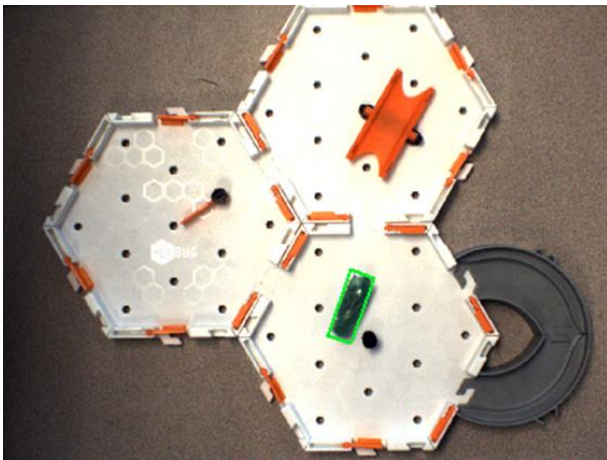
Pyramid Matching – Refine Matching

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

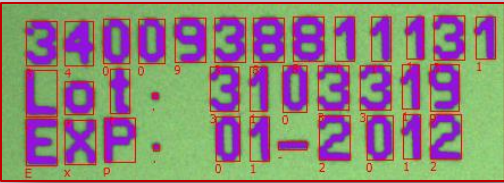

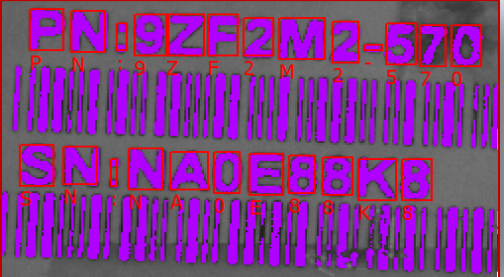

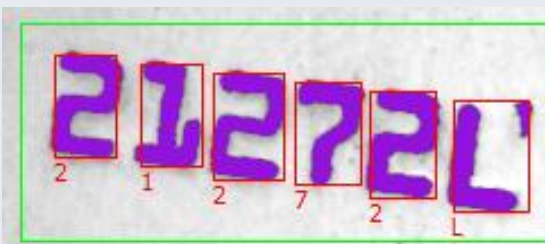
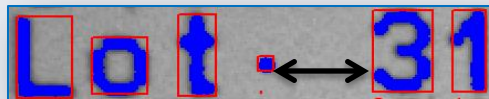


Vision Development Module: Object Tracking

- 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

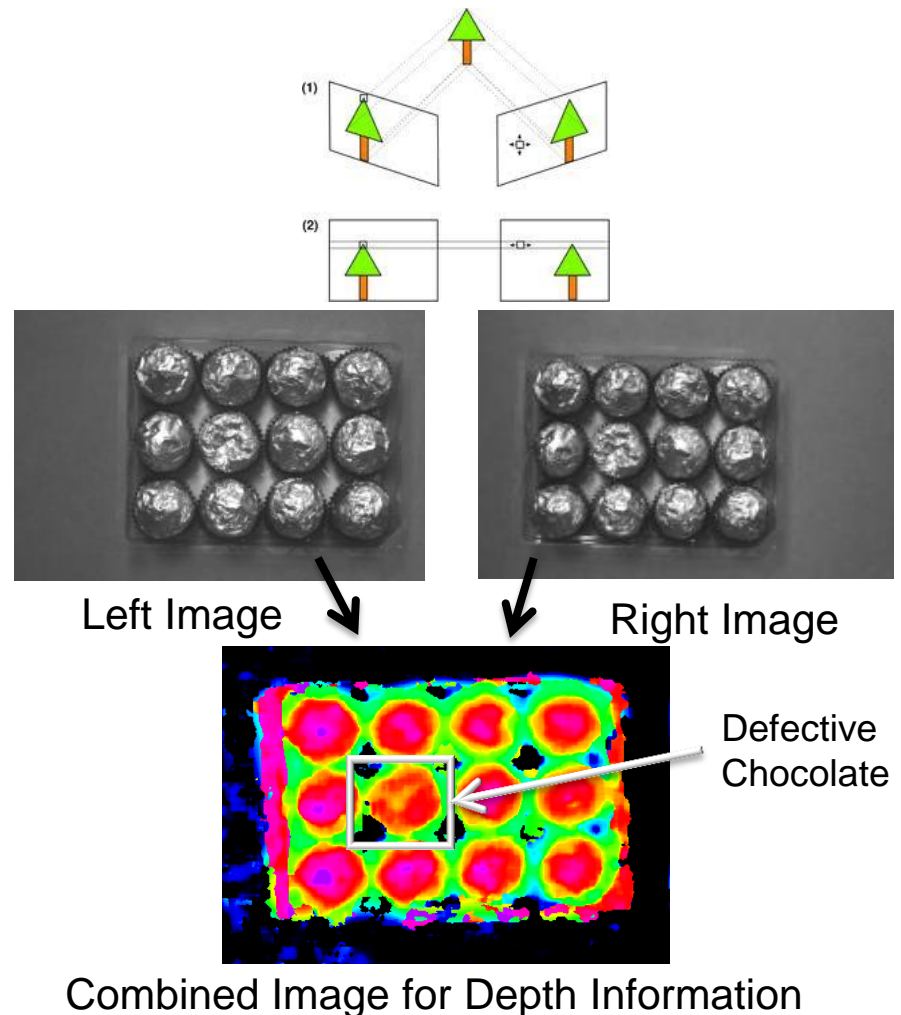


Vision Development Module: OCR

<p>Preprocessing : Multiline Detection</p>	 <p>The image shows a green background with purple text. The text is arranged in three lines: '3400938811131', 'Lot: 3103319', and 'EXP: 01-2012'. Each character is enclosed in a small red bounding box. The text is slightly rotated.</p>	<p>Segmentation: Local Threshold, Color Threshold</p>	 <p>The image shows the same text as the preprocessing step, but now the background is black and the text is white. The text is arranged in two lines: '18666040' and '18666040'. Each character is enclosed in a small red bounding box.</p>
<p>Noise Filtering</p>	 <p>The image shows the same text as the preprocessing step, but now the background is black and the text is white. The text is arranged in three lines: 'PN:9ZF2M2-570', 'SN:NA0E88K8', and 'SN:NA0E88K8'. Each character is enclosed in a small red bounding box. The text is slightly rotated.</p>	<p>Character separation</p>	 <p>The image shows the same text as the preprocessing step, but now the background is black and the text is white. The text is arranged in one line: '34009'. A vertical red line is drawn between the '0' and '9'.</p>
<p>Rotation detection</p>	 <p>The image shows the same text as the preprocessing step, but now the background is black and the text is white. The text is arranged in one line: '21272L'. Each character is enclosed in a small red bounding box. The text is slightly rotated.</p>	<p>Space Identification</p>	 <p>The image shows the same text as the preprocessing step, but now the background is black and the text is white. The text is arranged in one line: 'Lot: 31'. Each character is enclosed in a small red bounding box. A double-headed arrow is drawn between the colon and the '31'.</p>

3D Binocular Stereo Vision

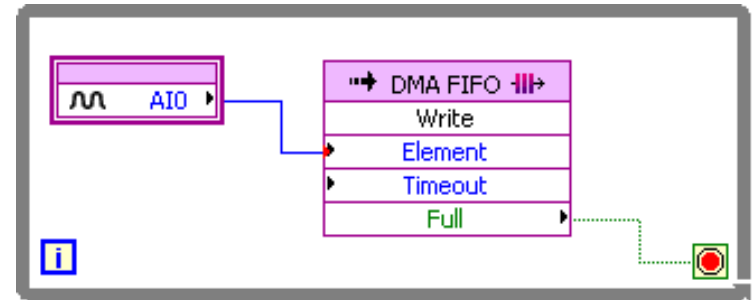
- New 3D Stereo Vision Features in Vision Development Module
- Calibrate cameras to analyze left and right images
- Generate depth and disparity maps (3D images)
- Suited for advanced inspection and vision guided robotics applications



LabVIEW FPGA - Abstraction to the Pin



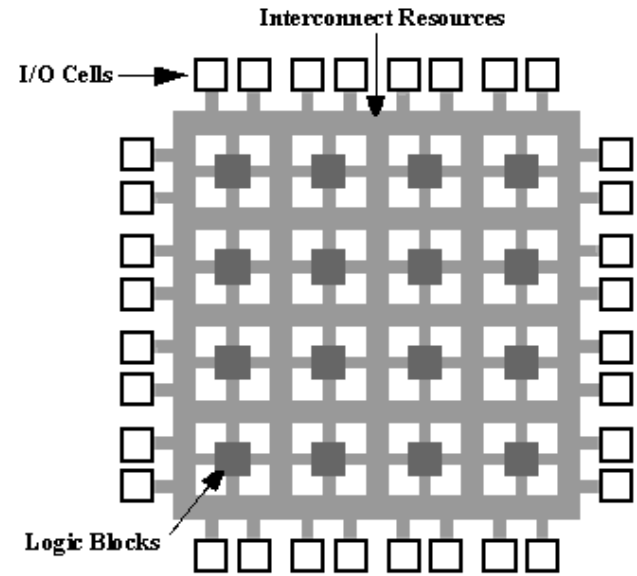
VHDL



LabVIEW FPGA

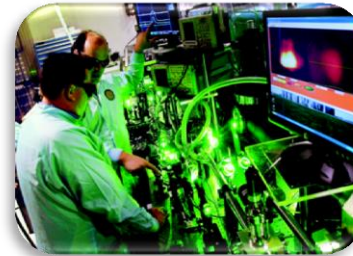
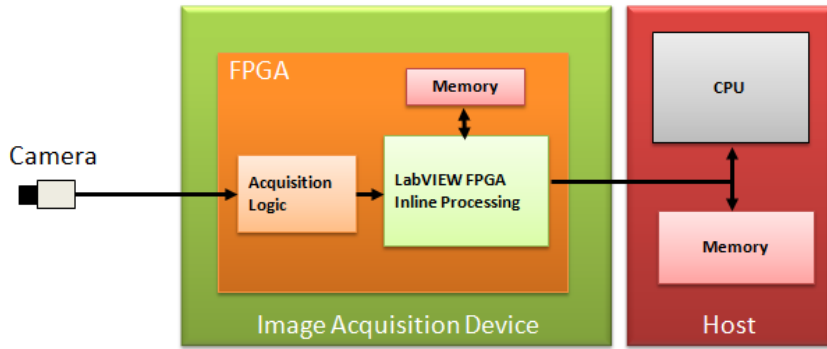
FPGAs

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



FPGA Image Processing

- High-speed control

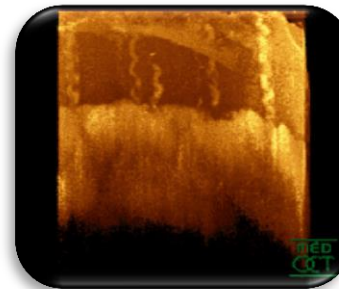
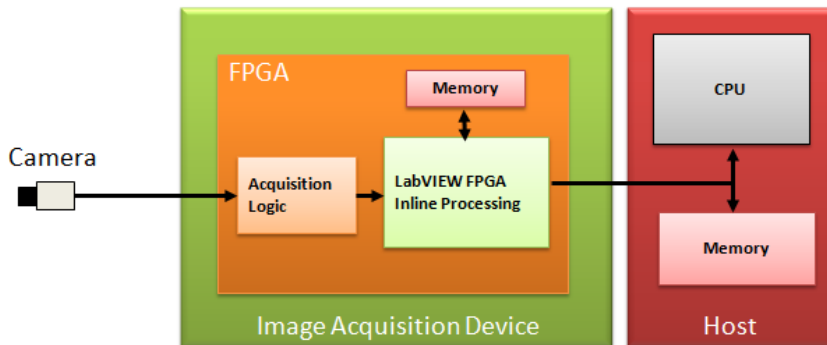


Laser Alignment & Tracking



High-Speed Sorting

- Image pre-processing

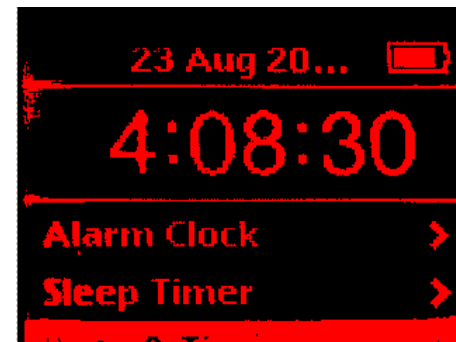
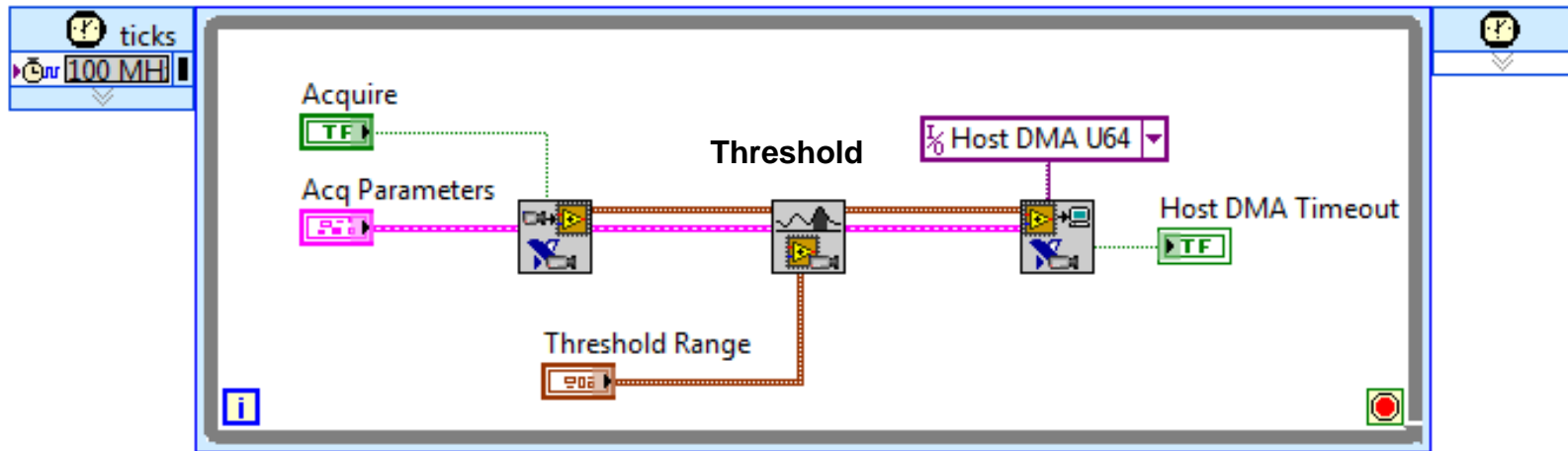


Optical Coherence Tomography



Web & Surface Inspection

Pixel Processing Example - Threshold

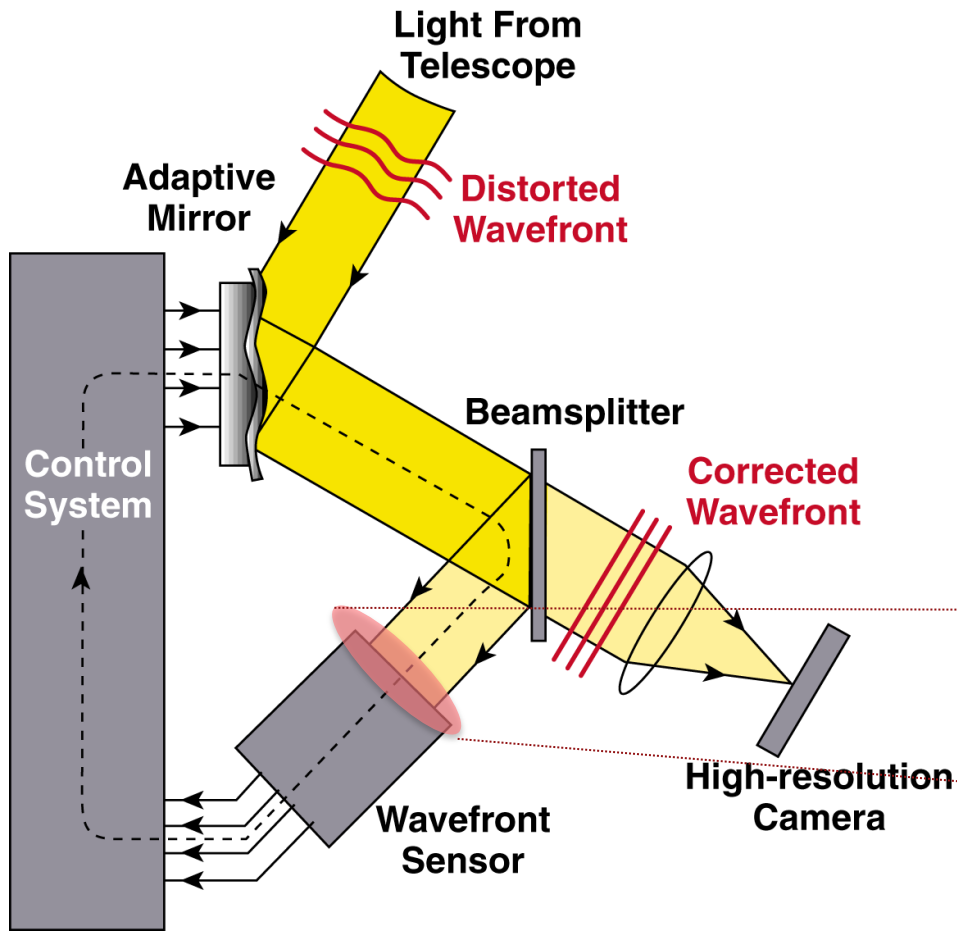


High-Speed Control

- 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



Adaptive Optics



Shack-Hartmann wavefront sensor

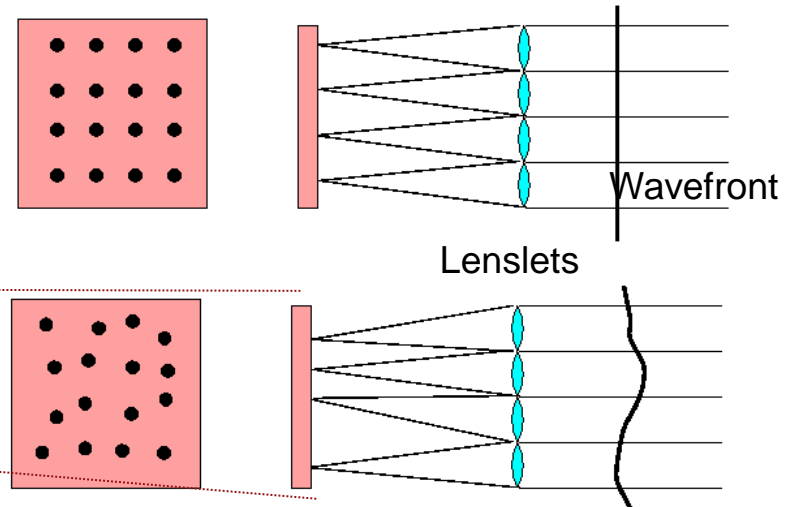
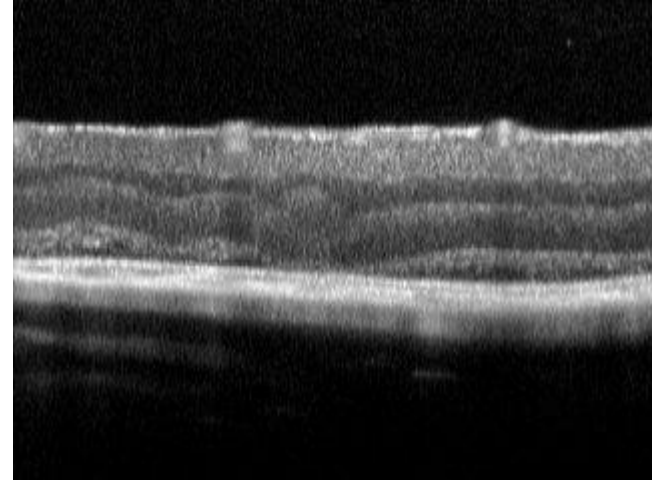


Image Pre-processing

- Optical Coherence Tomography (OCT)
 - Data scaling
 - FFT
 - Logarithmic LUT
 - Image display (host)
- Web and surface inspection
 - Flat field correction
 - Thresholding
 - Particle analysis



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

NIDays

WORLDWIDE GRAPHICAL SYSTEM DESIGN
2013 CONFERENCES

NIDays 2013



NIDays 2013

Multitematická technická konference pro inženýry, vědce a akademické pracovníky

[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](http://czech.ni.com/nidays)