

HALCON - The Power of Machine Vision

HALCON BASICS

Praxisorientiert PC based Vision Schulung auf Basis von
MVTecs HALCON

WAS IST HALCON?



The screenshot displays the HALCON HDevelop environment. The main window shows a 3D model of a green pipe joint. Below the model, control instructions are listed: Rotate: Left button, Zoom: Shift + left button, Move: Ctrl + left button. The 'Object Model 3D Inspect' panel shows parameters for 'ObjectModel3D', including 'Display Models' (checked), 'Model Id' (0), 'Color' (cyan), and 'Center' coordinates. The 'Program Editor' shows a script for 'main (:::)' with comments and code for visualizing the 3D model. The 'Variable View' panel shows the current state of variables, including 'ObjectModel3D' set to 0. The status bar at the bottom indicates the current image dump size and coordinates.

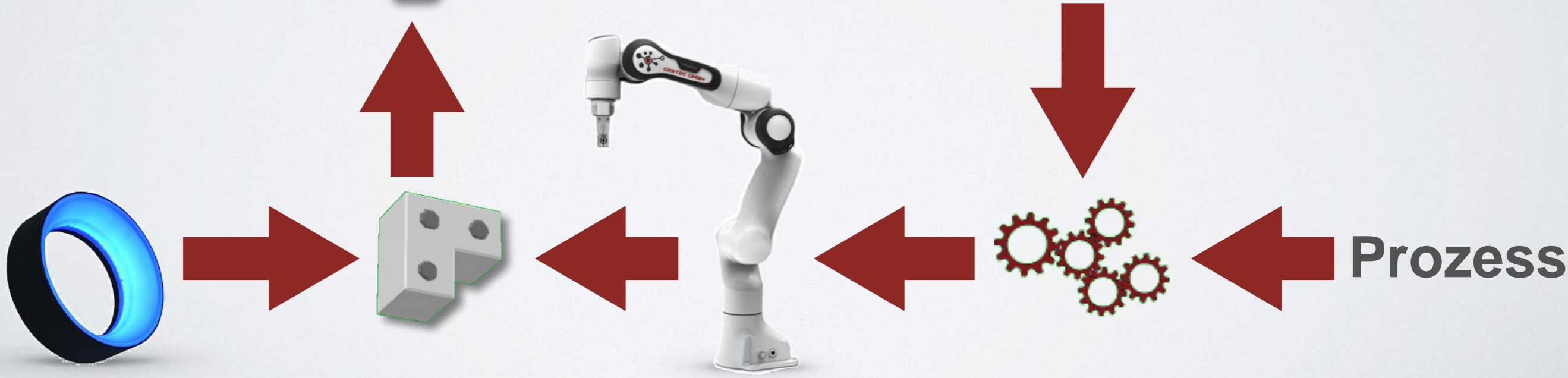
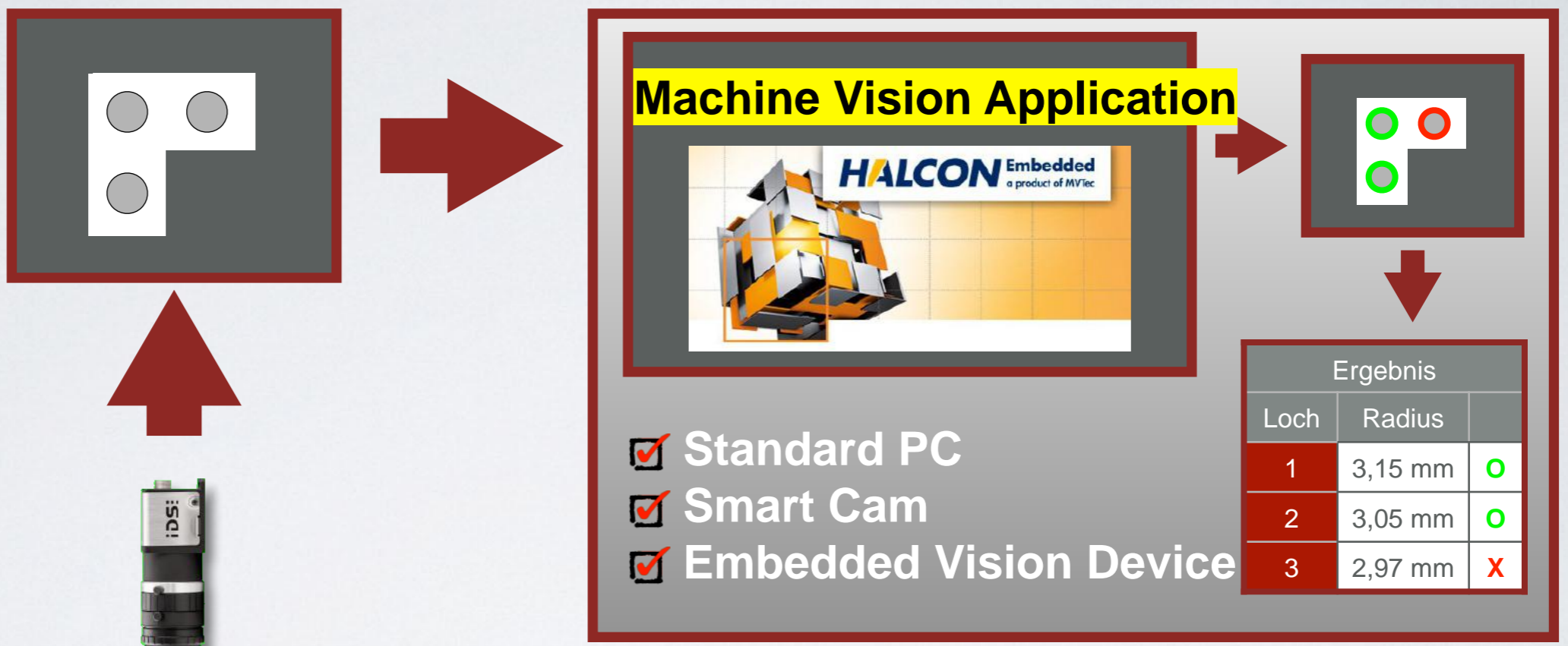
HALCON ist die umfassende Standardsoftware mit integrierter Entwicklungsumgebung.

Halcon ist Teil des Bildverarbeitungsprozesses einer Applikation



Prozess

Halcon ist Teil des Bildverarbeitungsprozesses einer Applikation



Die HALCON Library enthält verschiedene Tools für die Bildverarbeitung



Machine Vision Application

HDevelop

`find_ncc_model_defocused.hdev`
`classify_bottle_mouth.hdev` (...)

**HALCON
Image Processing
Library**

`(...).do_ocr_multi_class_mlp()`
`measure_pos()` `find_bar_code`
`fit_rectangle2_contour_xld()`
`edges_color()` `lines_gauss()` (...)

Die HALCON Library enthält verschiedene Tools für die Bildverarbeitung



Machine Vision Application

HALCON
Image Processing Library

Acquisition Interfaces

Image Acquisition Interfaces

Extension Package

Image Acquisition Interface
Programmer's Manual

USB3 Vision

uEye

GigE Vision

GenICam

Extension Package Interface
Programmer's Manual

Die HALCON Library enthält verschiedene Tools für die Bildverarbeitung



Machine Vision Application

HALCON
Image Processing Library

I/O Interface Template

HALCON I/O Interfaces



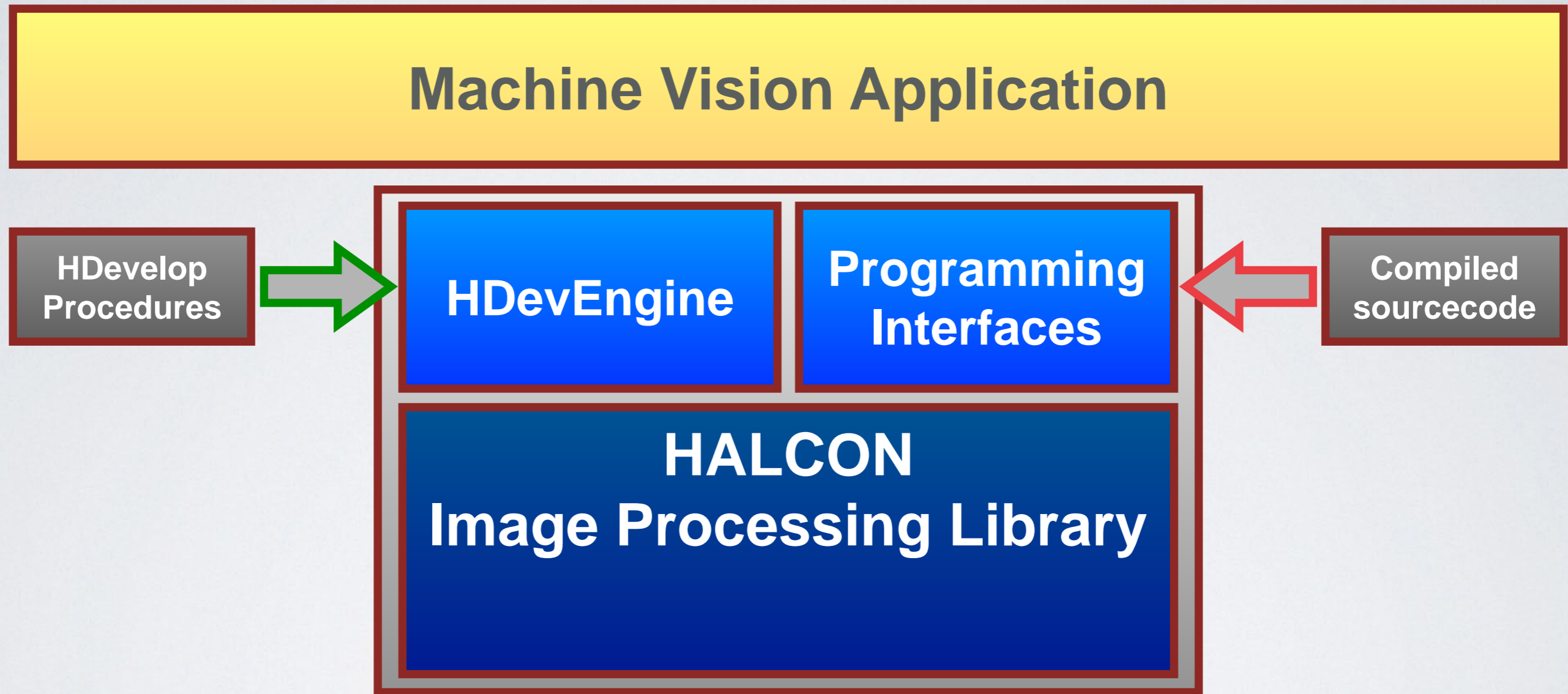
Custom I/O device
interface



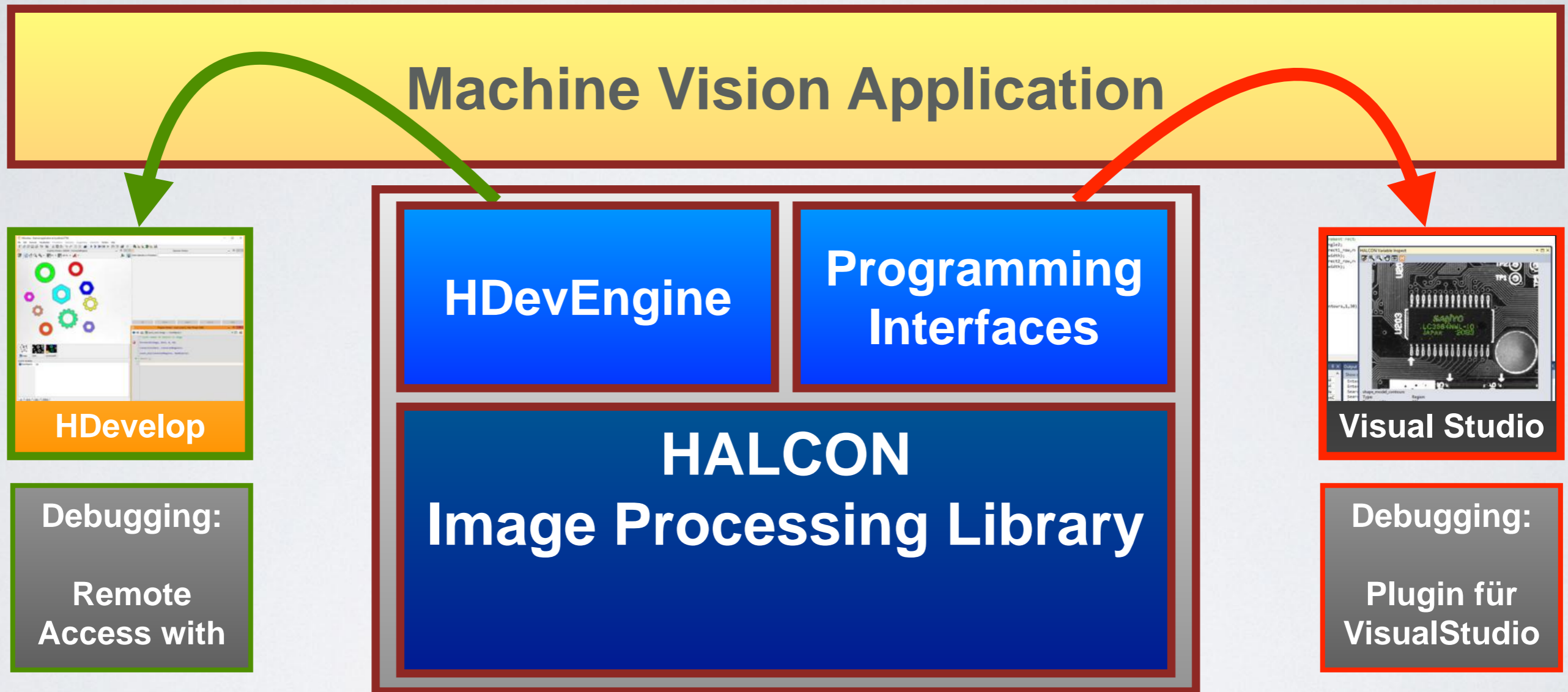
OPC-UA

< ... >

Die HALCON Library enthält verschiedene Tools für die Bildverarbeitung



Die HALCON Library enthält verschiedene Tools für die Bildverarbeitung



Die HALCON Library enthält verschiedene Tools für die Bildverarbeitung



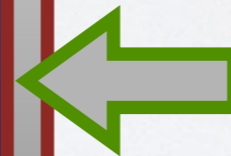
Machine Vision Application

HDevEngine

Programming
Interfaces

HALCON
Image Processing Library

How to do:
Examples



Die HALCON Library enthält verschiedene Tools für die Bildverarbeitung



Machine Vision Application

HDevEngine

Programming Interfaces

**HALCON
Image Processing Library**



Browse HDevelop Program Examples

Category	Find:	Example
Application area		
Industry		
Method		
Operator		
New in version		



HDevelop ist der schnelle Weg zu Ihrer Lösung



HDevelop

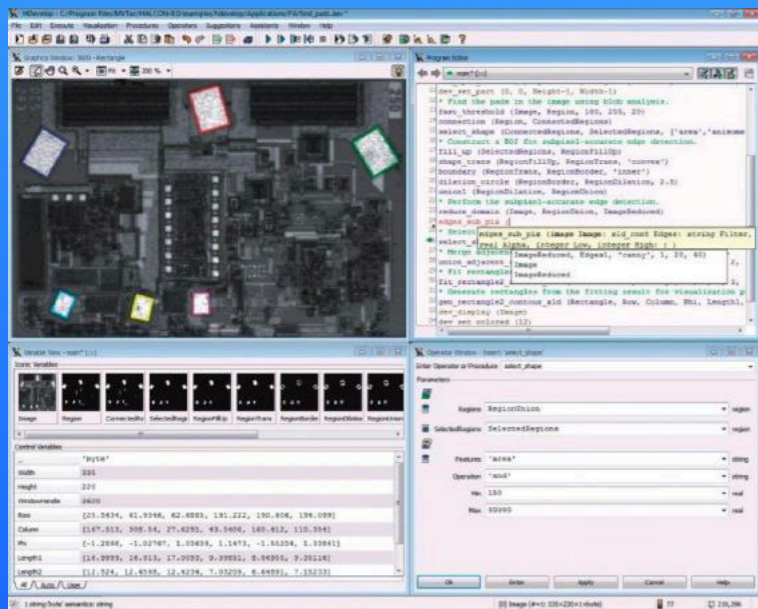
Visual Studio

Maschine

HDevelop ist der schnelle Weg zu Ihrer Lösung



1. Vision Programm entwickeln



HDevelop

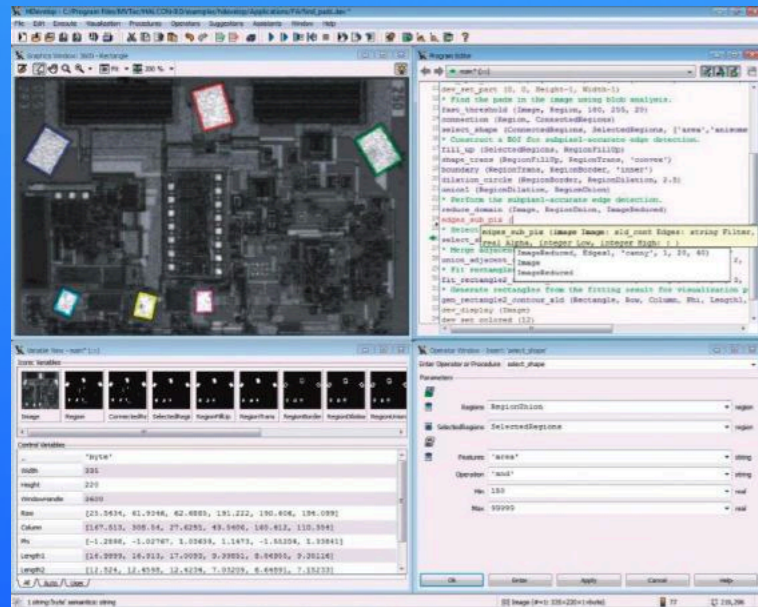
Visual Studio

Maschine

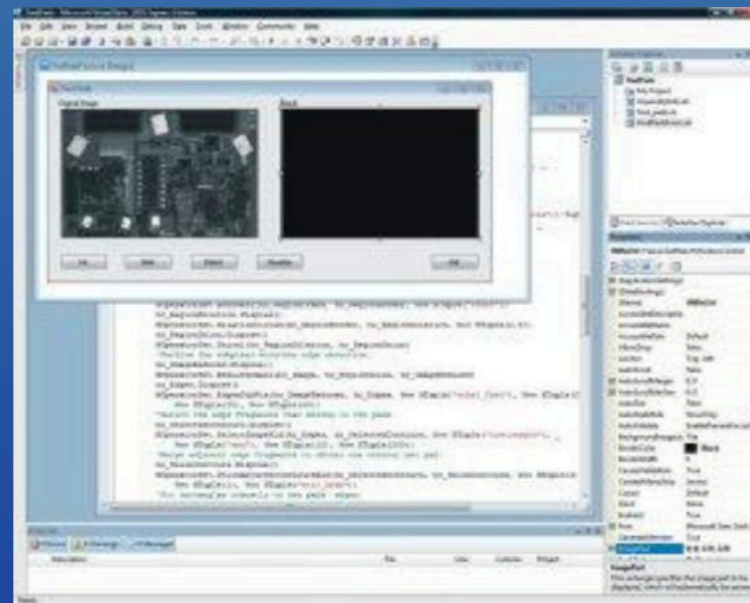
HDevelop ist der schnelle Weg zu Ihrer Lösung



1. Vision Programm entwickeln



2. User Interface hinzufügen



Export Code

HDevelop

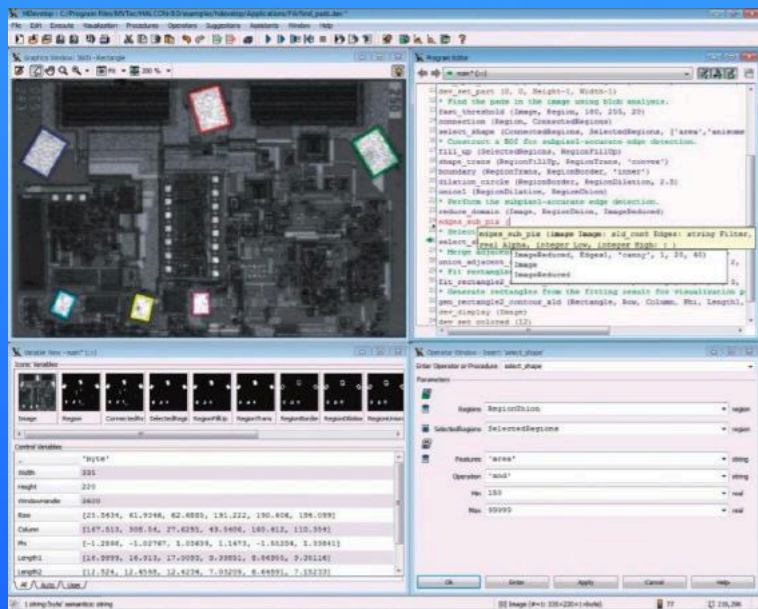
Visual Studio

Maschine

HDevelop ist der schnelle Weg zu Ihrer Lösung

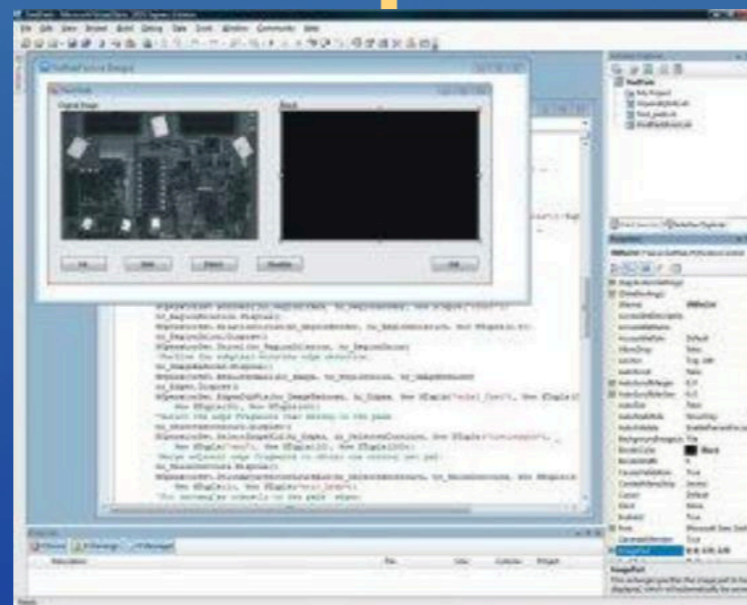


1. Vision Programm entwickeln



Export Code

2. User Interface hinzufügen



kompilieren

3. Programm ausführen



HDevelop

Visual Studio

Maschine



HDevelop ist der schnelle Weg zu Ihrer Lösung



HDevelop

Visual Studio

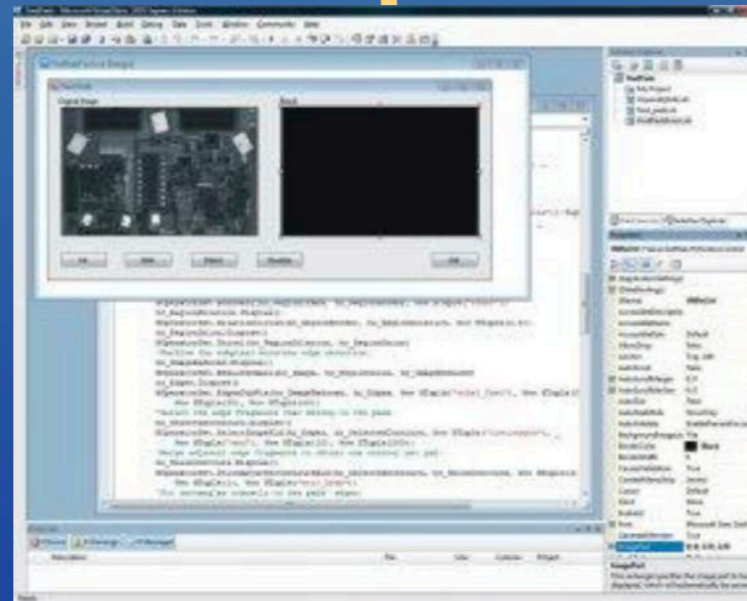
Maschine

HDevelop ist der schnelle Weg zu Ihrer Lösung



Design einer generischen
Anwendungsschnittstelle

kompilieren



HDevEngine

Konfiguriere

HDevelop

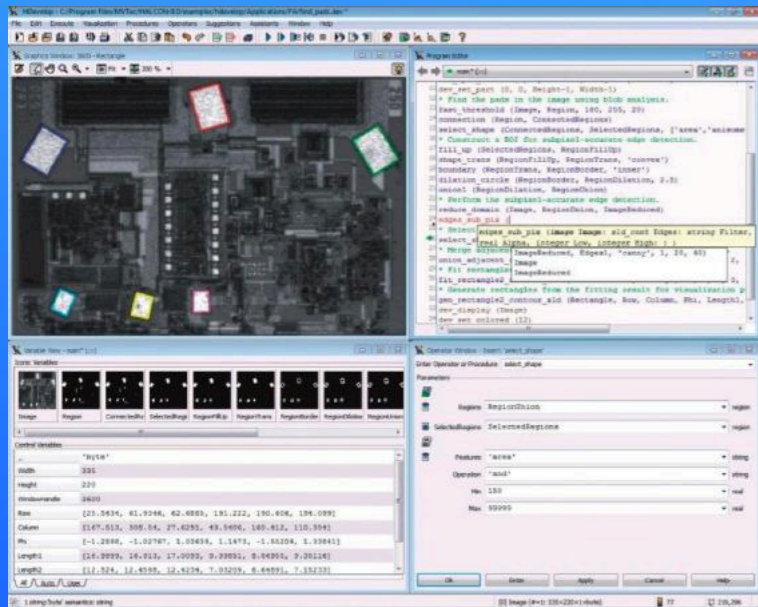
Visual Studio

Maschine

HDevelop ist der schnelle Weg zu Ihrer Lösung

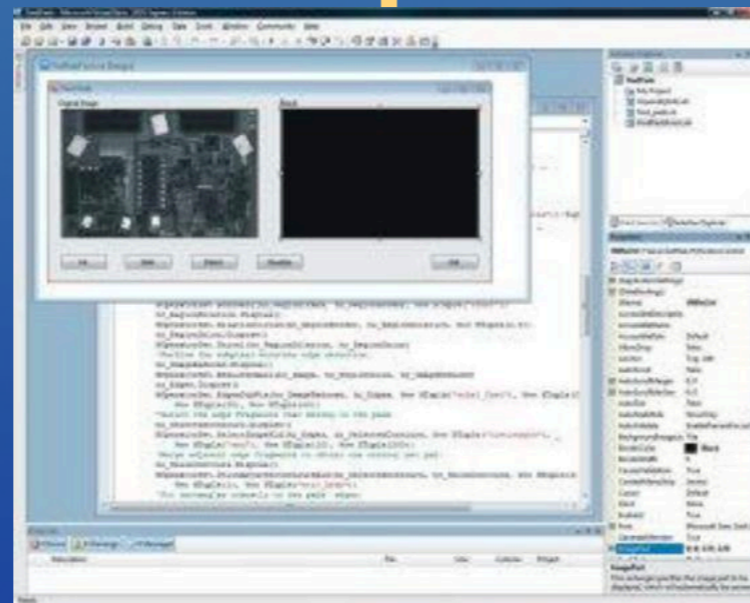


Vision Programm entwickeln



HDevelop

Design einer generischen
Anwendungsschnittstelle



Visual Studio

kompilieren



HDevEngine

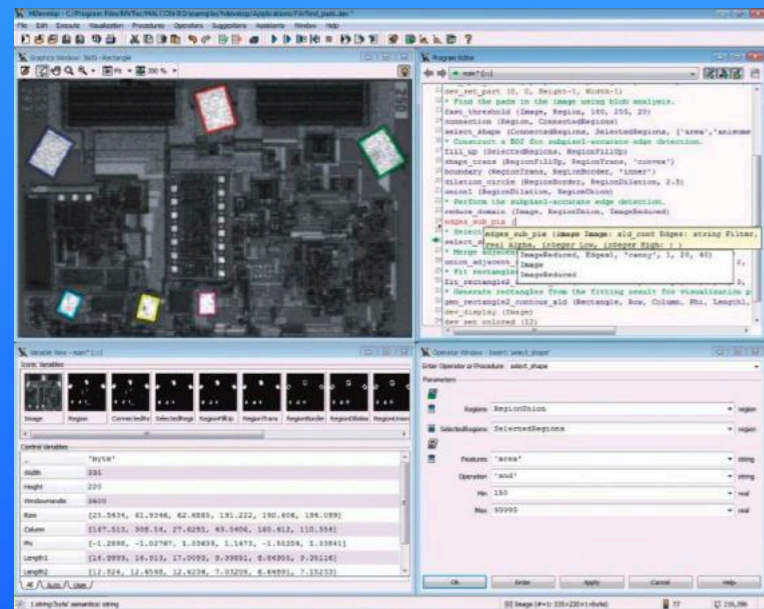
Konfiguriere

Maschine

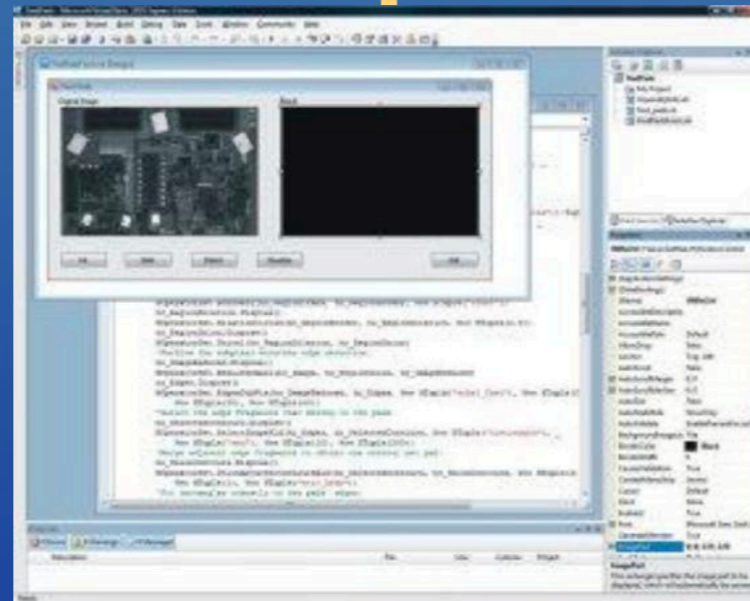
HDevelop ist der schnelle Weg zu Ihrer Lösung



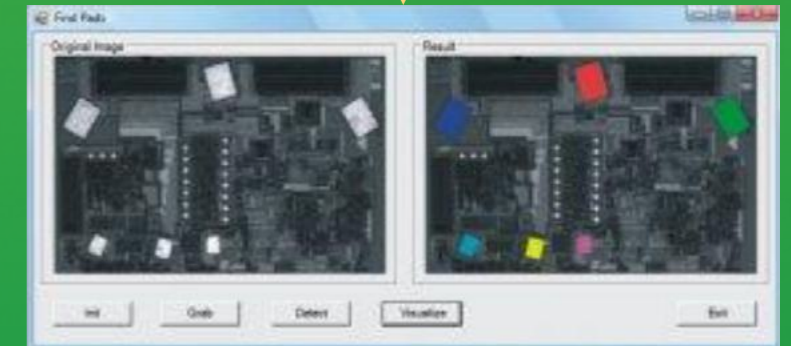
Vision Programm entwickeln



Design einer generischen
Anwendungsschnittstelle



Maßgeschneiderte Anwendung



kompilieren

HDevEngine

Konfiguriere

HDevelop

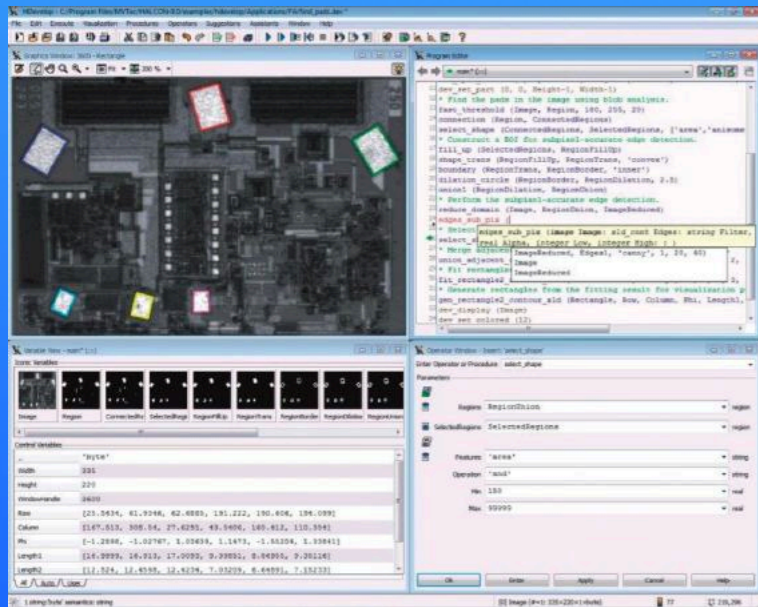
Visual Studio

Maschine

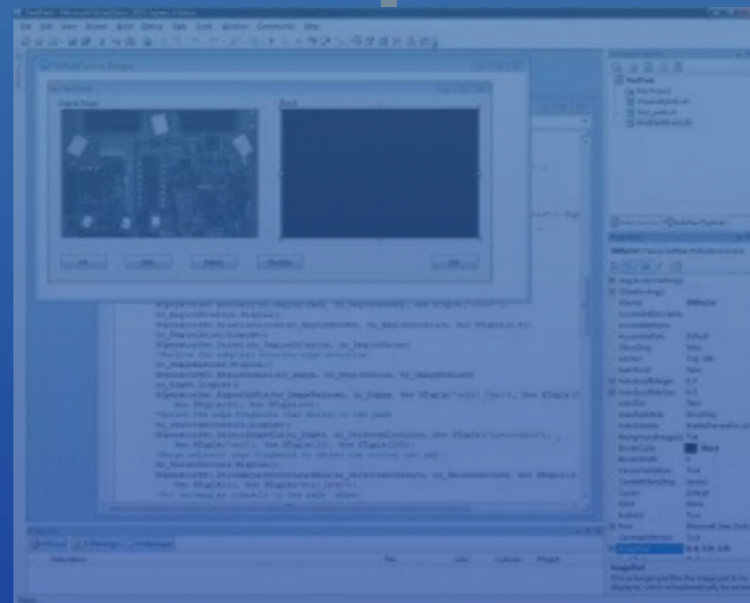
HDevelop ist der schnelle Weg zu Ihrer Lösung



Vision Programm entwickeln



Design einer generischen
Anwendungsschnittstelle



Maßgeschneiderte Anwendung



HDevEngine

Konfiguriere

HDevelop

Visual Studio

Maschine

HDevelop ist der schnelle Weg zu Ihrer Lösung

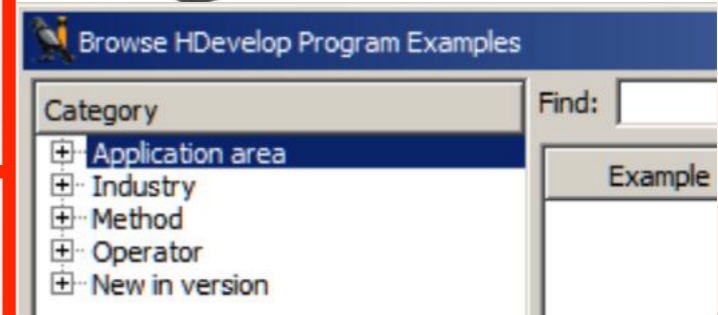


Machine Vision Application

HDevEngine

Programming
Interfaces

HALCON
Image Processing Library



HDevelop: Mehr als 1.100 Beispiele



Browse HDevelop Program Examples

Category

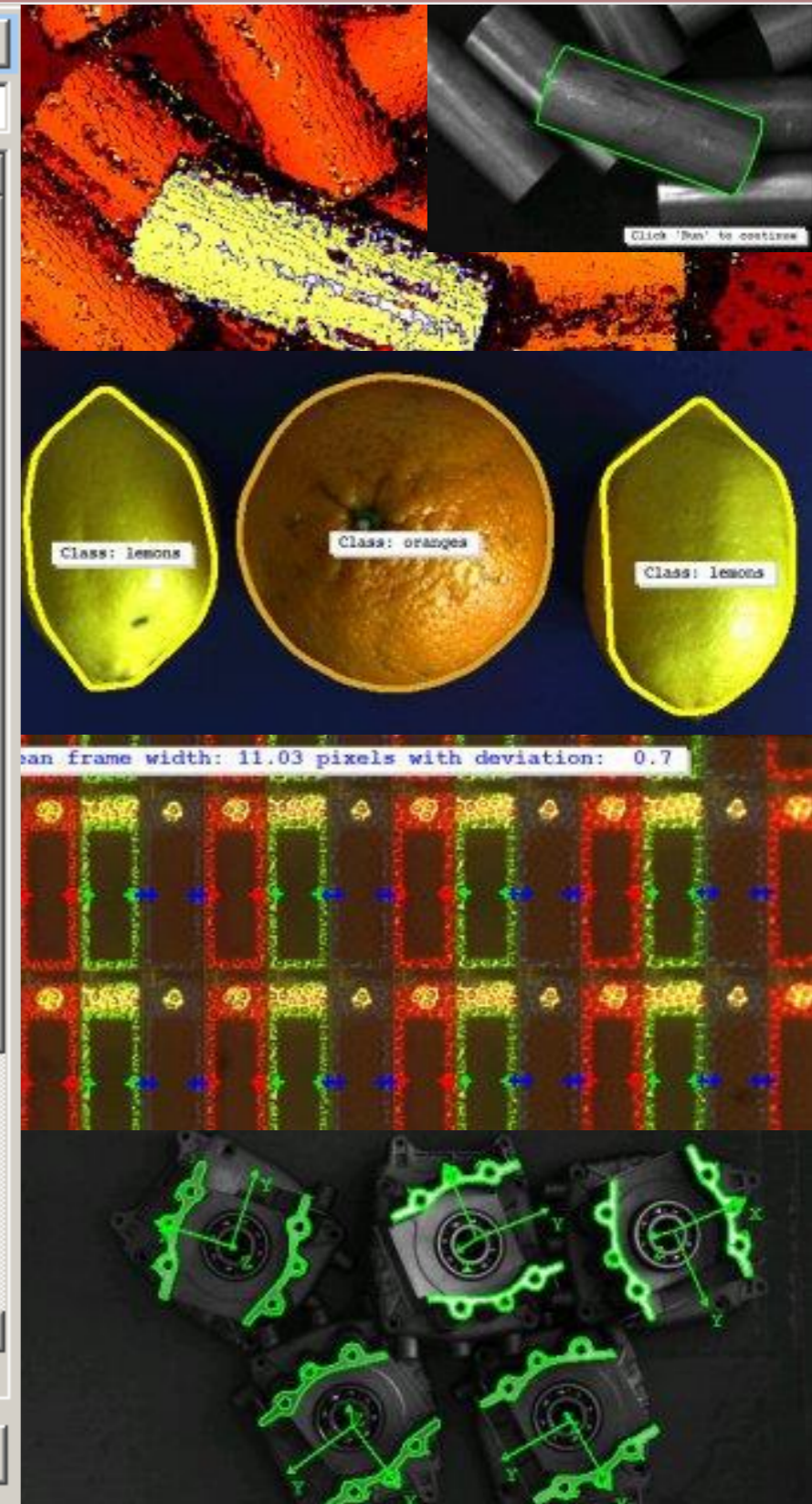
- Application area
 - Alignment
 - Color inspection
 - Completeness check
 - General
 - Identification with bar codes
 - Identification with data co...
 - Identification with OCR
 - Measuring and comparison...
 - Measuring and comparison...
 - Object recognition 2D
 - Object recognition 3D
 - Position recognition 2D
 - Position recognition 3D
 - Print inspection
 - Robot vision
 - Security systems
 - Surface inspection
 - Texture inspection
 - Traffic monitoring and driv...
- Industry
 - Agriculture, food**
 - Automobile parts and man...
 - Chemicals
 - Electric components and e...
 - General
 - Glass production and proc...
 - Health care and life science
 - Iron, steel and metal
 - Machinery
 - Packaging
 - Paper products
 - Pharmaceutical
 - Photogrammetry and rem...
 - Precision engineering and ...
 - Printing
 - Retail

Find:

Example	Description
apply_sample_idenfier.hdev	Identify wine labels using sample-b...
bottle.hdev	Read numbers on a beer bottle
bottlet.hdev	Train numbers on a beer bottle
check_bottle_crate.hdev	Count bottles contained in crates
check_fish_stick_dimension.hdev	Measure the size of raw fish sticks
check_hazelnut_wafers.hdev	Inspect quality of hazelnut wafers
check_soft_cheese.hdev	Check content of soft cheese packa...
classify_bottle_mouth.hdev	Detect defects on a bottle mouth u...
classify_citrus_fruits.hdev	Distinguish oranges and lemons usir...
color_segmentation_pizza.hdev	Find salami pieces on pizza based o...
count_fish_sticks.hdev	Perform a completeness check for f...
find_cocoa_packages_local_deformable...	Find a cocoa label using local deform...
find_cocoa_packages_max_deformation...	Find a cocoa label using shape-base...
find_ncc_model_exposure.hdev	Find an object despite linear illumina...
find_peanut_chocolate_candies_local_de...	Find a peanut chocolat candy label
find_text_bottle_label.hdev	Segment text on a bottle label for a...
identify_vegetables.hdev	Identify vegetables using sample-b...
inspect_bottle_mouth.hdev	Check bottle mouths for defects
label_word_process_mlp.hdev	Read a best-before label using a le...
locate_cookie_box.hdev	Locate a cookie box using descripto...
locate_cookie_box_multiple_models.hdev	Locate cookie boxes usina descripto...

Keep dialog open

Open Open in new HDevelop



HDevelop: Mehr als 1.100 Beispiele



The image displays a collage of HDevelop software windows, illustrating various image processing and feature analysis capabilities.

Feature Inspection - Bond - Gray Histo[?]

Feature	Value	Display
area	372736	0 100000
row	255.5	0 1000
column	363.5	0 1000
width	728	0 1000
height	512	0 1000
row1	0	0 1000
outer_radius	444.811	0 1000
inner_radius	256	0 1000
circularity	0.602892	0 1

Feature Histogram - DieGrey - Bond

Input Window: Active | Output Window: Input

Feature: circularity | Channel: 1 | Min: 0 | Max: 1

Insert Code: AND | none

Variable Inspect: RowEdge, ColEdge

	RowEdge	ColEdge
0	367.315	677.685
1	367.258	681.482
2	367.686	685.806
3	368.022	689.559
4	368.143	693.393
5	368.152	697.527
6	368.14	701.542
7	367.944	705.31
8	367.308	709.761
9	366.921	713.569
10	366.97	717.382
Min	365.755	193.722
Max	622	846.473
Mean	417	548.999
Deviation	672	200.972
Num	782	782

Gray Value Histogram - Image

Channel: 1 | Update:

Statistics:

Gray Values	Number	Percent
Peak: 156	5246	2.00119 %
Range: 1 ... 249	262144	100 %
Selection: 118 ... 194	210313	80.228 %
Outside:	51831	19.772 %

Zoom - Image

Size: 800% | Follow Mouse:

Coordinates: (221, 192, 99) | byte, 3 channel(s)

Row: 216 | Column: 222

Executed 106 program lines in 1.127 s - la

HDevelop: Mehr als 1.100 Beispiele



The screenshot displays the HDevelop software interface with the following components:

- Menu Bar:** File, Edit, Execute, Visualization, Procedures, Operators, Suggestions, Assistants, Window, Help.
- Assistants Menu:** A dropdown menu is open, listing: Open New Image Acquisition, Open New Calibration, Open New Matching, Open New Measure, and Open New OCR.
- Graphics Window:** Titled "3600 - VarImage", showing a grayscale image of the MIT logo with white edges.
- Code Editor:** Contains the following code:

```
|ZoomedEdges|
to NEdges by 1
40 ObjectSelected := ZoomedEdges[i]
41 get_contour_xld (ObjectSelected, RowEdge, ColEd
42 gen_region_polygon (Region1, RowEdge, ColEdge)
43 dilation_circle (Region1, RegionDilation, 2.5)
44 paint_region (RegionDilation, VarImageBig, VarI
45 endfor
46 zoom_image_size (VarImageBig, VarImageSmall, Width,
47 binomial_filter (VarImageSmall, VarImage, 3, 3)
48 create_variation_model (Width, Height, 'byte', 'dir
49 prepare_direct_variation_model (Image, VarImage, Va
50 dev_display (VarImage)
51 display_write_message (WindowHandle, -1, -1, 'Varia
52 stop ()
```
- Variable View:** Shows "Iconic Variables" with thumbnails for Image, Region, RegionFillUp, RegionDiffere, LogoArea, ImageReduce, and "Control Variables" with a table:

Variable	Value
-	43541
Width	451
Height	301
WindowHandle	3600
ShapeModelID	0
- Operator Dialog:** Titled "Operator", showing "binomial_filter" selected. Parameters: Image (Image), ImageBinomial (ImageBinomial), MaskWidth (5), MaskHeight (5).
- Status Bar:** "Executed 106 program lines in 1.127 s - last: display_write_message (15.6 ms) [0] VarImage (#=1: 451x301x1xbyte) 0 0,0"

HDevelop: Mehr als 1.100 Beispiele



The screenshot displays the HDevelop software interface. The main window is titled "HDevelop - unnamed" and contains a "Graphics Window: 3600 - Calibration 01C" showing a grid of calibration points. A yellow callout box highlights the "Open New Image Acquisition" menu option. A red dashed box highlights the "Calibration : Calibration 01" window, which shows a table of quality issues and a "Quality Issues" section.

Scope	Description	Quality
1 Image	Contrast is low	65%
2 Image	Plate in image is too small	46%
3 Sequence	Quality issues detected for some images	0%
4 Sequence	Number of images is too low	60%
5 Sequence	Field of view is not covered by plate images	67%
6 Sequence	Tilt angles are not covered by sequence	52%

Quality Issues

- Image Tests: All
- Sequence Tests: All
- Warn Level (%): 70
- Live Tests:

HDevelop: Mehr als 1.100 Beispiele



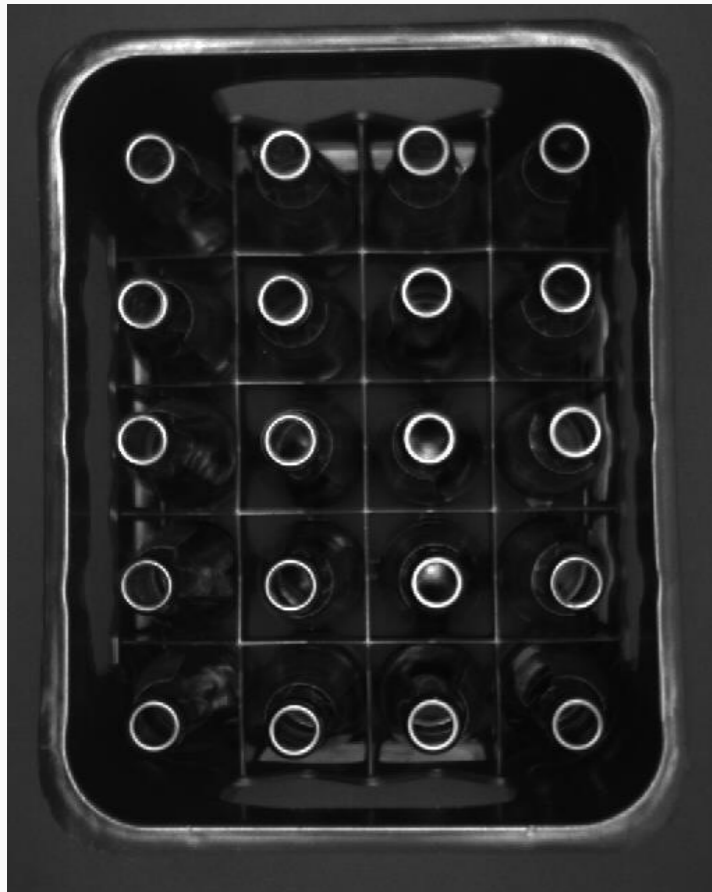
The screenshot displays the HDevelop software interface. The main window is titled "HDevelop - unnamed" and has a menu bar with "File", "Edit", "Execute", "Visualization", "Procedures", "Operators", "Suggestions", "Assistants", "Window", and "Help". The "Help" menu is open, showing options for "Help" (F1) and "HALCON Reference". A yellow box highlights the "Help" menu item, and a yellow arrow points from it to the "HDevelop Help Window".

The "HDevelop Help Window" is a separate window with a title bar and a toolbar. It contains a "Contents" tab and a list of topics. The "Solution Guide Basics" is selected and highlighted in blue. The main content area shows the HALCON logo and the text "the Power of Machine Vision". Below this, there is a section titled "Solution Guide I Basics" with a large image of a landscape and a large number "13". At the bottom, the MVTEC logo and "MVTEC Software GmbH" are visible, along with the slogan "Building Vision for Business".

A red dashed box outlines the "HDevelop Help Window". A red arrow points from the "Solution Guide Basics" entry in the table of contents to the "Solution Guide I Basics" section in the main content area.

- 1 Guide to HALCON Methods
- 2 Image Acquisition
- 3 Region Of Interest
- 4 Blob Analysis
- 5 1D Measuring
- 6 Edge Extraction (Pixel-Precise)
- 7 Edge Extraction (Subpixel-Precise)
- 8 Contour Processing
- 9 Matching
- 10 3D Matching
- 11 Variation Model
- 12 Classification
- 13 Color Processing
- 14 Texture Analysis
- 15 Bar Code
- 16 Data Code
- 17 OCR
- 18 Stereo Vision
- 19 Visualization
- 20 Compute Devices
- 21 I/O Devices

Von der Anwendung zur Lösung in drei Schritten



HDevelop - unnamed *

File Edit Execute Visualization Procedures Operators Suggestions Assistants Window Help

Graphics Window: 3600 - ConnectedRegions
Aspect 100 %

Operator Window - Insert: 'select_shape'
Enter Operator or Procedure select_shape

Parameters

- Regions ConnectedRegions region
- SelectedRegions SelectedRegions region
- Features 'area' string

Variable View - main* (:::)

Iconic Variables

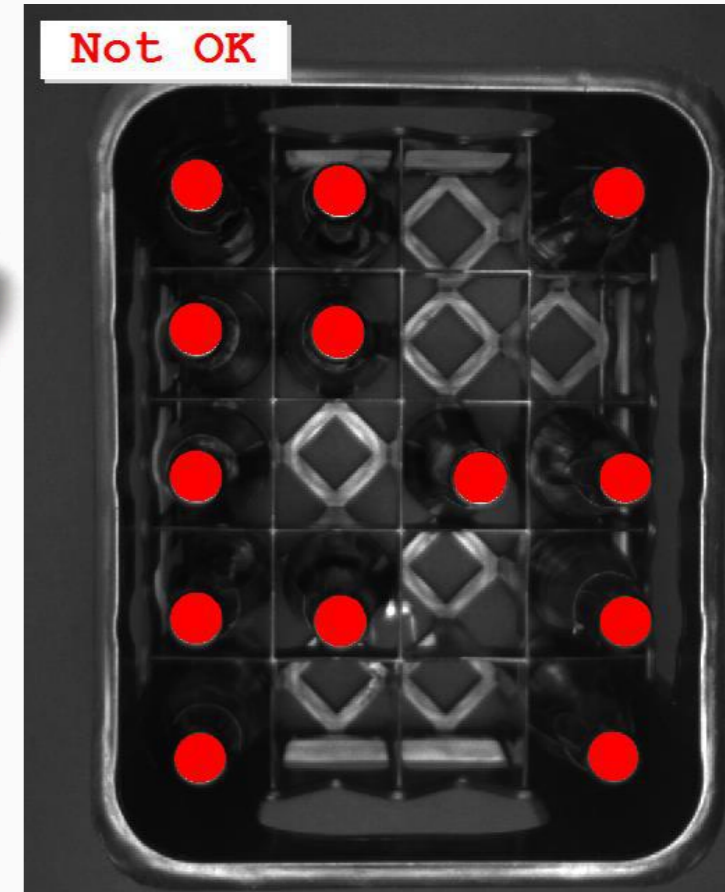
Control Variables

AcqHandle 284651252

Program Editor

```
1 * Code generated by Image Acquisition 01
2 open_framegrabber ('uEye', 1, 1, 0, 0, 0, 0,
3 grab_image_start (AcqHandle, -1)
4 while (true)
5   grab_image_async (Image, AcqHandle, -1)
6   smooth_image (Image, ImageSmooth, 'derich
7   threshold (ImageSmooth, Region, 100, 255)
8   connection (Region, ConnectedRegions)
9 endwhile
10 close_framegrabber (AcqHandle)
```

Choose regions with the aid of shape features. [0] ImageSmooth (#=1: 640x512x1xbyte) 15 145,212



1. Grab images

2. Test ideas

3. Run application



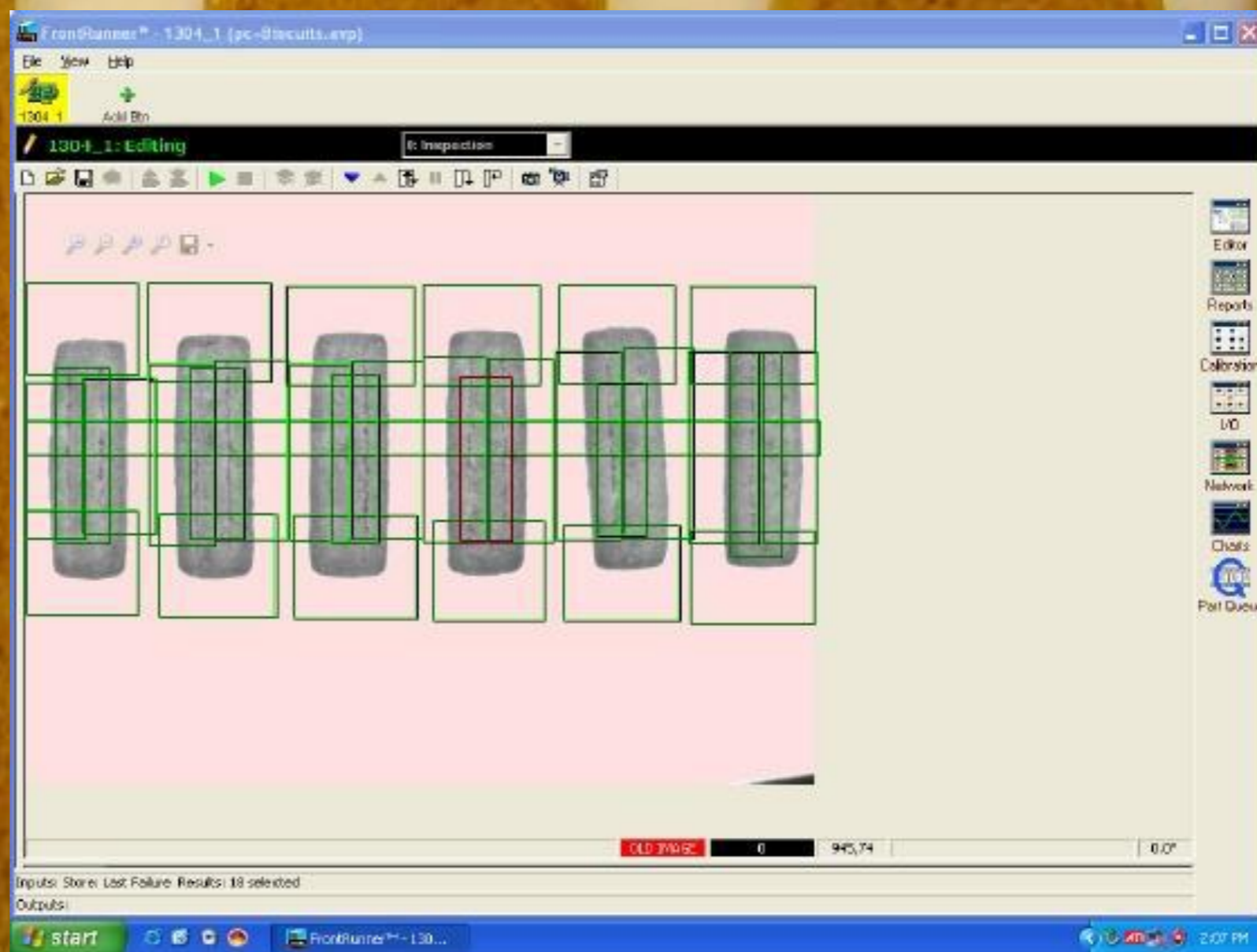
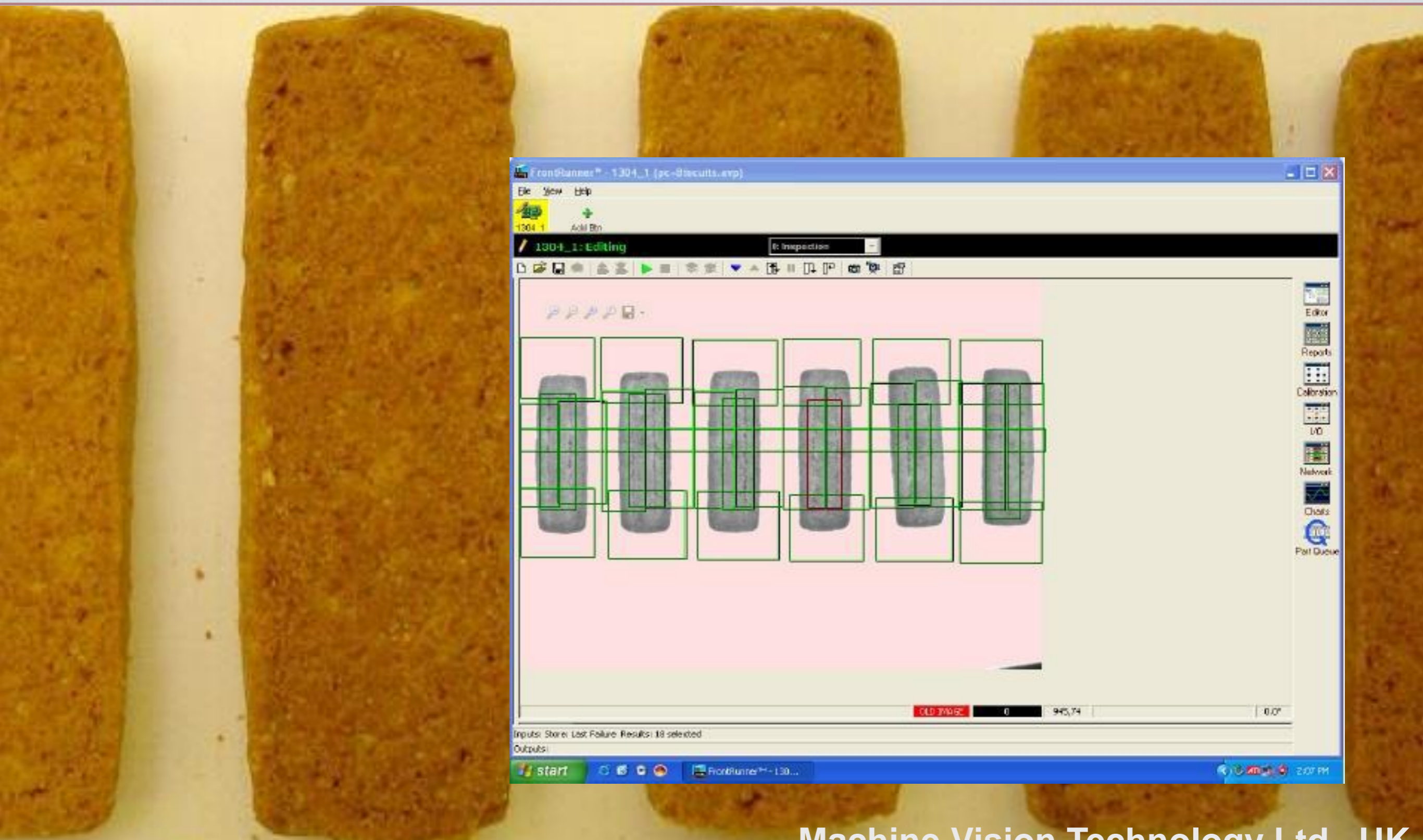
HDevelop: Mehr als 1.100 Beispiele



HALCON

Kunden Anwendungen

HALCON inspects biscuits





HALCON measures wheat quality



HALCON reads handwritten characters for an individual packet identification system



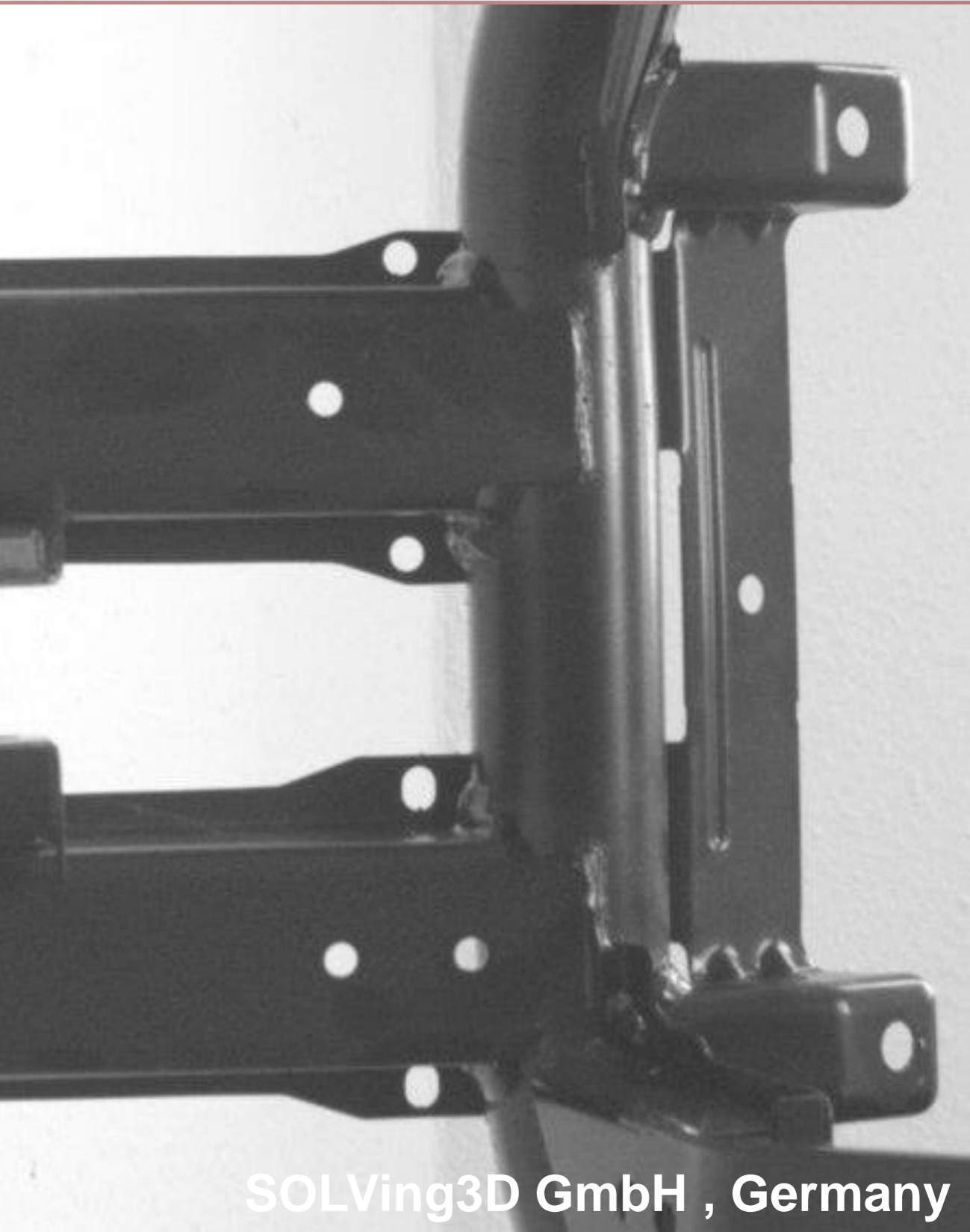


HALCON inspects coffee capsules

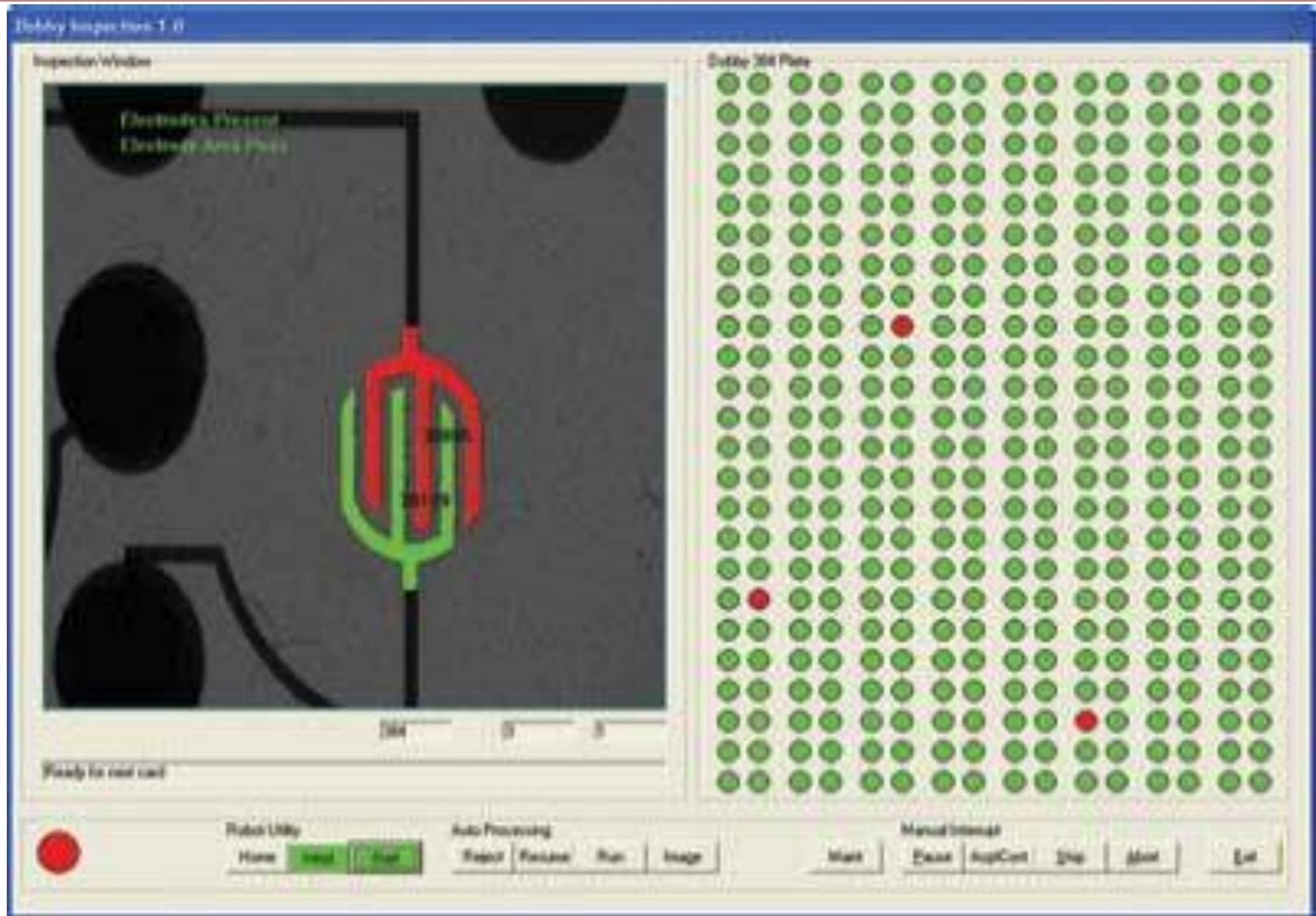




HALCON eases highly precise measurement



HALCON allows rapid inspection of micro electrodes with robots



HALCON inspects solar wafers



E-see Waferinspect 1.9.9

Irbeitslehre Testmessung Produkte Service HiFe

Bildanzeige Durchlicht Auflicht Microlicht

Zoom 20 x 20

4 Schmutz 5 Schmutz 6 Schmutz

1 Schmutz 2 Schmutz 3 Schmutz

Wafer Historie

Fixieren

Status System 10 Verbindung HMI 20 Bild fertig Durchlicht 1 Auflicht Lagefehler Fehler Wafer ID: M1
Status Kamera 7 Verbindung IO 30 Ergebnis fertig Durchlicht 2 Mikrolicht Trigger Wechsler Position 0° Zykluszahl: 1677

Konturprüfung

A Obere Kante:	124,95 mm	Fläche:	16778,39 mm ²
B Rechte Kante:	125,72 mm	Orientierung:	0,1°
C Untere Kante:	125,03 mm	Position (X,Y):	94,4 83,1 mm
D Linke Kante:	125,34 mm	Durchmesser:	175,83 mm

Oberflächenprüfung

Anzahl Ausbrüche:	2
Anzahl Chips:	0
Fläche Schmutz:	0,49 mm ²
Anzahl Risse:	0
Anzahl Löcher:	0
Micros:	Nein

Chamferprüfung

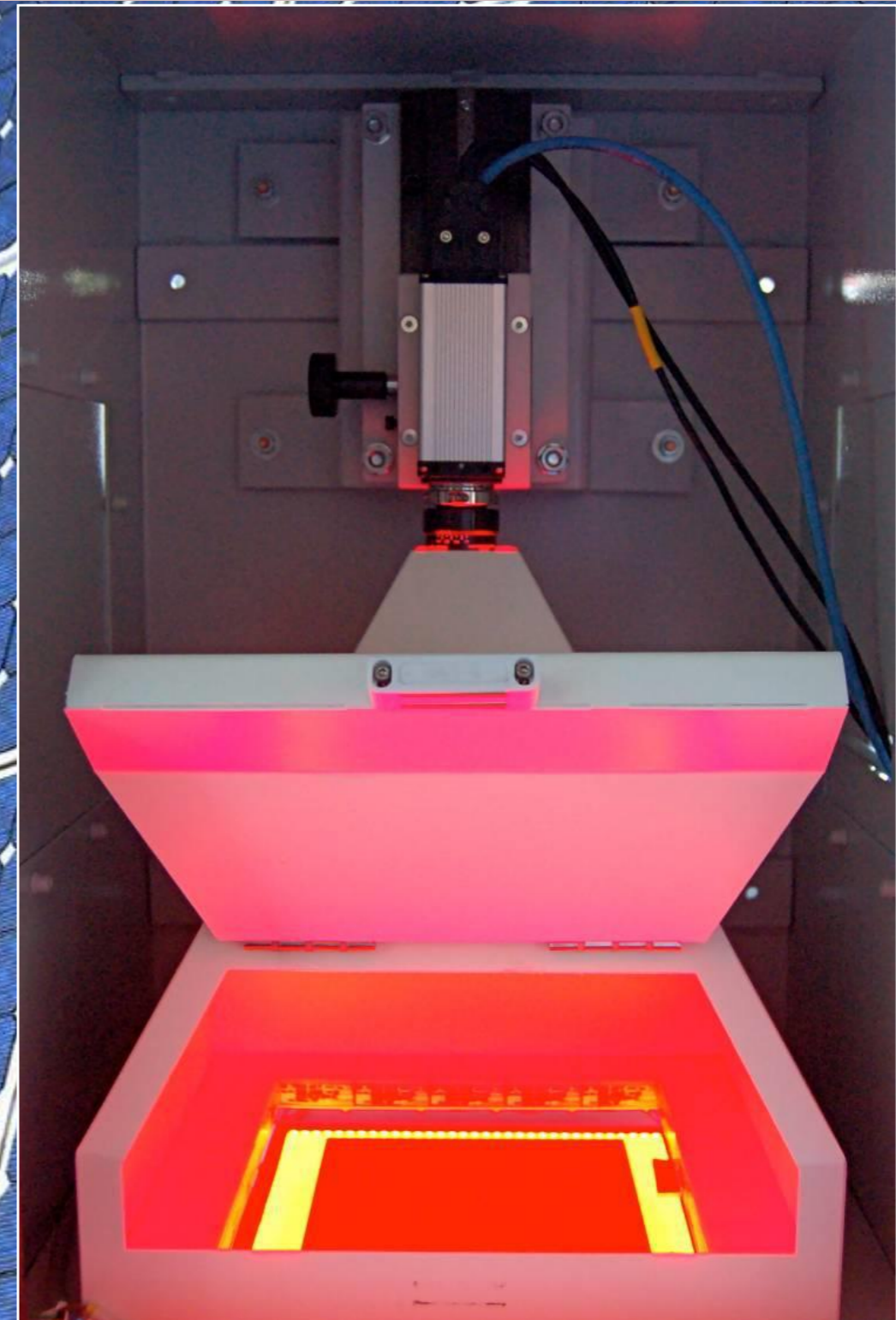
Ecke D/A		Ecke A/B	
Winkel Ecke:	90,103°	Winkel Ecke:	89,934°
Länge Fase:	1,08 mm	Länge Fase:	1,35 mm
Winkel Fase:	45,86°	Winkel Fase:	49,63°

Ecke C/D		Ecke B/C	
Winkel Ecke:	90,071°	Winkel Ecke:	89,893°
Länge Fase:	1,44 mm	Länge Fase:	3,59 mm
Winkel Fase:	44,12°	Winkel Fase:	74,84°

Alle quittieren Speichern

Waferinspect 1.9

Aktives Produkt: MultiGross Helldiagnoseprüfung: Aus Logging: An Temperatur: Temperaturausgleich: Aus Messung: 1 Prozesszeit (ms): 1621



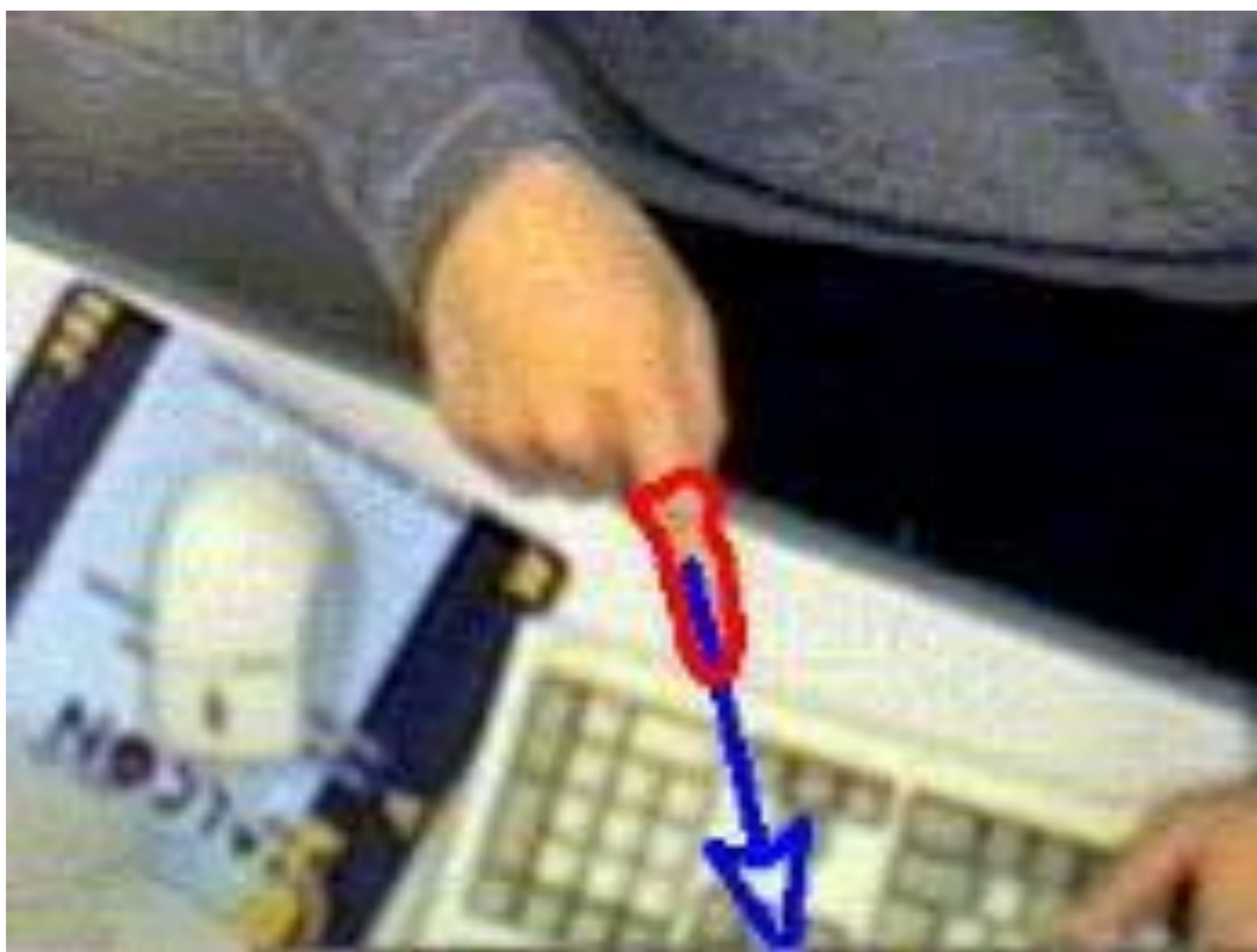
Eckelmann, Germany

HALCON simplifies robotic fruit picking

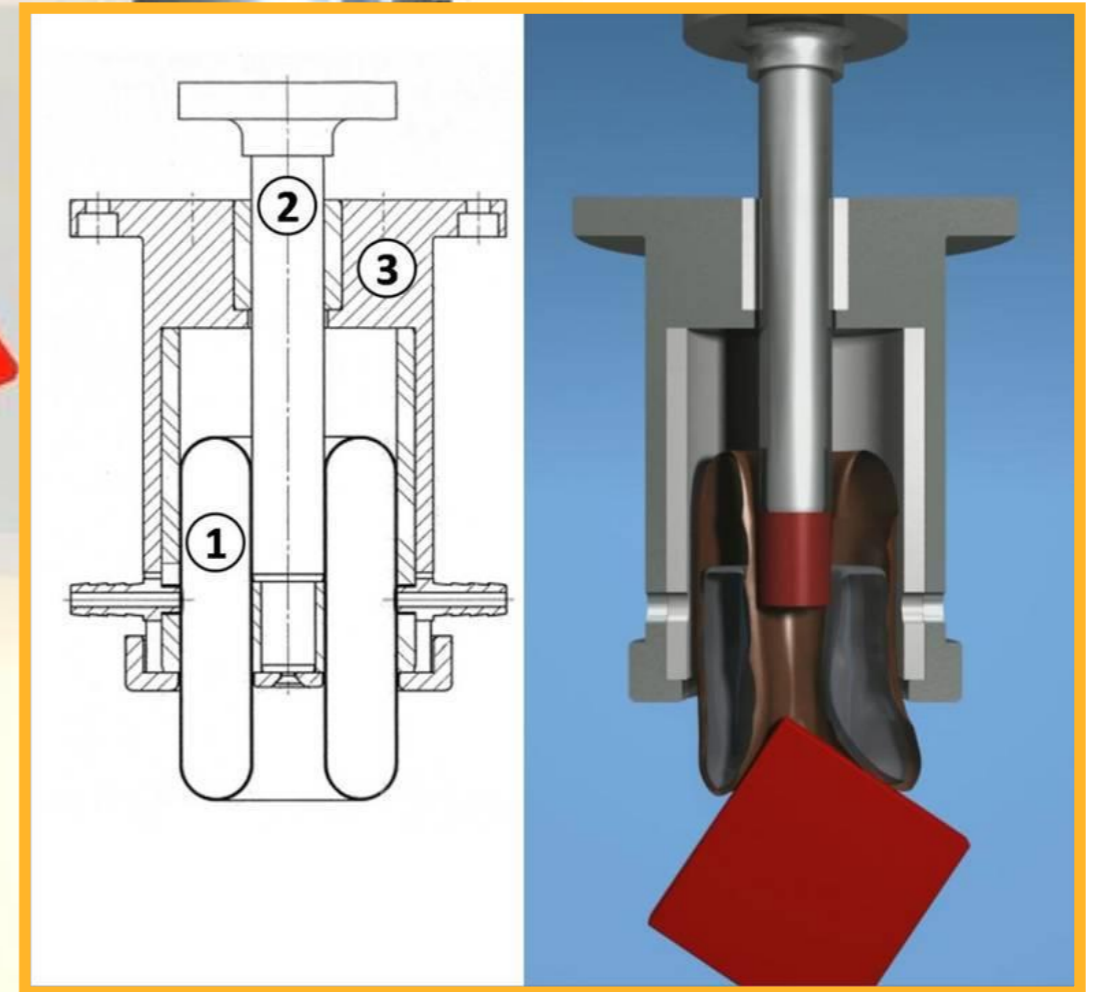
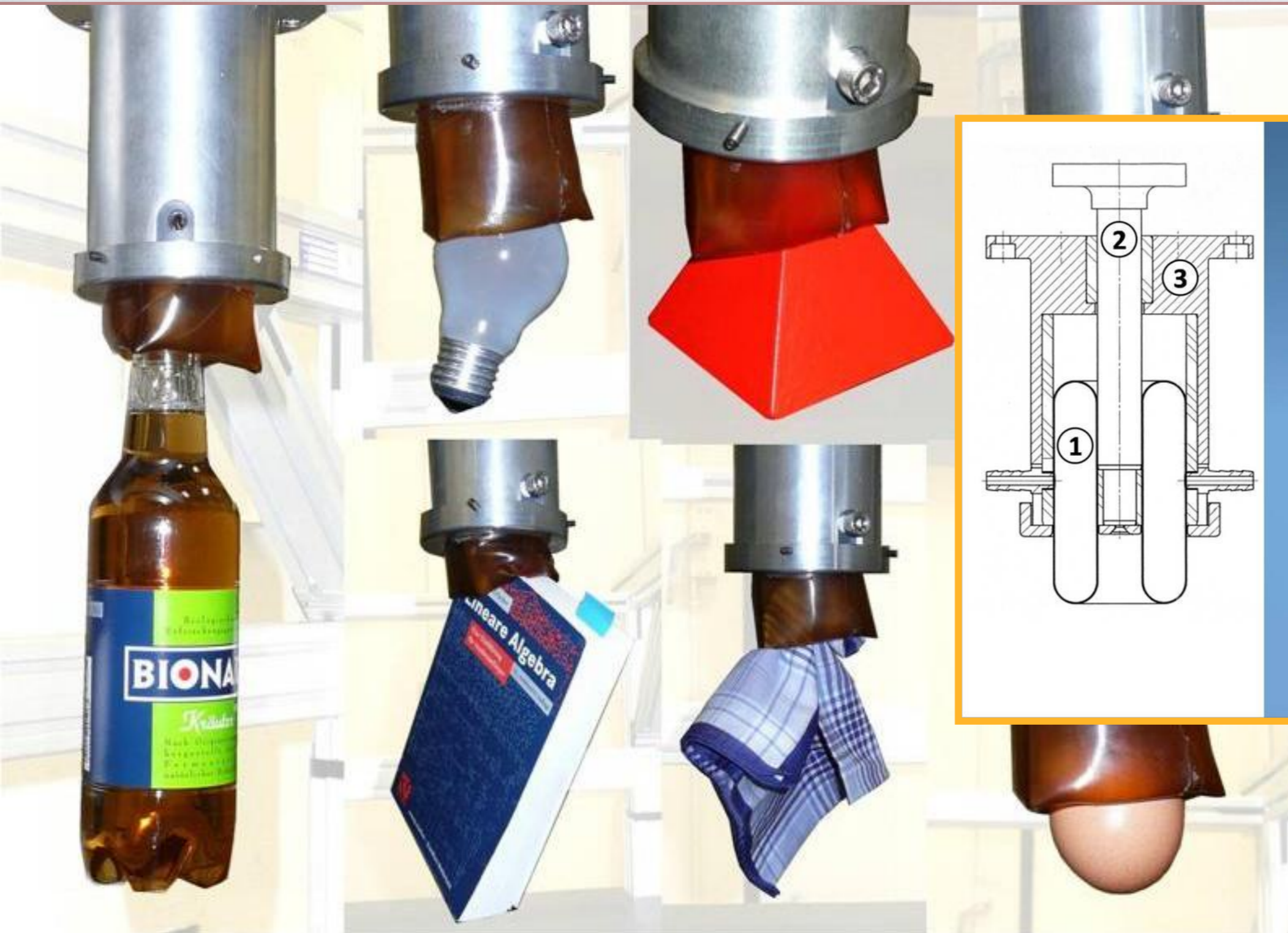




HALCON supports intelligent rooms



HALCON supports flexible handling with a new robot gripper



HALCON inspects bottles with high speed



IMAGE-3000 Centro-Stratec-Symplex Sorte: 20000

CAPS - "swing top" quality checking

Leistung 0 1/Min
0 24.000 48.000 0 bph



Fehlerbilder:

- 14Apr-16:22
- 14Apr-16:26
- 14Apr-16:26
- 14Apr-16:26

LÖSCHEN

Keine Bilder
 Nur Fehler
 Nur nächstes

Anzahl Flaschen: 01

Bild-Trigger: Neu Triggern

Rollen
 Bild halten

ellung Blob Checker Form Checker Kanten Checker Flächen Checker Kamera Programm beender

1-0-0 [07]



HALCON on the assembly line



ROBOWORKER Automation GmbH, Germany



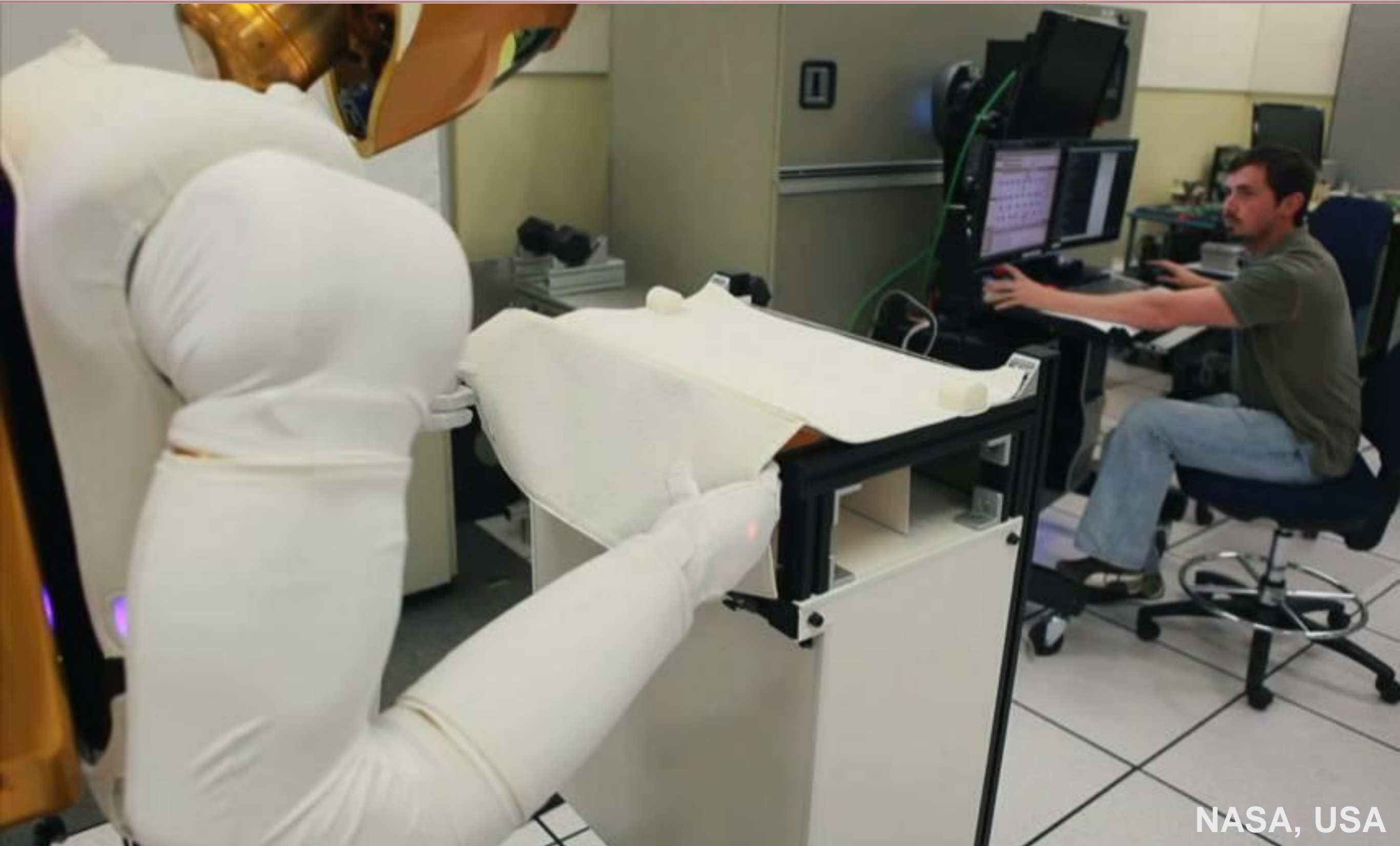
HALCON on the assembly line



Radius: 7.068 mm



NASA uses HALCON on the ISS



Applications with HALCON



Browse HDevelop Example Programs

Category

- Application area
- Industry
 - Aerospace and space travel
 - Agriculture, food**
 - Automobile parts and manufacturers
 - Ceramics
 - Chemicals
 - Electric components and equipment
- Precision engineering and optics
- Printing
- Retail
- Rubber, synthetic material, foil
- Semiconductors
- Solar
- Surveying
- Transportation
- Wood

Method

Find:

Example	Example
color_segmentation_pizza.hdev	Find salami pieces on pizza
count_fish_sticks.hdev	Perform a completeness check
find_cocoa_packages_local_defor...	Find a cocoa label using local deformation
find_cocoa_packages_max_defor...	Find a cocoa label using maximum deformation
find_deformable_s...	Find an object in a 3D scene
find_ncc_model_e...	
find_peanut_choc...	
find_text.hdev	
find_text_bottle_la...	
find_text_expiration_date.hdev	
identify_vegetables.hdev	
inspect_bottle_label_360_degr...	
inspect_bottle_mouth.hdev	Check bottle mouths for defects
label_word_process_mlp.hdev	Read a best-before label using machine learning
locate_cookie_box.hdev	Locate a cookie box using machine learning
locate_cookie_box_multiple_mod...	
locate_channel_yogurt...	
locate_producer_cons...	

Mean frame width: 11.03 pixels with deviation: 0.7

