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HALCON

a product of MVTec

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HALCON is for customers who want

- a comprehensive set of technologies
- to rely on experience
- to benefit from free support
- flexibility in their choice of hardware
- to protect their investment

I3

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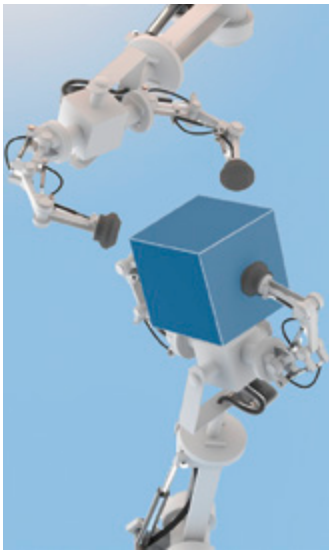
HALCON

Professional Software
for all Machine Vision Applications

FOOD, HEALTH CARE & LIFE SCIENCES

Surface and print inspection, fill level measurement, packaging inspection, OCR, bar code and data code reading: HALCON features robust and reliable solutions for all applications.



AUTOMOTIVE & ROBOTICS

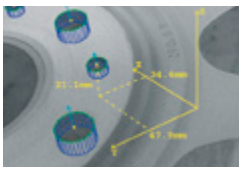
Determine the 3D pose of objects, extract 3D data for bin picking and robot path planning: HALCON's unique 3D vision techniques open new possibilities for numerous automotive and robotics applications.

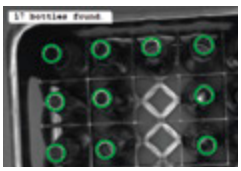
PACKAGING

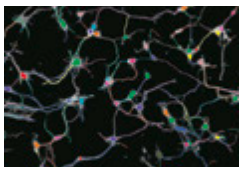
Quality control, completeness inspection, identification: HALCON offers outstanding methods in all areas of packaging.

MEDICAL IMAGE ANALYSIS

CT, MR, X-ray – no matter what source and resolution: HALCON processes 8/16/32/64 bit integer and float images.







Used in many industry sectors

Aerospace and space travel
Agriculture and food
Automobile parts and manufacturers
Ceramics
Chemicals
Electric components and equipment
Glass production and processing
Health care and life science
Iron, steel, metal
Machinery
Medical supplies
Mining
Packaging
Paper products
Pharmaceutical
Photogrammetry and remote sensing
Precision engineering and optics
Printing
Railroads and trains
Retail
Rubber, synthetic material, foil
Semiconductors
Shipbuilding
Solar, renewable energy, recycling
Surveillance and security
Telecommunication
Transport, logistics, trade
Wood and timber

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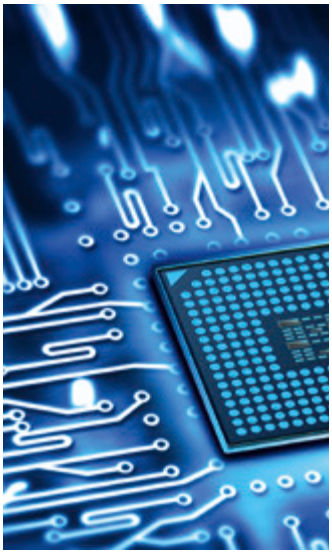
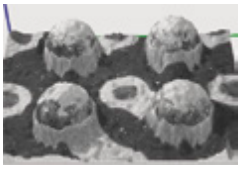


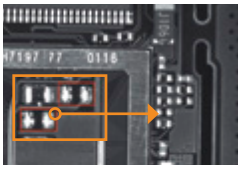
MACHINE VISION & INDUSTRIAL INSPECTION

Quality inspection, robot vision, and material flow control: HALCON offers speed, accuracy, and robustness for a wide variety of applications.

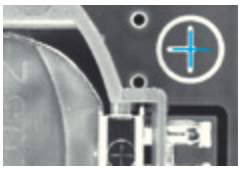
- **BOARD, WAFER & DIE INSPECTION**
  PCB, BGA, AOI/AXI, ball-wedge and wire bonding machines: HALCON recognizes defects with an accuracy better than 1µm.



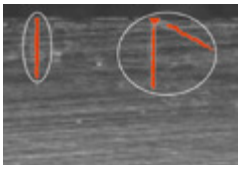
- **COMPLETENESS INSPECTION**
  Insufficient soldering paste, missing diodes, rotated components: HALCON detects all incomplete or incorrectly positioned parts within milliseconds.



- **POSITIONING & ALIGNMENT**
  Board alignment, fiducial localization: HALCON reliably finds objects with an accuracy better than 1/20 pixel even if they are partially occluded.



- **SURFACE INSPECTION**
  Different materials, as well as different error classes like holes, wrinkles, edge cracks, inclusions, contaminants, coating voids, scratches, spots, and dents: HALCON's advanced filtering techniques are tailored to your needs. The easy-to-use texture inspection even adjusts necessary parameters automatically.

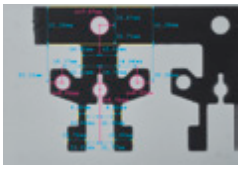


- **QUALITY ASSURANCE**
  Quality assurance of bar codes and data codes: HALCON grades in compliance with the standards ISO/IEC 15415, ISO/IEC 15416, AIM DPM-1-2006, and SEMI T10. HALCON secures the quality of your codes.

- **PRINT INSPECTION**
  Labels and forms printed on paper, plastic, or metal by any kind of printer: HALCON automatically compares trained patterns with your prints.

- **IDENTIFICATION**
  Identify and read bar and data codes and perform OCR: HALCON reads a single character in less than 0.1 ms. In addition, HALCON's sample-based identification (SBI) allows the identification of objects based only on visual features.

- **MEASURING**
  HALCON's superior edge detection and contour analysis techniques, in combination with powerful 3D camera calibration, extends measurement accuracy to the entire field of view.



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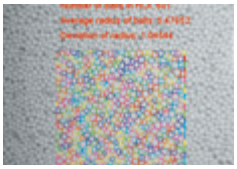
HALCON

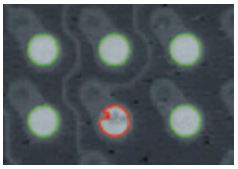
Leading-Edge Techniques
and Optimal Performance

BLOB ANALYSIS

Hysteresis, local, binary, and standard thresholding, plus more than 20 additional segmentation operators; area, orientation, and 50 more shape and gray value features:
HALCON performs blob analysis within milliseconds.



Processing of partially overlapping blobs.

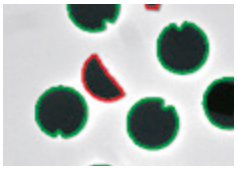


Extract blobs with subpixel accuracy.

MORPHOLOGY

Erosion, dilation, opening, and closing with arbitrary structuring elements: HALCON excels with the fastest and most comprehensive implementation of morphological algorithms.

Distinguish touching objects.

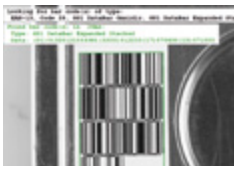


Detect contour defects.

BAR CODE & DATA CODE READING

All common bar codes can be read in any orientation even with an element width of less than 1.5 pixels. HALCON also reads ECC 200, QR, Micro QR, Aztec, GS1, and PDF417 codes of any size with modules even smaller than 2 x 2 pixels, as well as data codes with a damaged finder pattern, bar codes with significant overexposure or print growth, and even partly occluded bar codes.

PDF417 code



GS1 DataBar

OCR & OCV

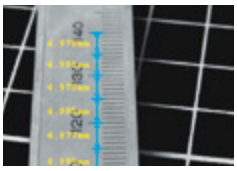
Train, classify, or verify your font using HALCON's powerful classifiers. Many pretrained fonts from different application areas (some based on deep learning technology) lead to highest recognition rates "out of the box" such as 0.65% error rate on the MNIST data set. Combined with HALCON's automatic text reader, performing OCR has never been easier.

Read dot prints on complex background.

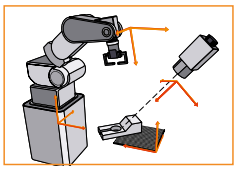
HALCON provides a syntactic and lexicon-based autocorrection.

3D VISION _ 3D CALIBRATION

Calibrate internal and external camera parameters to perform highly accurate metric measurements, e.g., up to 1 µm in a field of view of 10 mm – also with line scan and telecentric tilt cameras. Use HALCON's hand-eye calibration for vision-guided robot applications, like pick-and-place.



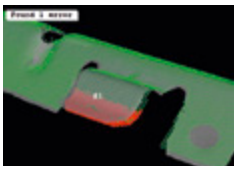
Distances on the caliper can be measured in the presence of perspective distortions.



Hand-eye calibration enables robotic grasping applications.

3D VISION _ 3D OBJECT PROCESSING

With HALCON's 3D object model various tasks can be performed, such as 3D registration, 3D object processing, as well as 3D object recognition and surface comparison.



Errors are detected using 3D surface inspection.

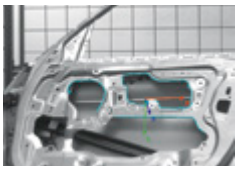
A 3D object model is segmented into connected components.

MATCHING _ CORRELATION-BASED MATCHING

HALCON's correlation-based matching is a method that is particularly robust against defocus, shape deformation, rotation, and texture.

MATCHING _ SHAPE-BASED MATCHING

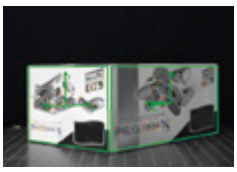
HALCON's superior subpixel-accurate matching technology finds objects robustly and accurately in real-time – even if they are rotated, scaled, perspectively distorted, locally deformed, partially occluded or located outside of the image, or undergo nonlinear illumination changes. Images with 8 or 16 bits, as well as color or multi-channel images, can be processed. Objects can be trained from images or from CAD-like data. Moreover, HALCON's unique component-based matching is able to locate objects that are composed of multiple parts that can move with respect to each other.



HALCON's perspective deformable matching robustly localizes objects with perspective distortions.

MATCHING _ DESCRIPTOR-BASED MATCHING

Planar objects with texture are localized with HALCON's descriptor-based matching. This method is extremely fast and localizes the objects in any rotation and tilt.



HALCON's descriptor-based matching locates planar objects extremely fast.

HALCON's local deformable matching finds objects with surface deformations.

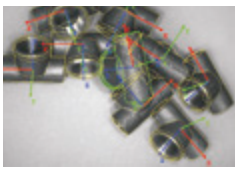
3D MATCHING _ SHAPE-BASED 3D MATCHING

Recognition and 3D pose determination of arbitrary 3D objects: HALCON's cutting-edge 3D matching determines the position and orientation of 3D objects represented by their CAD model.

Localization of a known object with 3D matching.

3D MATCHING _ SURFACE-BASED 3D MATCHING

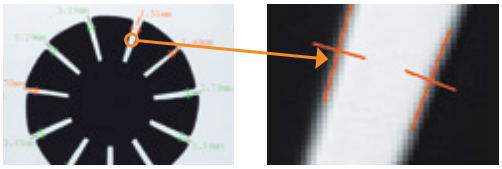
HALCON's surface-based 3D matching is optimized to find objects with arbitrarily shaped or even deformed surfaces by combining 3D point cloud data and edge information from distance images.



Surface-based 3D matching with multi-view stereo.

MEASURING _ 1D MEASURING

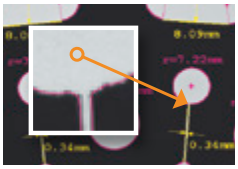
Measure edges along lines or arc segments: HALCON's powerful algorithms perform subpixel-accurate measurements in less than a millisecond. In combination with gray-value calibration even non-linear gray-value responses can be compensated to achieve highest accuracy.



Inspect the distances between the blades of a fan.

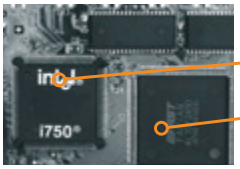
MEASURING _ 2D MEASURING

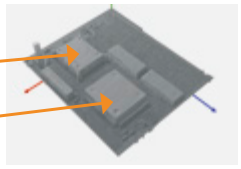
Fitting an ellipse to a subpixel contour output of an edge filter allows you to achieve highest precision. HALCON's metrology model automatically extracts contour data from images with more than one channel, e.g., from color images.



MEASURING _ 3D MEASURING

HALCON's outstanding algorithms reconstruct the disparity, distance images, or 3D coordinates of surfaces with many different methods: binocular, multi-view, and photometric stereo, sheet of light, and depth from focus. The 3D pose of circles and rectangles can also easily be determined with only one camera. The segmentation and fitting of 3D primitives allows accurate measurement of, e.g., cylinders, spheres, and planes.





For more information please see: **www.halcon.com/technical-data**

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HALCON

More than Software

Worldwide Extensive Support and Training

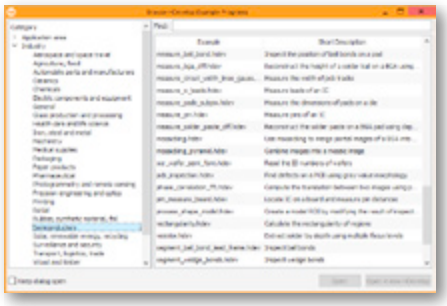
- Free application evaluation, also prior to purchase
- Free worldwide support for HALCON users by MVTec's distributors
- Free upgrade to new versions within the first year after purchase
- Worldwide trainings, also individually tailored to the customer's needs
- Easy maintenance by free web download of newest software releases

Comprehensive Documentation and Fast Development

HALCON offers documentation for every user and level – ranging from the "Quick Guide" to the "Solution Guide". Numerous example programs for every application area, which can be found with an easy-to-use browser, serve as starting point for own applications. Furthermore, HALCON offers a highly interactive Integrated Development Environment (HDevelop) for machine vision.

Protection of Investment

Compatibility is an important factor for protection of investment. The machine vision software in which you invest today, must still be suitable tomorrow – wherever the advances in technology lead us and however the requirements of individual systems will change. In order to meet all needs, HALCON supports a great amount of image acquisition devices as well as a large variety of operating systems and programming languages. HALCON naturally provides maintenance and availability of a version for years, also after purchase. Every new HALCON version is released with many technical innovations as well as improvements and enhancements in all areas – including documentation and examples.



Examples Browser

Solution Guide

www.adept.net.au

Reliability

HALCON is proven worldwide in hundreds of thousands of installations. The sophisticated algorithms are developed by MVTec's engineers, who have more than 30 years of experience in machine vision. HALCON is concentrated core competence – developed by the only software manufacturer worldwide purely developing software for machine vision.

Unique Technologies

HALCON offers the full set of standard machine vision technologies. Beyond that, HALCON offers many unique features like various matching techniques or different identification techniques like sample-based identification. Please find a comprehensive list on www.halcon.com.

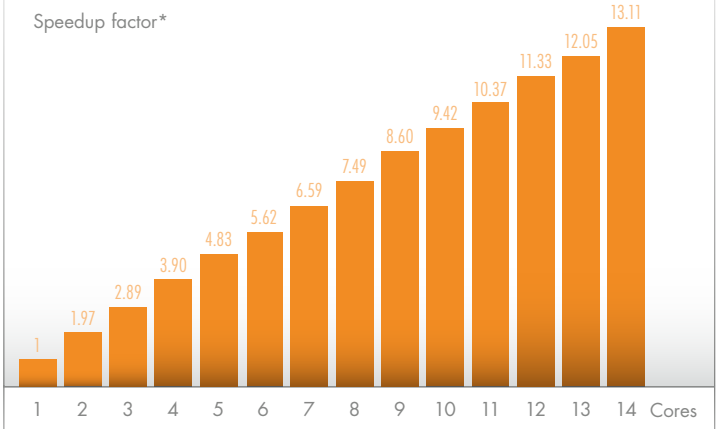
Speed

HALCON is implemented for highest performance, e.g., by actively exploiting multi-core platforms and special instructions sets like AVX2 and NEON, as well as GPU acceleration. For more information please see www.halcon.com.

Automatic Operator Parallelization (AOP)

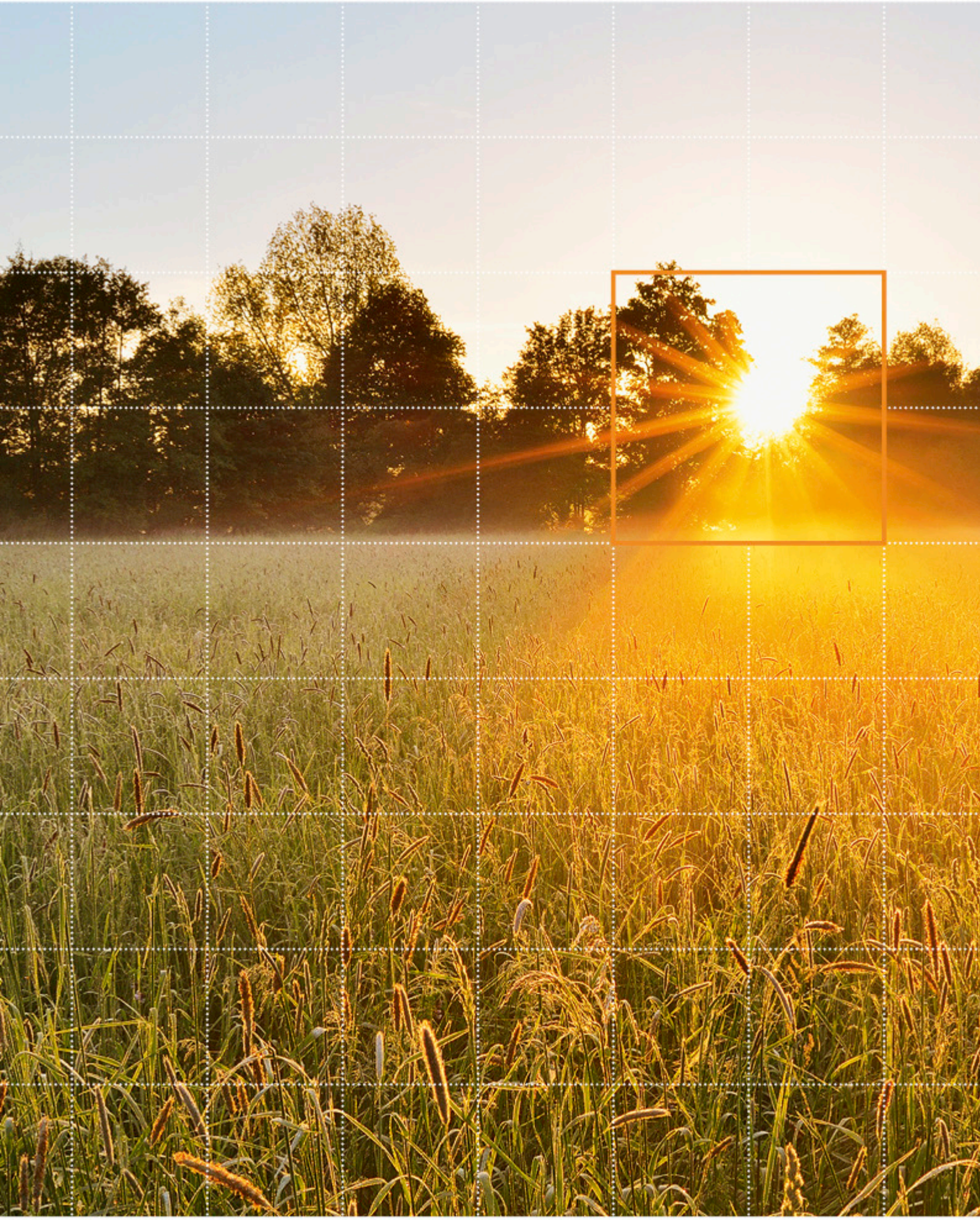
Multi-core and multiprocessor computers help vision systems to increase their speed considerably. Since the year 2000, HALCON offers an industry-proven automatic operator parallelization that actively supports this speed enhancement. HALCON automatically parallelizes operators when started on a multi-core computer by distributing the data, such as images, to multiple threads, one for each core.

HALCON's AOP Speeds Up Operators



** Speedup factor of the operator median_image with mask size 13x13 on a Intel Xeon E5-2690 v4 @ 2.60 GHz, 14 cores, image size 1280x1024. Note that the achievable speedup generally depends on the used HALCON operator and the image size.*

HALCON



I3

HALCON is for developers who want

- the power of rapid prototyping
- support of a large variety of operating systems
- flexibility in programming languages
- to protect their code
- to develop also on non-standard platforms

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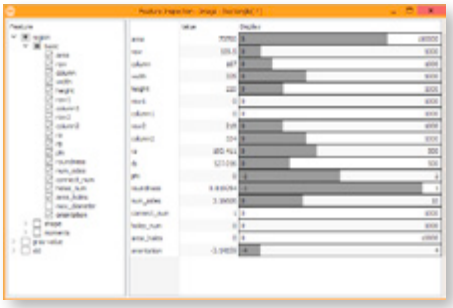
HDevelop Integrated Development Environment (IDE)

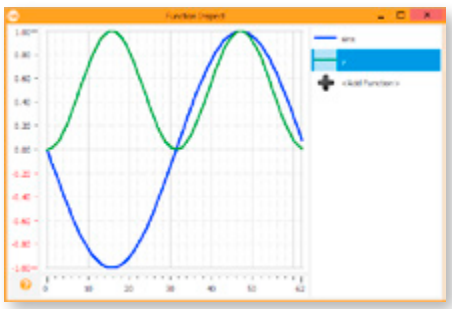
HDevelop is HALCON's highly interactive programming environment. Running on Windows, Linux, and macOS, it enables you to develop image processing solutions fast and efficiently. This can be done even while acquiring images from an image acquisition device. There is a multitude of graphical tools for data and image inspection. The HDevelop GUI is available in various languages.

- The dialog "Browse HDevelop Example Programs" lets you select examples via topics and categories. No matter in which industry you are engaged, you will find appropriate examples out of more than 1000 with three mouse clicks.
- Programming becomes very easy: syntax checks, suggested values for parameters of operators, suggested successors, and alternative operators reduce the chances of programming errors. Syntax highlighting and an integrated online help with full-text search within the full text editor help debugging and maintaining complex applications.
- The benefits of multi-core architectures can easily be exploited: HDevelop supports concurrency through parallel programming, even during export to C, C++, and .NET languages like C# or VB.NET.
- HDevelop enables easy code sharing between developers: code can be organized into procedures, which can also be stored as password-protected external procedures and organized in procedure libraries.
- HDevelop includes tools for real-time interactive inspection of image properties to obtain parameter settings for your program. Gray and feature histograms, as well as feature inspection and an ROI manager, allow to quickly select or create blobs in your images and generate code with a single click. For quick and intuitive visualization, there is a line profile and a zooming display. Breakpoints, detailed error messages, bookmarks, and procedures make development smooth.
- Get immediate feedback on the execution of an operator and let HDevelop visualize iconic variables, e. g., as 3D plots or contour lines. The HDevelop profiler tool helps analyzing each operator's execution time.
- Thanks to the profound experience HALCON is based on, HDevelop is tailored to the needs of machine vision applications and provides a GUI that is optimized for usability.

Feature Histogram



Feature Inspection



Function Inspect

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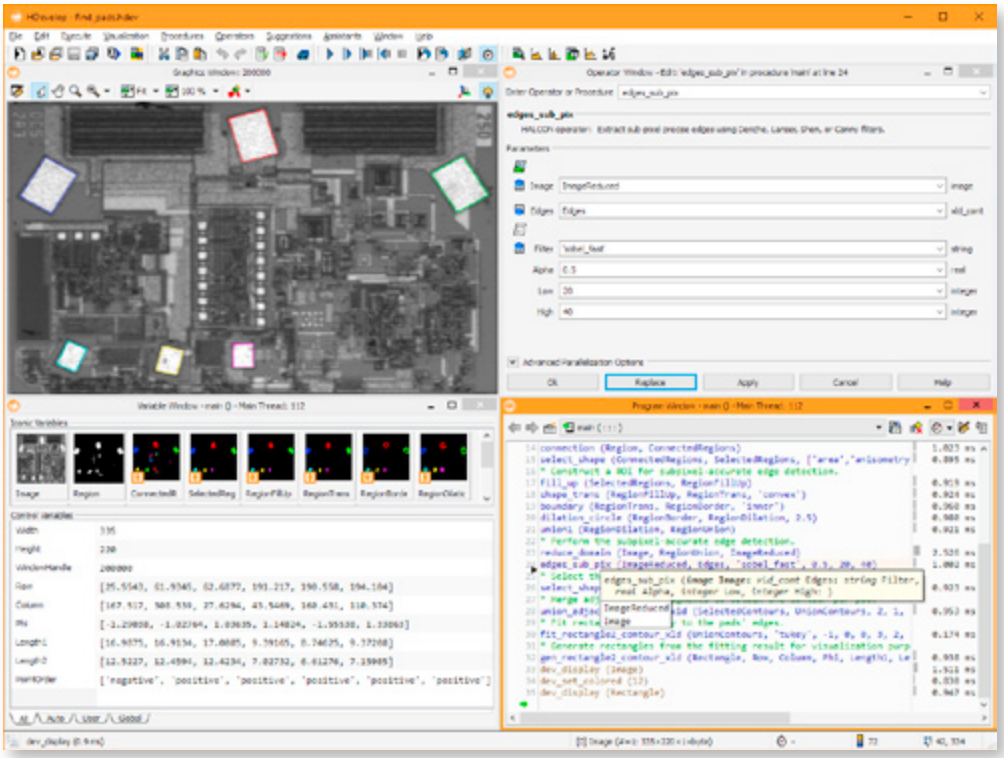
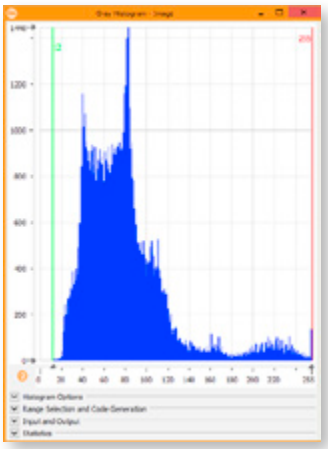
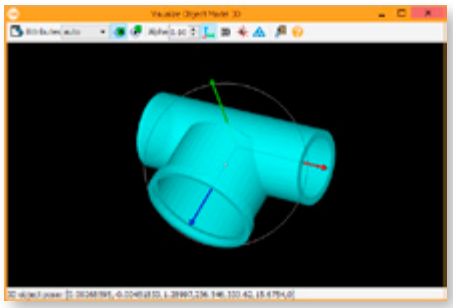
The software engineer can develop the application with the help of a full text editor. Editing assistance and the ability to copy and paste lines, as well as advanced autocompletion provide easy-to-use help for programming in the full text editor.



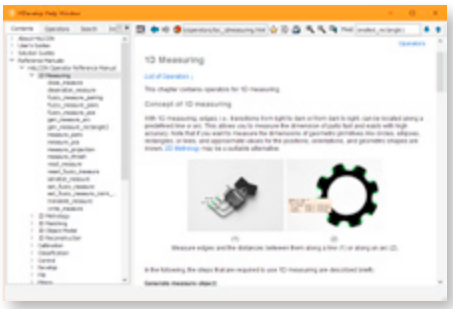
HDevelop



Gray Histogram



3D Visualization



Online Help

Line Profile

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Working with **HDevelop**

HDevelop contains assistants for common subtasks. The graphical user interface of those HDevelop assistants can be used to interactively set up and configure your solution and insert the corresponding code sequence into the HDevelop program on demand.

Image Acquisition Assistant

The image acquisition assistant simplifies the selection, initialization, and configuration of hundreds of industrial cameras and frame grabbers. The assistant allows to preview images and to interactively control all device-specific parameters. After adapting the parameters to your needs, the assistant inserts the corresponding code into the program on demand.

Measure Assistant

The HDevelop measure assistant is a front-end to HALCON's 1D measuring. It finds edges and measures distances between edges along a preselected line or circular arc in an image. On demand, the assistant inserts the corresponding code into the program.

Matching Assistant

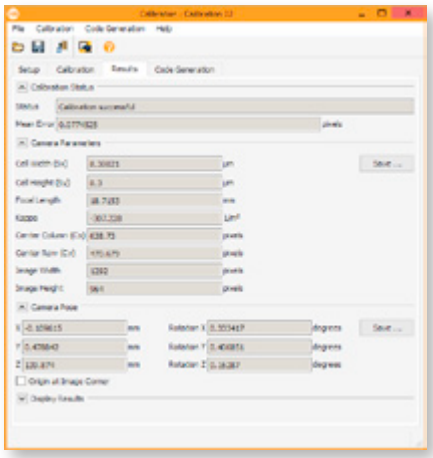
The matching assistant is a powerful tool specifically designed for the interactive use of HALCON's shape-based matching, correlation-based matching, descriptor-based matching, and deformable matching. It assists in finding parameter settings for object recognition, as well as matching applications, and inserts the suitable code into the program on demand.

OCR Assistant

The HDevelop OCR assistant allows interactive use of HALCON's powerful OCR classification. It helps to determine parameter settings, train custom OCR classifiers, verify OCR classifiers and inserts the corresponding code into the program on demand.

Camera Calibration Assistant

The camera calibration assistant helps the user to implement the necessary calibration of the camera easily and accurately in order to correct lens distortions from images and to be able to measure objects in 3D world coordinates. After setting the parameters, the assistant inserts the suitable program code into the HDevelop program on demand.



Camera calibration assistant - Showing results

Camera calibration assistant - Visualization

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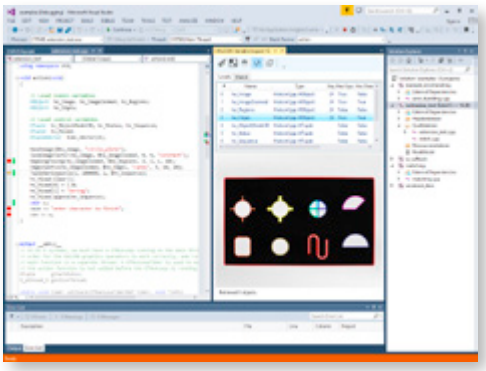
Programming with **HALCON**

HALCON offers various interfaces to access all of HALCON's more than 2000 powerful operators from programming languages like C, C++, and .NET languages like C# or VB.NET. HALCON's open architecture allows you to access defined data structures and thus to integrate HALCON with further software components such as a user interface or process control. HALCON also supports parallel programming, e. g., multithreaded programs. Thus, multiple threads can call HALCON operators simultaneously. All this, together with HALCON's inbuilt high-performance memory management, lets you concentrate on your application development and quickly come to a solution.

HALCON/.NET

In HALCON/.NET all HALCON operators and data structures are available as high-level classes, greatly simplifying the development of your application. HALCON/.NET can be used in .NET languages like C#, Visual Basic .NET, and C++. It can be used on Windows and with Mono also on Linux.



HALCON variables can be inspected directly within Visual Studio

HALCON/C++

With HALCON/C++ you can access the whole functionality of HALCON based on a C++ class hierarchy. This enables you to develop programs that are very compact and easy to maintain. HALCON/C++ is available on Windows, Linux, and macOS.

HDevEngine

HDevEngine – the "HDevelop Engine" – is a library that acts as an interpreter and lets you directly load and execute HDevelop programs and procedures from within your C++, C#, or Visual Basic application. This allows you to change the vision part of your application without the need of compiling it.

Powerful Debugging

HALCON supports debugging efforts of software developers tremendously. Using HALCON's extension for Visual Studio, C++, and C#/.NET developers can inspect HALCON variables (tuples and iconic) directly within Visual Studio. When executing HDevelop procedures inside a C# or C++ application via HDevEngine, the machine vision part of the application can be debugged directly within HDevelop – even remotely – by connecting it with HDevEngine.

Protection of Know-how

HALCON secures the know-how of the software developer: code, which is saved in external or local procedures, as well as code of entire procedure libraries or programs can be secured with a password. Therefore, functionality can be shared without revealing the program code.

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Platforms and Interfaces

HALCON Architecture

The flexible architecture of HALCON ensures its compatibility with future developments, for example, the portability to other operating systems or the integration into new programming environments. This protects your investment in your applications.

Operating Systems

HALCON is available for standard PCs running Windows (32- and 64-bit), Linux (64-bit), and macOS.

Extension Packages

This unique feature allows you to integrate your existing or newly developed image processing algorithms into HALCON. Thus, you get a common view on all the image processing parts of your application and facilitate maintenance and future development. An open, extensively documented interface enables you to utilize the powerful internal data structures of HALCON.

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HALCON Embedded

HALCON Embedded means HALCON running on your non-standard platform. HALCON is portable to various microprocessors/DSPs, operating systems, and compilers. HALCON Embedded enables the development of the software part of a machine vision application on a standard platform and thereby greatly eases the programming of an embedded system. Simply stated: Development is done on a PC, while the application runs on an embedded system.

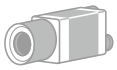
HALCON Embedded is available for various smart cameras and other embedded platforms.

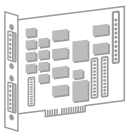
For latest information see www.halcon-embedded.com

Image Acquisition Interfaces

HALCON includes a powerful software interface to provide a common view on different image acquisition devices, including line scan cameras, 3D cameras, and cameras with non-standard resolutions or more than 8 bits per pixel. A multitude of ready-to-use interfaces allow to easily connect to hundreds of industrial cameras and frame grabbers. In particular, HALCON supports all commonly used standards like GigE Vision, GenICamTL, and USB3 Vision.

For latest information see www.halcon.com/image-acquisition





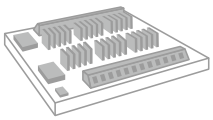
GIGE VISION

USB3 VISION

GENICAM

Digital I/O Interfaces

HALCON includes a software interface for digital I/O. Thus, you can use various I/O devices directly with HALCON. Furthermore, HALCON provides ready-to-use interfaces to all PLC control systems using the OPC UA and the OPC Classic standards.



OPC UA

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The Company behind **HALCON**

MVTec Is Dedicated to Machine Vision Software

MVTec is the only software manufacturer worldwide purely developing software for machine vision. The company employs highly qualified experts for machine vision with up to 30 years experience in this technology. The passion for machine vision is the driving force of the entire MVTec staff, including the management, which personally stands behind the high quality of MVTec's products and services.

MVTec products are "Made in Germany", developed right at our competence center in Munich. The services and products are distributed worldwide by MVTec's extensive distributor network. In addition, MVTec, LLC works out of Boston, MA (USA).

MVTec Actively Engages in Associations and Standardization Committees

MVTec shares its years-long experience with the machine vision community. Therefore, MVTec is a member of Automated Imaging Association (AIA) and Verband Deutscher Maschinen- und Anlagenbauer (VDMA).

Furthermore, MVTec is a driving force behind standardization processes to increase its customers' flexibility and to reduce development costs. For example, the standardization of image acquisition interfaces and protocols means a considerable added value, as no proprietary connections have to be developed and maintained any more. Therefore, MVTec is a long-term contributing member of the GenICam standard group and an active member of the GigE Vision and USB3 Vision Technical Committees.

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MVTec Offers Customized Solutions

Besides offering high-end machine vision software, MVTec builds customized solutions – from consultancy, studies, and prototypes up to complete software solutions. Working closely with the customer, MVTec's solutions development team draws from decades of combined application development experience to deliver complete and cost-effective software solutions based on MVTec's standard products.

MVTec Is Part of a Global Network

From the beginning, MVTec has been a driving force of the machine vision community, networking closely with partners, customers, universities, and associations.

MVTEC IMAGE ACQUISITION PARTNER PROGRAM

In order to provide the best possible integration of hardware and software for the customer, MVTec cultivates close partnerships to a large number of suppliers of image acquisition devices.

MVTEC CERTIFIED INTEGRATION PARTNER PROGRAM

MVTec selects engineering companies, who realize their implementations with MVTec's software products. The companies in this program are qualified by their skills to create high-end and challenging machine vision applications in an outstanding way.

MVTEC CERTIFIED TRAINING PARTNER PROGRAM

MVTec strives to ensure highly qualified support and the best training for its products. For this, the company runs the MVTec Certified Training Partner Program for its distributors. Members of this program are trained by MVTec to give specific courses for its products to customers, all with a high level of proficiency.

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HALCON

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What Is HALCON?

HALCON is the comprehensive standard software for machine vision with an integrated development environment (HDevelop) that is used worldwide. It enables cost savings and improved time to market. HALCON's flexible architecture facilitates rapid development of any kind of machine vision application.

What Is Included?

MVTec HALCON provides outstanding performance and a comprehensive support of multi-core platforms, special instruction sets like AVX2 and NEON, as well as GPU acceleration. It serves all industries, with a library used in hundreds of thousands of installations in all areas of imaging like blob analysis, morphology, matching, measuring, identification, and 3D vision.

Why HALCON?

HALCON secures your investment by supporting the operating systems Windows, Linux, and macOS. The full library can be accessed from common programming languages like C, C++, and .NET languages like C# or VB.NET. HALCON guarantees hardware independence by providing interfaces to hundreds of industrial cameras and frame grabbers, in particular by supporting standards like GenICam, GigE Vision, and USB3 Vision.

Your Distributor

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