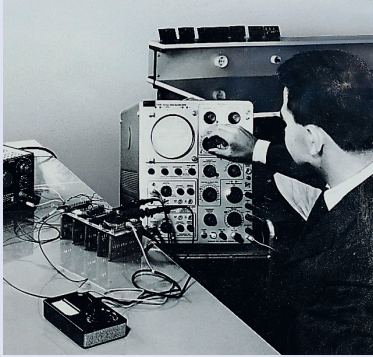# REFERENCE GUIDE

Vision Systems

⊙DATALOGIC

EMPOWER YOUR VISION

DATALOGIC AT A GLANCE

Datalogic began its entrepreneurial adventure in 1972, when **Dr. Romano Volta** started developing and producing optical-electronic control appliances for the packaging, textile and ceramics sectors. Romano Volta sensed the revolutionary scope of the bar code and started developing a manual reader able to read it, combining electronics, mechanics, optics and information technology. In 1974 Datalogic brought this technology into the Retail world, in a supermarket in Troy, Ohio and then applied it to the whole industrial world, giving life to the only true Bar Code Company at a global level.

Today, Datalogic is a global leader in the automatic data capture and factory automation markets, specialized in the design and production of bar code readers, mobile computers, sensors for detection, measurement and safety, RFID, vision and laser marking systems. Throughout the entire value chain, Datalogic solutions increase the efficiency and quality for processes in the Retail, Manufacturing, Transportation & Logistics and Healthcare industries.

45+ years
of experience

500 engineers
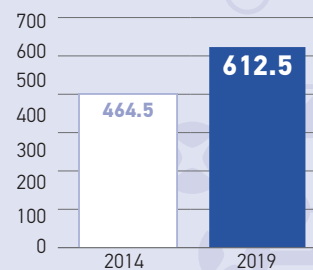in 11 R&D centers and 3 DL Labs in: Italy, USA, Vietnam, China, and Germany

1,200+ patents
filed and more than 350 in approval

3,000+ Employees
in 28 countries:
20% Americas,
57% EMEAI, 23% APAC

A constant growth
(total revenues mln Euros)

2014: 464.5
2019: 612.5

10,6% Revenues
invested in R&D

10 Manufacturing and Repair facilities
in US, Brazil, Hungary, Slovakia, Italy, China, Vietnam and Australia

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WHY DATALOGIC

- **Dominant player** in both automatic data capture and industrial automation markets

- Recognized global **leader**

- **Deep expertise** in every target industries

- Leading **innovator**

- Top performing products for **all needs**

- **Close to customers** worldwide presence with thoroughly tailored services

- **End-to-End Solutions** to streamline any process

- **Strong culture** of high values

INDEX

VISION SYSTEMS

The Vision Systems Product Group of Datalogic is built upon the acquisition of PPT Vision Inc. in 2011. For over 30 years, PPT Vision has focused exclusively on the development of vision systems technology for in-line automated inspection and factory automation. Thanks to its extensive experience of thousands of successful vision systems installations throughout the world, PPT has become a recognized world leader in vision systems innovation and has brought unique benefits to customers:
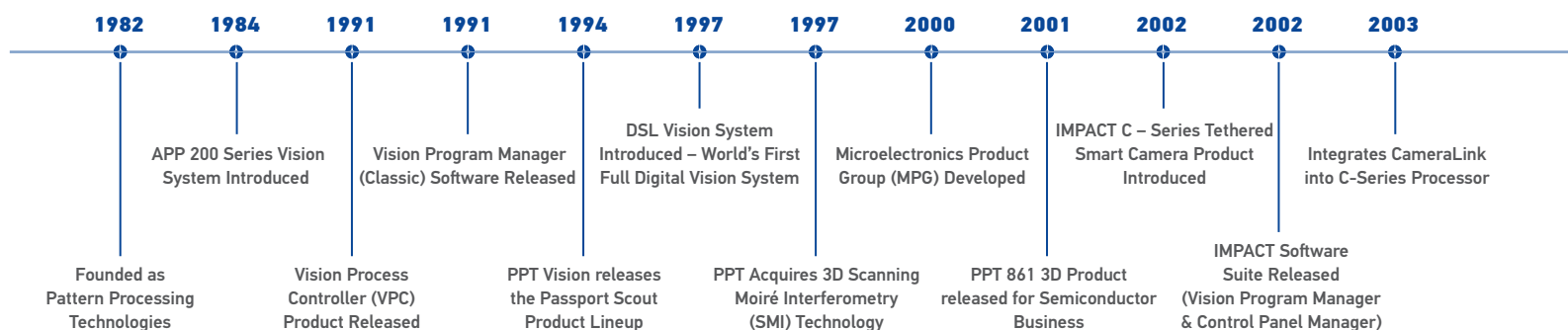
- A single vision systems software platform - Programming software that is flexible, powerful, and common to all smart cameras and embedded vision system products. This means no operator cross-training and no need to maintain different software platforms– just select the hardware you want and go! Transfer inspection programs from one camera to another and back again without redeveloping the application.
- Flexibility and Security – Control Panel Manager (CPM) - a control panel software that is not only secure, but field-configurable and common to all products. Protect your inspection and system configuration from unauthorized users, but allow qualified personnel as much flexibility as they need. CPM provides ultimate flexibility when compared to complicated software programming languages and allows you to create control panels in a mere fraction of the time. Connect and view data from one or many vision systems with just a click of a button.

- Time-to-market - Personalized, technically superior and committed customer support. We can provide you with as much support as you need when it comes to delivering application solutions. Choose one of our highly skilled and qualified application engineers or training specialists, or select a certified partner to guide you from application concept to installation and qualification of your system.
- Large product portfolio - Hardware platforms that allow our customers to expand their range of applications. From stand-alone compact smart cameras to the highest performance embedded processors, we can deliver a vision system optimized for your inspection needs. Choose a smart camera in an inline or right angle version, color or greyscale sensor, CCD or CMOS sensor; it does not matter because we have you covered. For vision processors, select from a single to multi-headed area scan or line scan cameras that range from VGA to ultra-high resolution images.

Today, after completion of the integration process between Datalogic and PPT Vision Inc., the combined product lines of the two companies encompasses both hardware and software while covering a wide range of performance and price point requirements. Selling through a global network of experienced distributor and integration partners, Datalogic is the complete solution provider for all your vision systems needs.

TECHNOLOGY TIMELINE

1982	1984	1991	1991	1994	1997	1997	2000	2001	2002	2002	2003

APP 200 Series Vision System Introduced (1984)

Vision Program Manager (Classic) Software Released (1991)

DSL Vision System Introduced – World's First Full Digital Vision System (1994)

Microelectronics Product Group (MPG) Developed (2000)

IMPACT C – Series Tethered Smart Camera Product Introduced (2002)

Integrates CameraLink into C-Series Processor (2003)

Founded as Pattern Processing Technologies (1982)

Vision Process Controller (VPC) Product Released (1991)

PPT Vision releases the Passport Scout Product Lineup (1991)

PPT Acquires 3D Scanning Moiré Interferometry (SMI) Technology (1997)

PPT 861 3D Product released for Semiconductor Business (2001)

IMPACT Software Suite Released (Vision Program Manager & Control Panel Manager) (2002)

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KEY BENEFITS

VISION SYSTEMS PRODUCT GROUPS

Smart Cameras
Vision processors
Vision systems Software

Our complete family of high-performance smart cameras and embedded vision systems systems utilize the same software across all products. The hardware consists of smart cameras, and embedded vision systems. These products are specifically designed and developed by our engineers to meet all your manufacturing inspection requirements and to get your application up and running faster than anyone else in the industry – Guaranteed!

INNOVATION

Through continuous development and refinement, our product line is the most complete hardware and software solution available on the market today.

EXPERIENCE

With 35+ years in the vision systems business and thousands of successful customer installations, our organization and your partners are able to solve the most challenging inspection applications within a wide variety of markets and manufacturing settings.

RESPONSIVENESS

Together with our global distribution and integration partners, pride our self on providing a level of training and support that is unmatched in the industry.
We listen, then execute – turning our customers' requirements into solutions faster than anyone else.

| 2003	2004	2005	2006	2010	2011	2013	2014	2015	2016	2017	2018	2019
	IMPACT T – Series Inline Smart Camera Introduced		IMPACT A – Series Right Angle Smart Camera Introduced		PPT Vision acquired by Datalogic		P-Series Smart Cameras introduced		MX-E Vision Processor Introduced		New Pattern Find Tool Introduced	
OCR Software Released		Datalogic SCS1 Smart Camera Introduced		MX40 Multi camera vision processor Introduced		A30 and T4x-Series Smart Camera Introduced		MX-U Vision Processor Introduced		New Advanced OCR Tool Introduced		MX-E90 high-end Vision Processor introduced

# AUTOMOTIVE

1. ENGINE BLOCK VERIFICATION

Allows manufacturers to verify and quantify the proper placement and size of critical bolt hole locations as well as to identify if secondary processes, such as thread tapping or surface machining, have been successfully completed. This type of early inspection prevents the manufacturer from adding more cost to defective materials or allows for the identification of flawed high value parts that can be reworked.

2. EPOXY BEAD VERIFICATION
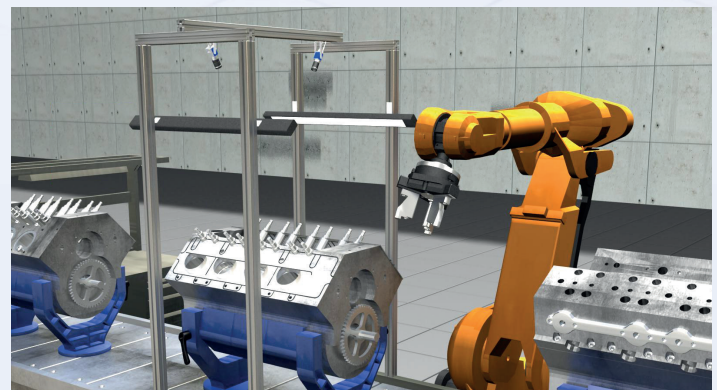
This verification checks for the proper placement, shape or quantity of a sealant or epoxy bead on a surface that will be mated with other critical surfaces or components. Damaged or improperly formed beads, identified by the system, can also indicate issues with the bead application process. Early identification of these problems can provide huge savings to the manufacturer as well reduced quality issues to the customer.

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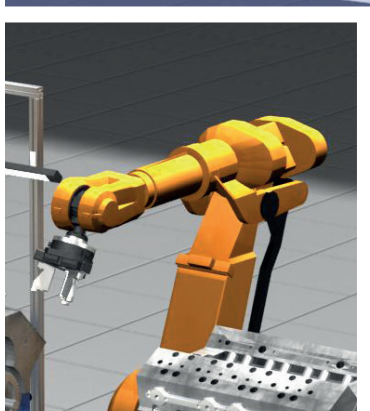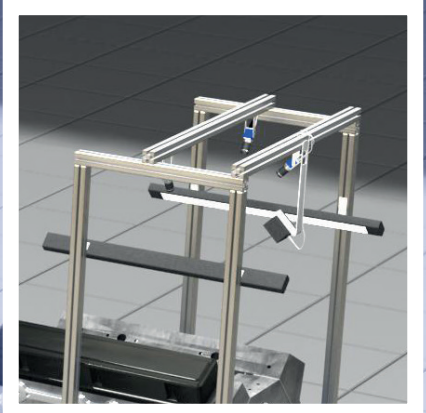
3. COMPONENT PRESENCE / POSITION
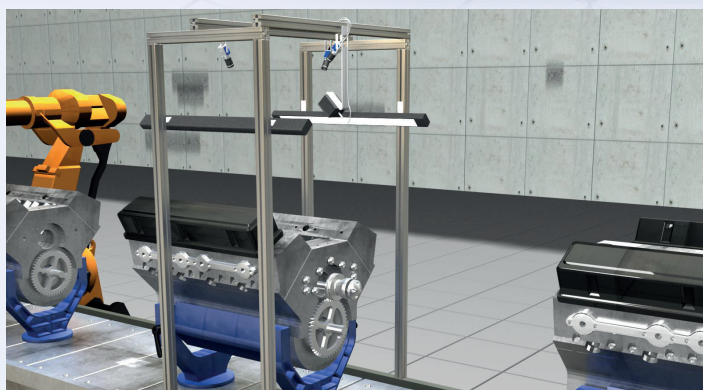
This inspection eliminates the need for manually verifying single or multiple features or components on a single assembly. These features may include proper orientation, right size or correct color as well as the ability to confirm multiple product configurations or variations. The benefit of 100% inspection, provided by the vision system, insures only the properly assembled product gets to the customer.

ELECTRONICS

1. RAW MATERIAL INSPECTION

2. GOLD PLATING INSPECTION
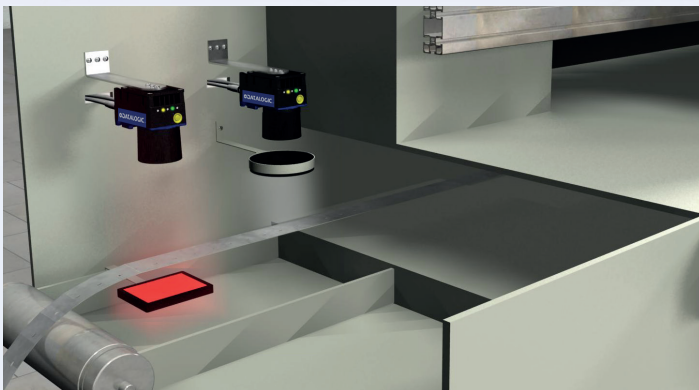
The pre-process inspection allows for inspection of raw material prior to secondary processing. This eliminates adding value to low quality material. In connector manufacturing, the strip width and pilot hole locations are critical to the process. Likewise, surface defects such as porosity, stains and scratch inspection is critical to the final product.
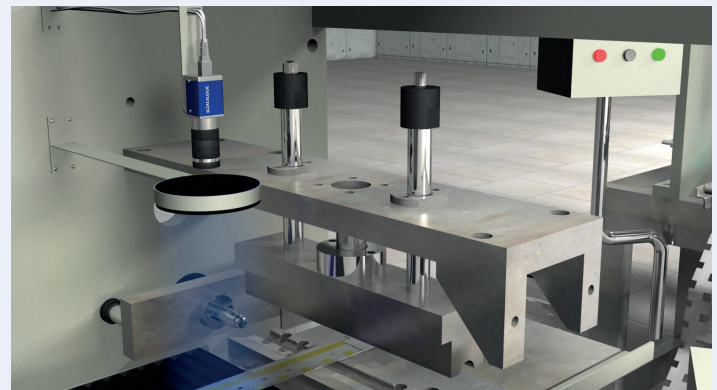
Post plating inspection provides assurance that highly value material such as gold is accurately placed in the correct position on the brass strip. 100% inspection of the plating allows the operator to monitor the process and make on the fly corrections to the high value continuous product with little or no downtime as well as low waste of processed material.

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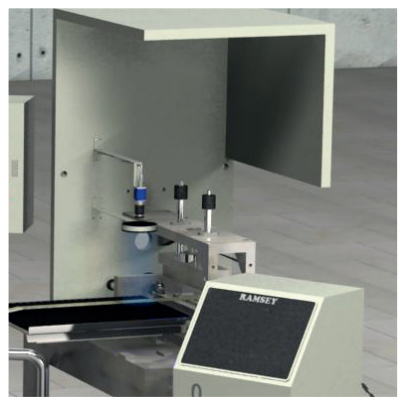
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3. TRIMMED MATERIAL INSPECTION

4. INSERT MOLDING INSPECTION
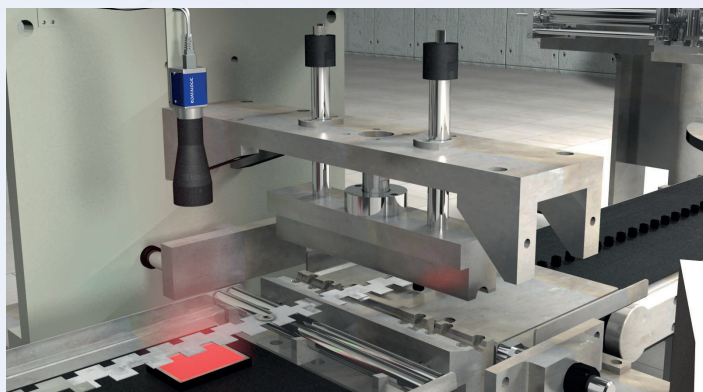
Post stamping inspection verifies 100% dimensional tolerance acceptance on internal features that cannot be inspected, without destructive methods, after the secondary forming or assembly is completed. Other types of inspections that can be addressed simultaneously include burr detection and secondary plating inspection.

Insert molding inspection allows for verification of properly formed molded plastic housings as well as performing final measurement checks on critical dimensions of the connector. This inspection identifies areas of material shortage as well as excess material that can cause non sealing or locking conditions or excessive connector insertion forces.
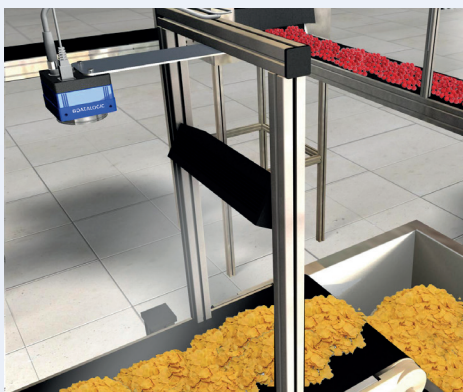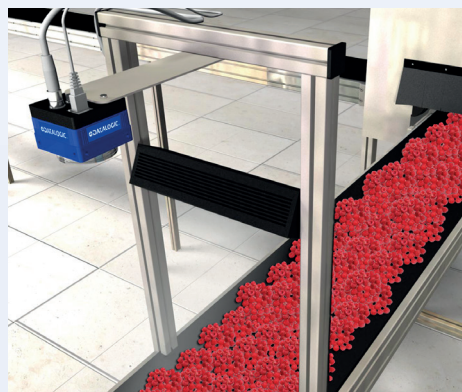
PACKAGING
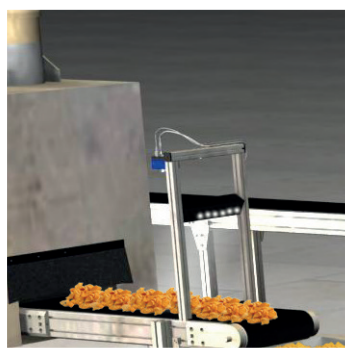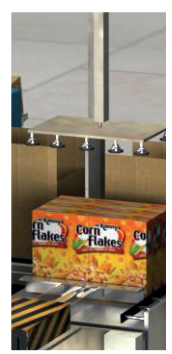
1. POST BAKING INSPECTION

This high speed inspection checks for the consistency of food products after coming out of the baking or frying process to guarantee the food is not over cooked or discolored and reducing customer complaints.

2. FRUIT CLUMP DETECTION

Clump detection identifies when certain types of food stick together to form large masses of food. Masses of food may not be fully processed or cooked, too large for the subsequent process and ultimately cause large amounts of waste or possible health concerns by being under processed.

3. CONTENT FILL AND MIX INSPECTION

The content fill inspection provides assurance that the product is properly placed in the package and verifies the presence of any secondary components before the sealing of the package. With a properly configured system additional information such as product fill height can also be determined. These inspections help to guarantee the customer always receives the correct amount of product.
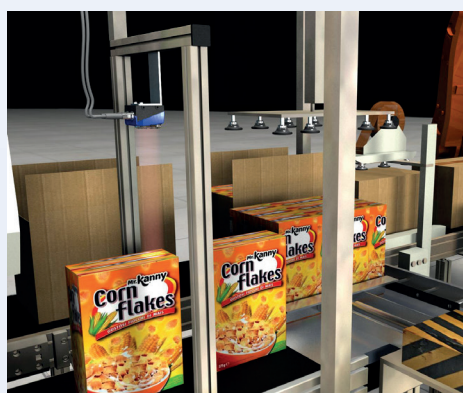
ⒹDATALOGIC

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## 4. OPEN FLAP DETECTION

5. EXPIRATION DATE PRESENCE

6. LABEL INSPECTION

Flap detection verifies all of the flaps on a box food package are fully formed and sealed to insure freshness of the product as well as uniform shape for secondary packing of the product and a positive visual effect for the customer.

100% verification of date and lot codes and code quality can be accomplished with vision systems at extremely high rates of speed. This allows for traceability and regulation requirements of food products.
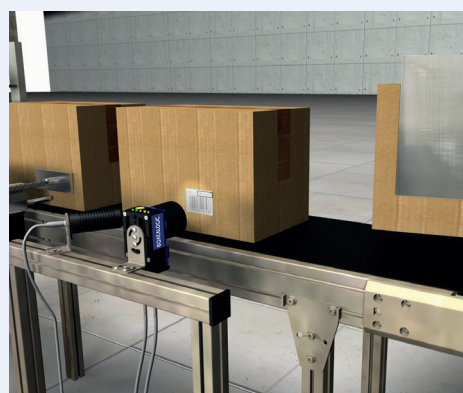
Verifying the different variables on a label (e.g. product weight, cost, ingredients and current promotions) can be accomplished through the use of optical character recognition (OCR) as well as reading barcodes to identify product contents. This feature is especially important when tracking products that contain allergens or require the presence of other health related information on the label.

MEDICAL & PHARMA
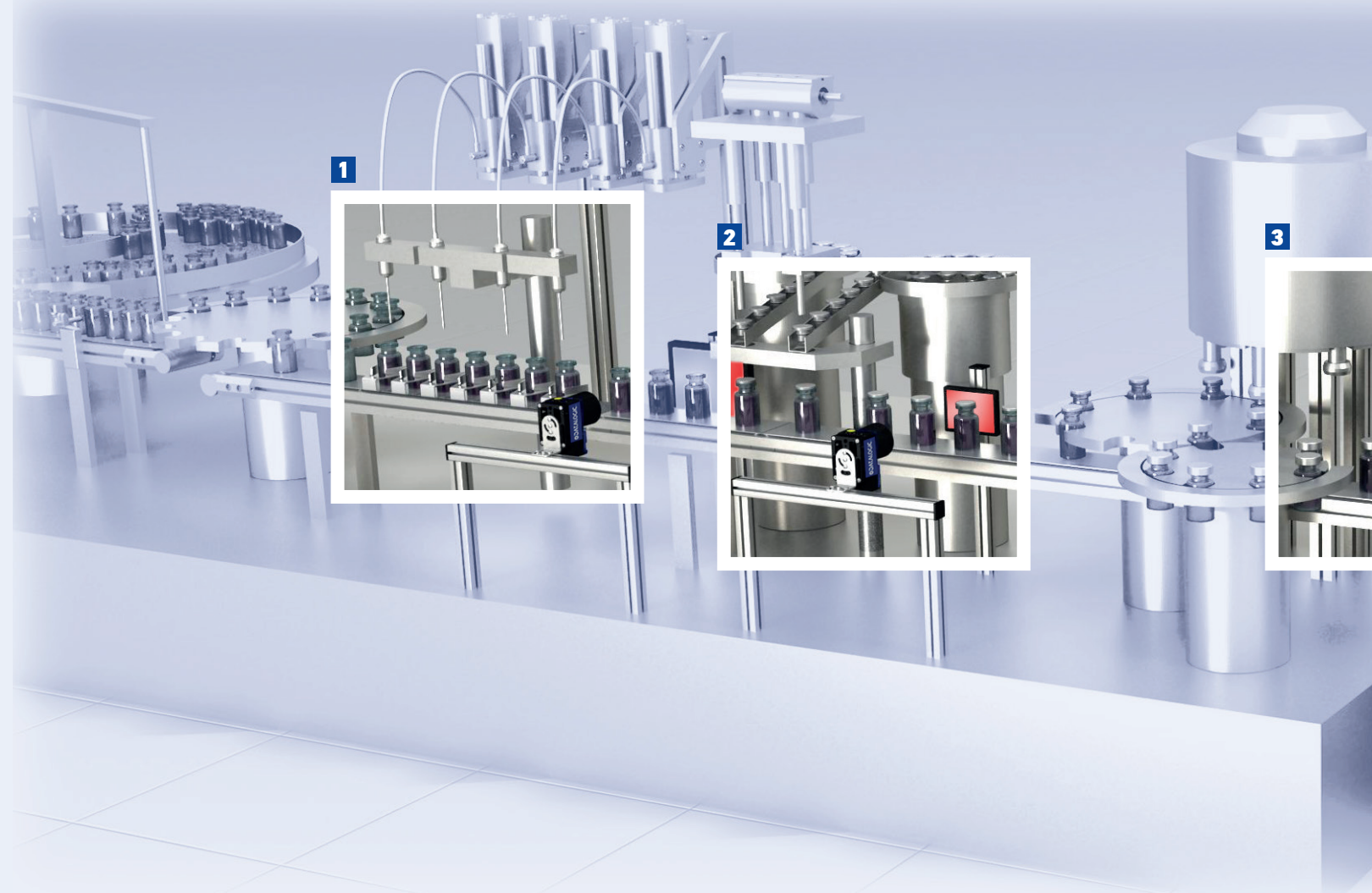

1. LIQUID LEVEL INSPECTION

This inspection provides for the amount of liquid in transparent bottles and can be done quickly and effectively through the use of vision systems. Properly applied, this inspection ensures the bottle is filled to specification while eliminating waste and costs associated with overfill or under fill conditions.

2. CAP INSPECTION

This inspection ensures the product quality by verifying the bottle cap is present and applied correctly. Normally, this inspection is performed at high rates of speed prior to the sealing and final packaging process where visual inspection is not possible without reopening the sealed package.
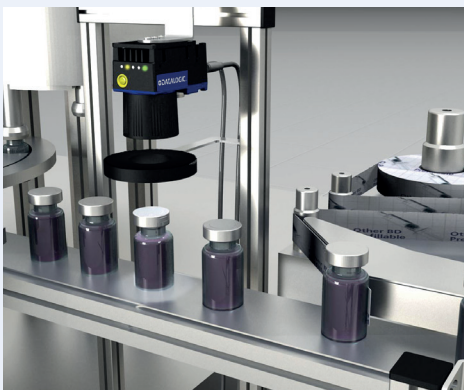
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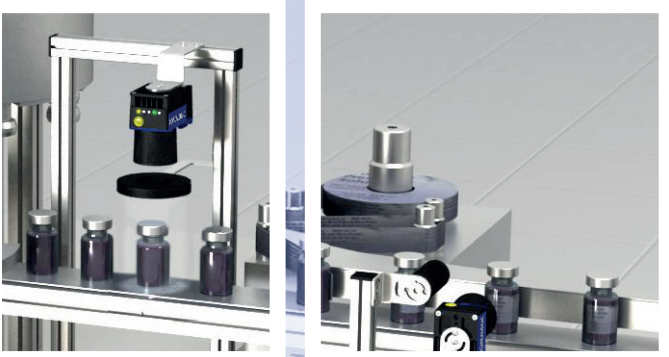
3. SAFETY SEAL INSPECTION

Verifies the product is protected with a properly applied tamper proof seal before leaving the factory or a clean area within the manufacturing facility. Ultimately, this inspection eliminates product contamination through the packaging integrity of the product.

4. LABEL INSPECTION

Checking for critical variable product information on labels (including product weight, ingredients, warnings, etc.) can be accomplished through the use of optical character recognition (OCR), barcode or matrix code readers – all available on smart cameras and vision systems. This feature is especially important when tracking products that contain materials that are ingested or require the presence of other health related information to be printed on the product label.
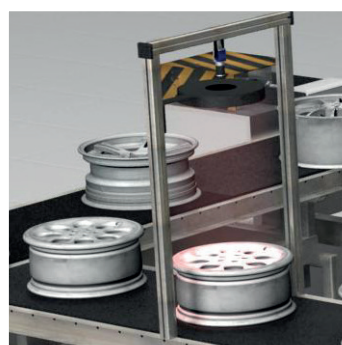
5. BOX INSPECTION

Allows the user to check for and verify the completeness of product packaging. This includes verification of the product count, product type and any miss-packaged or damaged items inside the product carton.
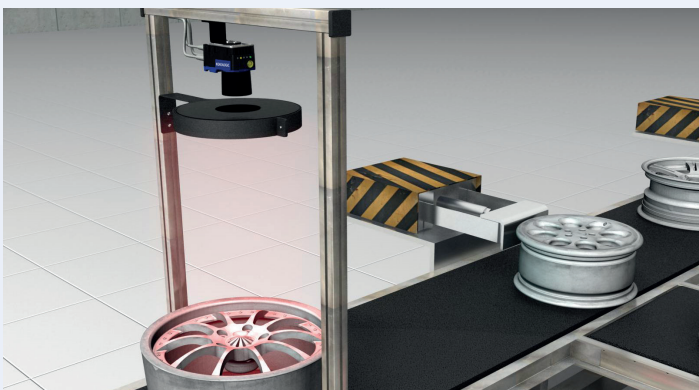
GENERAL MANUFACTURING

1. RIM SORTING

The vision system determines the product model by gross physical characteristics of the inspected rim. In this particular inspection, the key characteristics are the spoke pattern and product diameter. This type of inspection allows for more automation, which in turn, reduces added potential product damage by manual handling and increases the production rates through higher line efficiency.

2. RIM INSPECTION
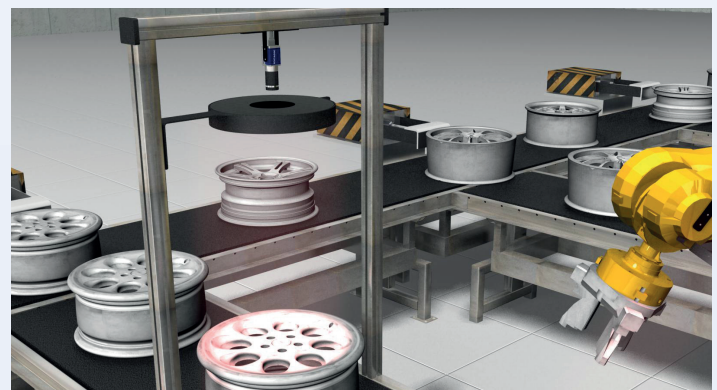
This vision system verifies the surface quality and inspects critical dimensions of key features. These inspections reduce any human subjectivity and collect process information that can be used to identify problem areas in the manufacturing line. This captured data is used for further analysis of the process and ultimately problem resolution, reducing costs related to returned products from unsatisfied customers.

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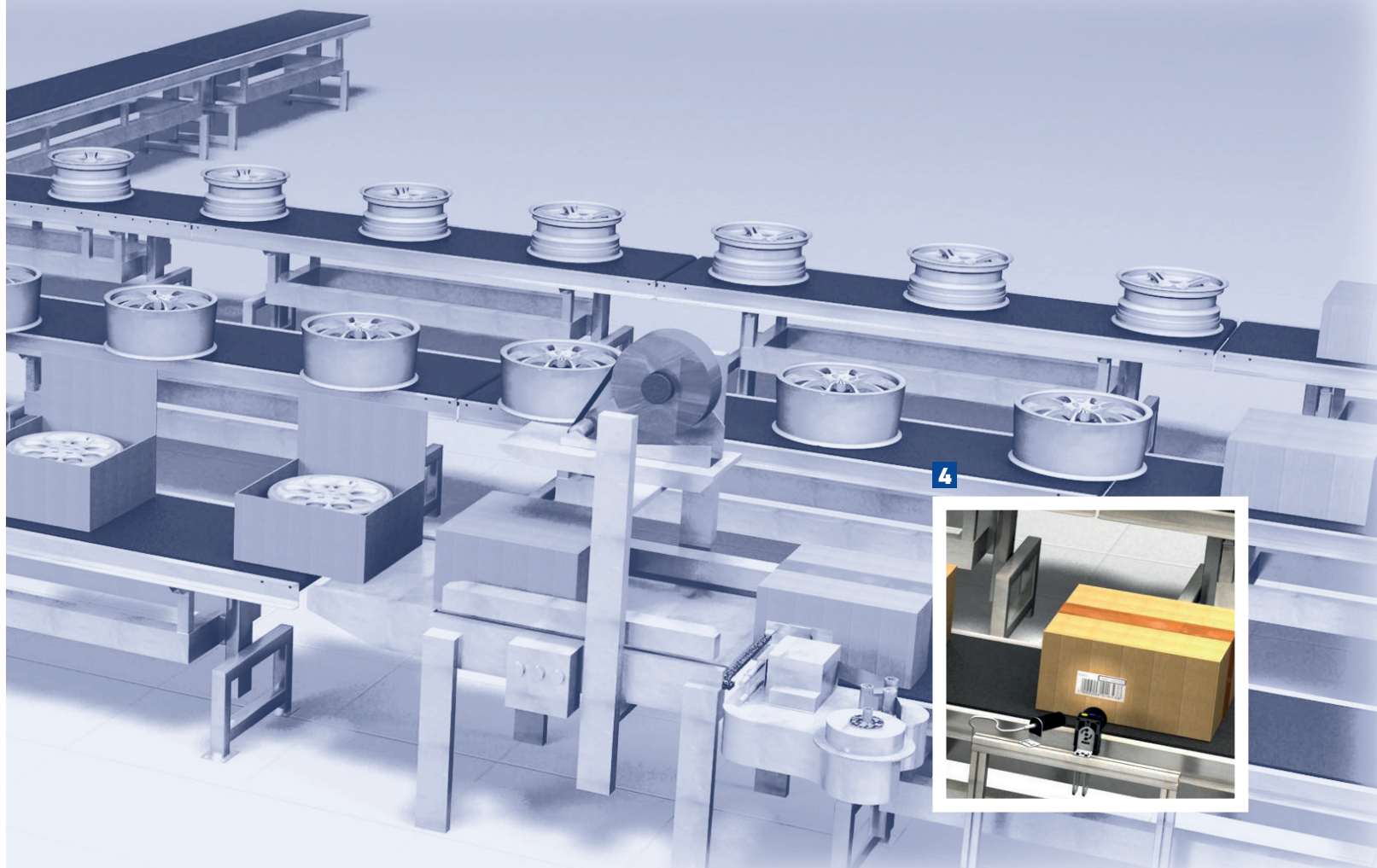
3. RIM ROBOT GUIDANCE

4. LABEL INSPECTION

The vision system identifies the position and orientation of the rim to allow the robot to position itself correctly for picking up the rim. This type of guidance prevents damage to the rim due to incorrectly aligned fixtures on the robot.

The vision system verifies the printed label matches the current product and ensures the label is readable for transportation and customer identification. This inspection prevents the return of incorrectly labeled parts form the customer and ensures stocking accuracy reducing costs related to miss marked parts.
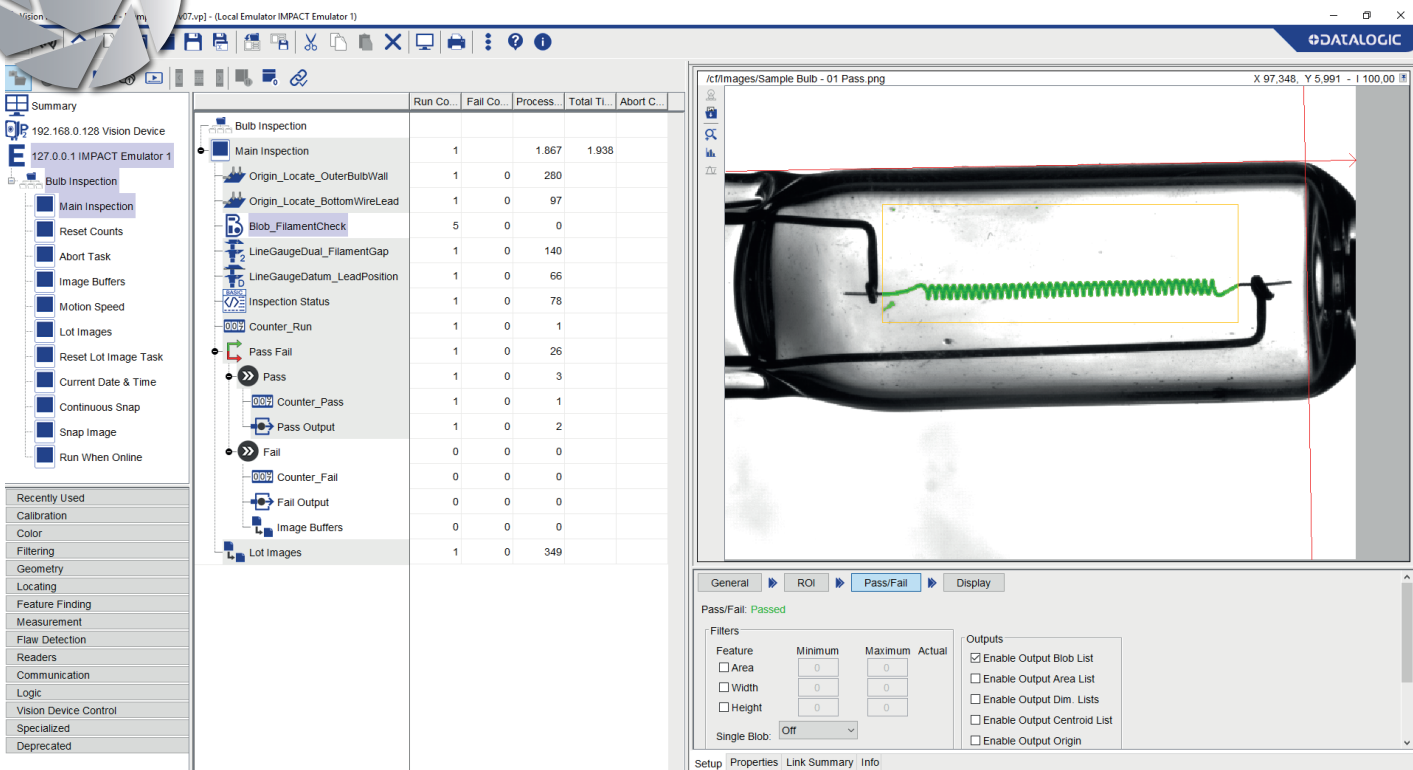
IMPACT SOFTWARE

Impact Software Suite, with over 120 inspection tools and 50 user interface controls, allows users to create unique inspection programs and develop user interfaces quickly and easily.
All this can be done without the loss of flexibility, like traditional configurable systems, or the need for vast amounts of development time like traditional SDK environments.

Vision Program Manager (VPM)

Vision Program Manager (VPM) provides hundreds of image processing and analysis functions. Use VPM to enhance images, locate features, measure objects, check for presence and read text and bar codes.

Features and Benefits

One software fits all
The entire range of smart cameras and vision processors can be configured through the Impact Software suite. Users need only learn one program thus shortening their learning curve. Once developed, the same application can be used on different hardware platforms with no modifications or reprogramming.

Ease-of-use
Impact Software suite is a graphical user interface where no programming is required. Neither VPM nor CPM forces a user to write code. Rather, developers need only to drag-and-drop tools into the tree view and set parameters. Thanks to the embedded emulator, settings can be tested immediately with images previously stored on the PC.

Wide range of controls
With more than 120 controls, Impact is one of the most complete vision systems software suites available on the market. Image filtering, calibration, feature locating, flaw detection, measurement, and code reading are just few examples of the wide range of tools available which allow users to solve even the most challenging applications.

Control Panel Manager (CPM)
Developers can easily create a customized user interfaces thanks to Control Panel Manager (CPM). This software allows users to build up full HMIs just by dragging and dropping controls onto a panel. Authorized operators have the possibility to check images, results and statistics as well as to adjust or modify the working parameters of inspection tasks.

Impact Software powers the full line of integrated vision solutions, from simple to complex. The investment in software and training is preserved as inspections grow.
Programs for the same inspections can be easily shared or transferred across multiple inspection points within the factory.
One software – countless applications!

Control Panel Manager (CPM)

Control Panel Manager (CPM) simplifies development of operator interfaces while providing the ability to make on-the-fly adjustments to critical machine controls. Use CPM to create operator interface panels to view and adjust critical machine controls.
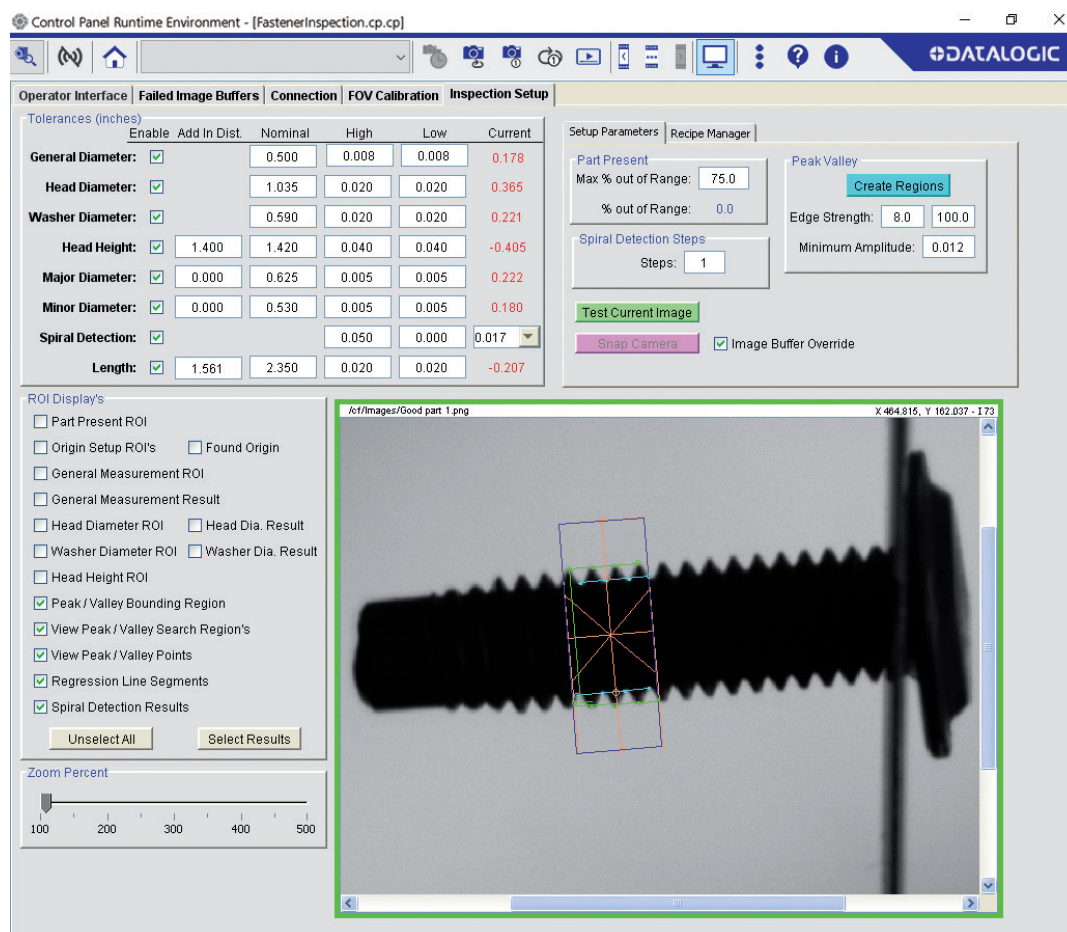
Highlights

- Easy to understand, tree-view logic flow
- Tool Setups guide users through step-by-step tool configuration
- Includes inspection and user interface development programs as well as a runtime user interface
- Runs on all smart camera and vision processor platforms
- Provides complete programmatic or manual control of hardware settings
- Provides real time parameter changes of cameras
- Controls and displays images and data from multiple smart cameras or vision processors
- Password protection allows only authorized users to make changes
- Built-in Emulator saves time when creating, testing and debugging your vision program without a camera
- Software easily communicates with higher level control system via TCP/IP, Ethernet/IP, Modbus and OPC protocols.

APPLICATION-SPECIFIC VISION TOOLS

IMPACT LITE is the new software application that powers the P-Series Smart Cameras. Part of the Datalogic IMPACT Vision Systems Software Suite, IMPACT LITE redefines software functionalities delivering easier and faster device programming while maintaining the traditional interface. With IMPACT LITE, application prototyping and deployment is quicker than ever with features like: drag and drop tools into the inspection tree, one click control linking, parameter adjustment with sliders and combo box controls.

Vision Program Manager (VPM)

IMPACT LITE features a selection of the most commonly used inspection tools. This set of algorithms has been chosen by Datalogic specialists with 35+ years of experience to meet typical application requirements while keeping the device configuration quick and easy.

IMAGE FILTERING
- Edge Enhancement
- Morphology Dilate
- Morphology Erode

LOCATING
- Blob
- Circle Gauge
- Line Find
- Origin
- Pinpoint Pattern Find

FEATURE FINDING
- Average Intensity
- Blob
- Circle Gauge
- Color Blob
- Color Checker
- Contrast – Multiple ROI
- Edge Point Find
- Line Find
- Wide Edge Point Find

MEASUREMENT
- Circle Gauge
- Line Find
- Line Gauge
- Line Gauge Dual ROI
- Multiple Point to Point Measurements

FLAW DETECTION
- Average Intensity
- Blob
- Color Blob
- Contrast – Multiple ROI
- Greyscale Template
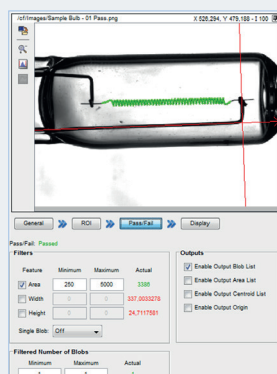
READERS
- Code Reader
- OCR

COMMUNICATION
- Discrete Input
- Discrete Output
- EtherNet/IP Explicit Data
- EtherNet/IP Explicit Message
- EtherNet/IP Read Implicit
- EtherNet/IP Write Implicit
- Serial Port Out
- TCP/IP Port Out
- Image Archiving
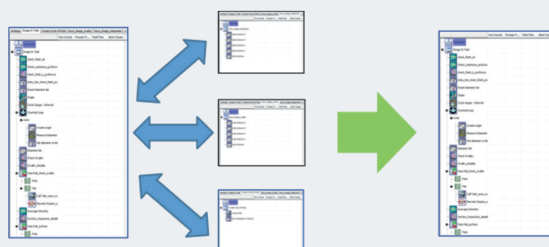- PROFINET IO Read
- PROFINET IO Write

LOGIC
- Counter
- Pass Fail
- Switch
- String Builder

Ease of use

Tool parameter setup with graphical controls

Single task configuration for simple application deployment and quick inspection debugging

The P-Series Smart Camera combined with IMPACT LITE is ideal for solution providers and automation engineers new to vision systems technology. The ultra-compact and cost effective camera solution provides both an easy-to-use device while delivering powerful inspection software.

VPM Display

IMPACT LITE software includes the VPM Display, a pre-configured monitoring software application that allows operators to supervise the quality control results as well as the vision systems device. The VPM display does not require programming or configuration; the panel is automatically generated when configuring the smart camera.
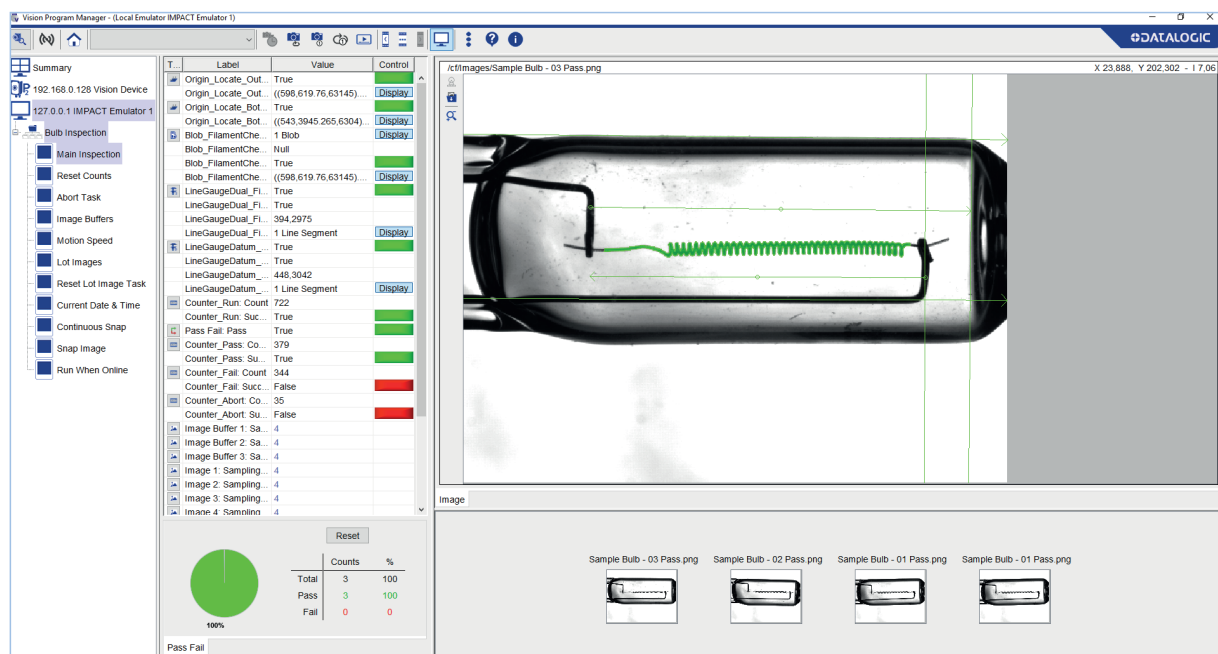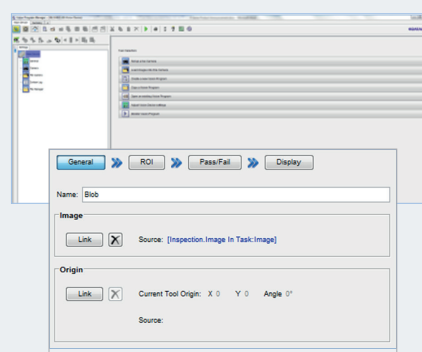

The VPM display offers full monitoring functionalities, such as:

- Live image displaying
- OK/NOK overall statistics
- Inspection switching
- Tool results (logic and numeric)
- Overlay graphic enable/disable
- Input setup
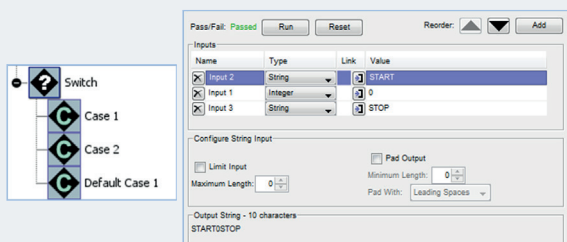
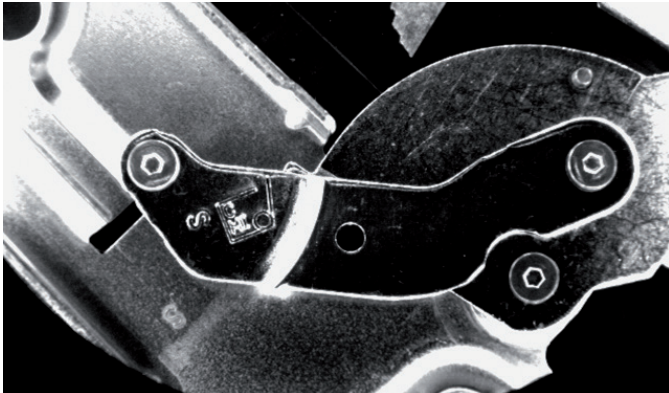New Switch and String Builder tools to simplify logics and output data formatting

New panel look & feel improving the software usability and intuitiveness

APPLICATION-SPECIFIC VISION TOOLS

Feature Finding

- Detect presence/absence of objects
- Detect randomly oriented or amorphously shaped objects
- Verify whether an object grayscale or color is within acceptable range
- Identify edges of uniformly bright or dark objects
- Determine the sharpness of an edge through the use of gradient

Flaw Detection
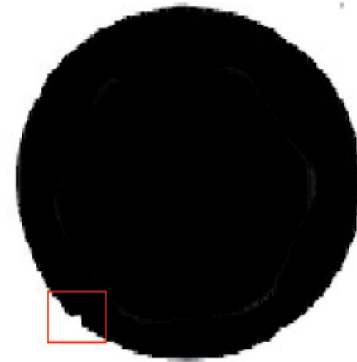
- Determine if objects are out of range
- Filter objects based on size and shape
- Detect differences between a trained object and run-time objects.
- Detect subtle defects in varying background
- Detect defects along the boundary edge of objects

Locate
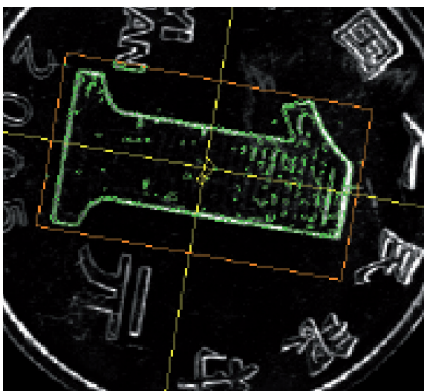
- Use a locate tool to find the object itself or a feature within the object to use as a reference for other tools
- Edge detection to find the corner of an object
- Find the center of mass of an object
- Multiple pattern find tools can be used to find a trained pattern within the image in 360° rotation

Image Filtering
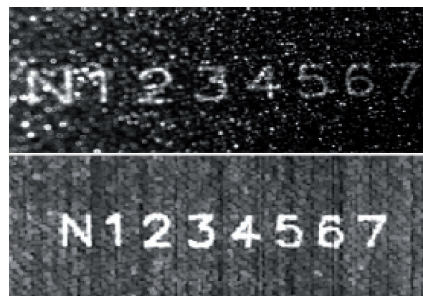
- A complete set of image filtering tools available:
- Average, Median, Gaussian
- Morphology open, close, erode, dilate
- Edge enhancement
- Binarization
- Image subtraction
- Light leveling
- Pixel fill

Colors
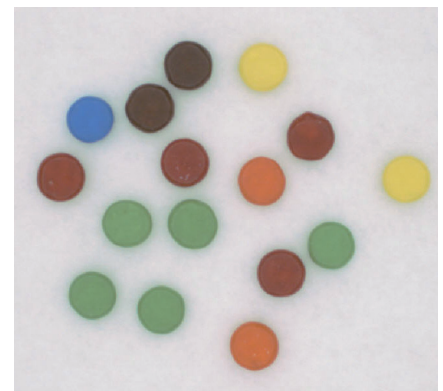
- Find randomly orientated or amorphously shaped colored objects
- Compare an object color with at trained color
- Color image offers red, green, blue, yellow, magenta, cyan and greyscale formats for use by other tools

◇DATALOGIC
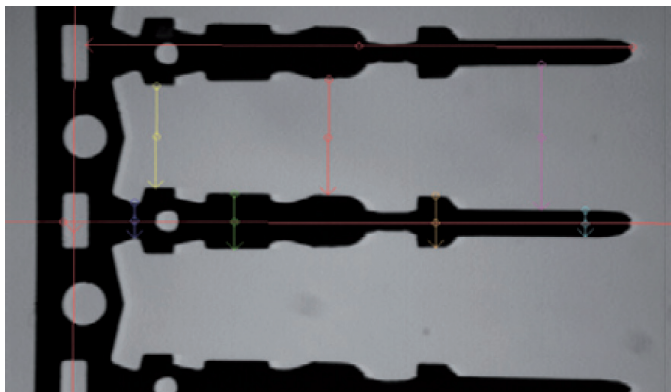
Measurement

- Pixel or subpixel accuracies are possible
- Measure the angle between to linear objects
- Make multiple measurements within one tool
- Point to point and pont to line measurements
- Measure radius, center, and concentricity of circular objects

Code Readers & OCR

- State of the art 1D and 2D barcode readers. Find multiple codes within one image
- Extremely wide range of code symbologies supported
- Omni-directional code reading
- OCR – Optical Character Recognition – able to read character strings
- OCV – Optical Character Verification – able to verify if the content of a string matches with a trained one

Logic Programming
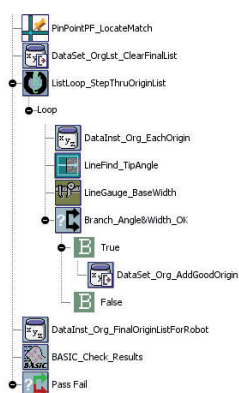
- Tree-view programming structure allows for better tool organization and only run tools when requested
- Logic tools allow for decision-making capabilities without scripting
- Perform logical and mathematical calculations in a flexible and easy way

Image Calibration
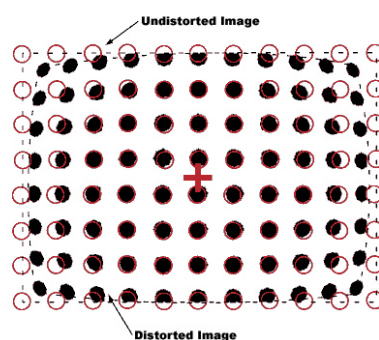
- Allows a user to remove perspective and radial distortion from an image as well as convert pixel to real world values
- Unwrap a curved object or correct a slanted object within an image (primarily used with OCR)
- Combine multiple images into one large image
- Reduce resolution by sampling the image

Data Communication
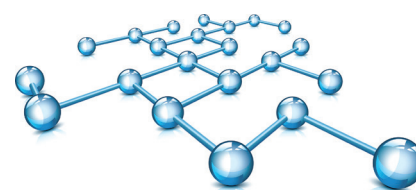
- Discrete I/O serial, TCP/IP, PROFINET IO and Ethernet/IP
- Supports HTTP, FTP and web serving protocols
- Modbus, PCCC and OPC server communication

APPLICATION-SPECIFIC VISION TOOLS

Pattern Sorting Tool

The Pattern Sorting Tool (PST) is a unique machine vision software tool that is able to recognize thousands of different objects according to their appearance, delivering the ability to identify products without the use of bar code detection. This leading-edge algorithm detects thousands of different patterns in an extremely effective way.

The Pattern Sorting Tool guarantees maximum performance and consistency in any situation; even patterns on difficult textures and in cluttered fields of view are detected yielding accurate product identification. This tool is a tremendous breakthrough in the machine vision industry. No other algorithm available is able to offer as reliable and robust recognition over such wide pattern databases.

Applications
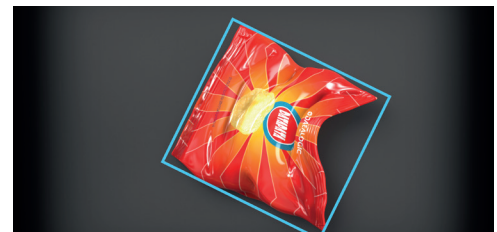
IMPACT Pattern Sorting Tool identifies and locates objects even in soft packaging such as chips, biscuits, frozen goods and pasta, enabling robot picking and sorting.

Its capability to manage large databases of patterns allows Pattern Sorting Tool to distinguish among thousands of different items manufactured or travelling on a conveyor. The algorithm delivers robust recognition in any situation: 360°pattern rotations, perspective distortions, different scales and light variations.

◇ DATALOGIC

Product Highlights
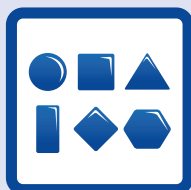
Large pattern database management

The Pattern Sorting Tool handles databases with thousands of different patterns. Users can easily create new databases or edit existing ones.

Partially occluded pattern detection

The Pattern Sorting Tool effectively handles partially occluded patterns. By leveraging its ability to extract and match several pattern features simultaneously, the algorithm is able to identify patterns even when partially damaged or occluded.

Recognition of Patterns Regardless of Size & Orientation

The Pattern Sorting Tool finds a trained pattern no matter its position and orientation. The algorithm can detect a reference pattern even when its dimensions are not fixed.

Unaffected by Lighting Variations

The Pattern Sorting Tool extracts and matches features with minimum dependency to lighting. This guarantees extremely reliable pattern detection even when the surrounding lighting is variable and inconsistent.
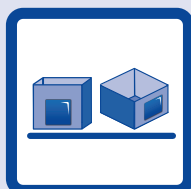
Recognition of Out-of-Plane Rotations

The Pattern Sorting Tool effectively handles perspective distortions, out-of-plane pattern rotations. This capability is essential for inspection of objects having variable and inconsistent positioning or irregular shapes (e.g. boxes on a conveyor belt, non-planar objects).

Color Match

When color detection is enabled, the Pattern Sorting Tool allows to distinguish patterns that differ from colors.

Capability of discriminating similar patterns

The PST allows users to draw a secondary ROI to search slight differences within a specific area of two similar patterns. As a result, patterns with small differences can be distinguished.
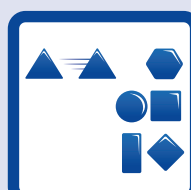
Fast pattern training and database update

No need to retrain the database when adding or removing few patterns. A smart train ROI, automatic unknown pattern training and labelling speed up application deployment process.

APPLICATION-SPECIFIC VISION TOOLS

Advanced OCR Tool

The advanced OCR tool is a powerful vision software tool able to read challenging alphanumeric strings printed over labels or directly marked (DPM) into industrial products. This new tool ensures robust and reliable reading of hard to read characters under difficult conditions, such us non-uniform background, variable light conditions, and curved surfaces.

Available with the IMPACT software, Advanced OCR is extremely intuitive featuring quick character training and easy to use string verification modes. Users can segment a string instantly with the auto segmentation capability and then train characters by typing them in. Two string verification modes, OCR and OCV, together with three different options for verify string inputs guarantee full application flexibility.

Advanced OCR is the best solution for reading ink-jet printed dot matrix strings on package labels and embossed characters on mechanical parts or components, respectively in the Food & Beverage and Automotive industries.

Applications
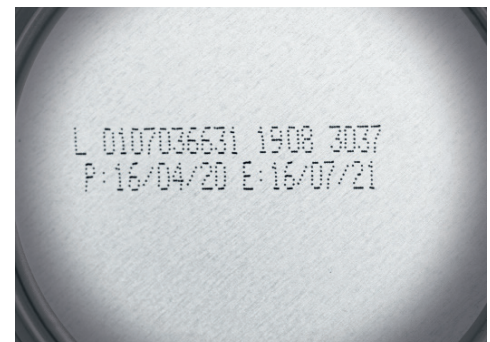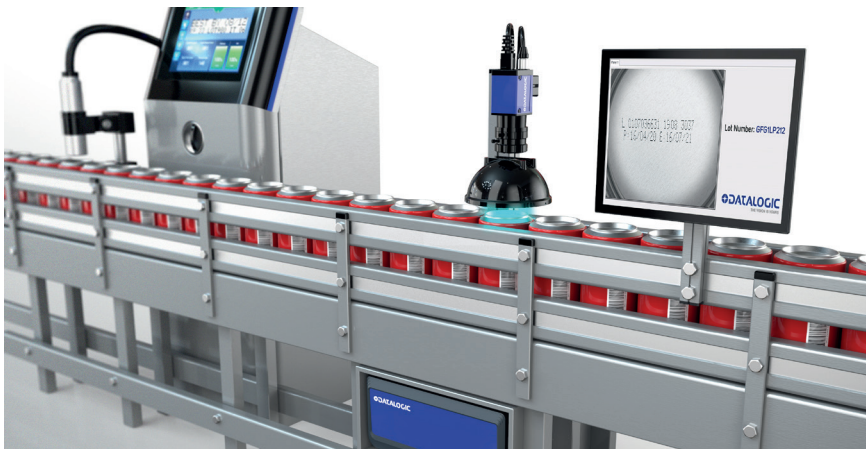
The outstanding Advanced OCR software algorithm ensures the highest reading reliability of ink-jet dot matrix characters on challenging surfaces (i.e. cans, bottles,..)

IMPACT Advanced OCR tool is able to effectively read serial numbers directly marked on automotive parts, even when surfaces are strongly reflective, rough and curved.

⊕ DATALOGIC

Product Highlights
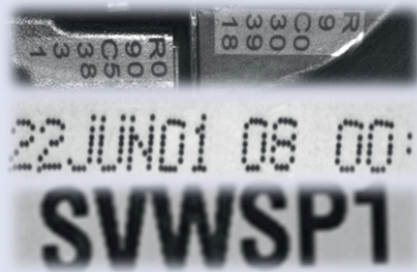
Effective with difficult to read characters
The Advanced OCR tool is highly effective with ink-jet dot matrix or engraved characters. It is also able to read low contrast and slanted characters. When characters are trained, it recognizes them even if they are not well spaced and touching each other.

Robust against variable background and difficult light conditions
Advanced OCR delivers robust and reliable readings even with variable background or corrupted by noise. It ensures excellent performances even with difficult light condition.

Reliable with challenging codes
Advanced OCR tool works perfectly with distorted printings, embossed and marked codes, as well as easily perishable labels. It is the best solutions for the most challenging codes even on irregular surfaces.
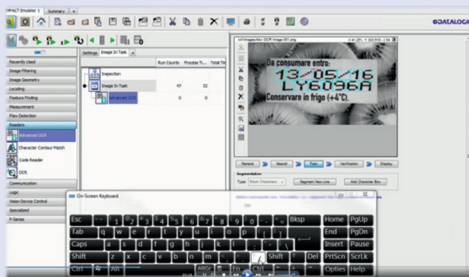
Easy of use and fast OCR application development
Advanced OCR is extremely intuitive ensuring quick characters training and easy management of the database of fonts. OCR and OCV modes together with three different string verification options deliver full application flexibility.

UNDERSTANDING VISION SYSTEMS

Vision Systems

Edward H. Adelson

Vision systems are different from human vision. Human brain infers what eyes cannot see. It can create composite images from multiple angles.

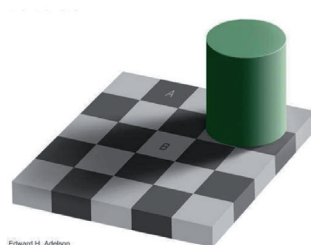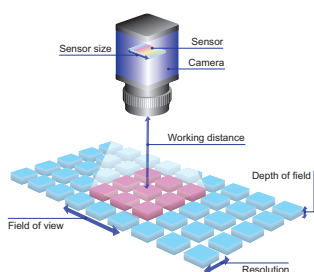A and B squares seem to have different colors (i.e. A darker than B) but actually they do not. By removing surroundings, they have exactly the same greylevel and this is how they are perceived by an electronic eye.

A machine vision monochromatic (greyscale) image will only show differences in contrast. So, a good image for vision systems is different than for human vision.

VISION SYSTEMS GLOSSARY

Working Distance (WD): The distance from the front of the lens to the object when in sharp focus.
Field-of-View (FOV): The imaging area that is projected onto the imager by the lens. Note that most imagers used today provided a 4:3 aspect ratio (4 units wide and 3 units high).
Depth-of-Field (DOF): The range of the lens-to-object distance over which the image will be in sharp focus. Note that the shorter a lens' focal length is, or the more closed a lens' aperture is, the greater the available depth of field.
Resolution: The ability of an optical system to distinguish two features that are close together. Note that both imagers and lenses have their own respective resolutions. Always consider the benefits of better camera resolution, but lens resolution is nearly always better than needed for most factory applications.

Camera Selection

4 x 4   10 x 10   16 x 16
24 x 24   36 x 36   72 x 72
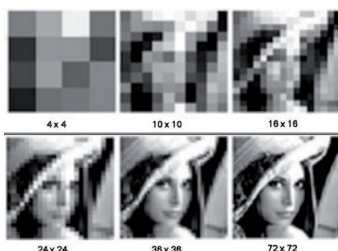
Resolution
Resolution is a measure that identifies the camera capability to acquire image details. Higher resolution means more image detail. The convention is to describe the pixel resolution with the set of two positive integer numbers, where the first number is the number of pixel columns (width) and the second is the number of pixel rows (height), for example as 640 by 480. Another popular convention is to cite resolution as the total number of pixels in the image, typically given as number of megapixels, which can be calculated by multiplying pixel columns by pixel rows.

Acquisition (frame) rate
Frame rate is the frequency (rate) at which a camera is able to acquire consecutive images (area scan camera) or consecutive lines (line scan camera). Frame rate is typically expressed respectively in Frames Per Second (FPS) or Thousands of Line per Second (KHz).

Greyscale VS Color
Most of vision systems applications are solved using greyscale cameras. In a greyscale image the value of each pixel represents the light intensity information. The color depth identifies the number of different intensities (i.e. shades of grey) that can be detected by every image pixel. Color depth is typically expressed in bits or greylevels (e.g. 8 bits = 256 different shades of grey).

8 bit(256 greylevels)	0	26	51	77	102	128	153	179	204	230	255

On the contrary color images contain 24 bits of information per pixel (as opposed to a grayscale's 8 bits), thus giving a color camera 3x more dynamic sensitivity. Note that most color cameras actually use a grayscale imager with a Bayer Filter. Intensity passing through 2x2 pixel grids are interpreted and converted into a color image. Note that there are twice as many green pixels since the human eye is most sensitive to green.

◈ DATALOGIC

Lens Selection

Focal
lenght

f

Vertical
angle
of view

Picture
angle

Camera
lens

Camera
sensor

Horizontal
angle
of view

Field
of view
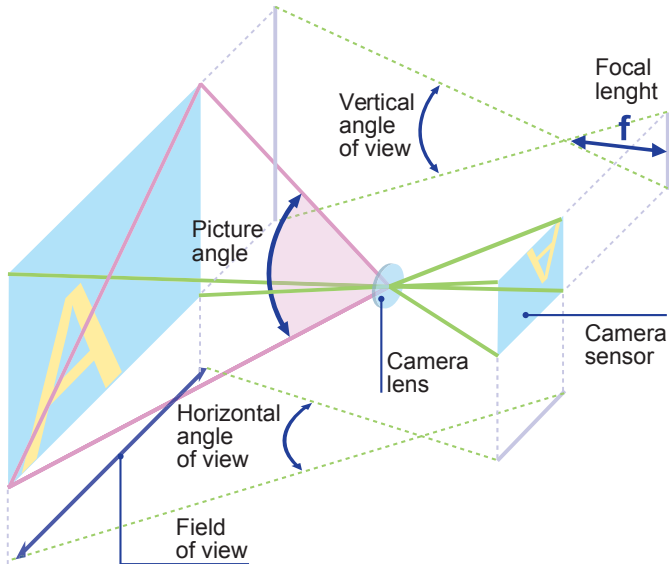
Focal Length:
The focal length of a lens is defined as the distance from the optical center of the converging lens to the focal point, which is located on the imager, when "in focus". Units are typically in mm.

Aperture (f-stop):
The ratio of the focal length of the lens to its effective diameter. Shown as f-stop or f/f. Each f-stop would allow either 1/2x or 2x light compare to the next f-stop. A larger aperture opening results in a smaller f-stop value. Note that the more closed a lens' aperture is, the greater the depth of field.

S-Mount

S-Mount lenses feature male M12 thread with 0.5 mm pitch on the lens and a corresponding female one the lens mount.
Most commonly used with compact devices like Vision Sensors or Smart Cameras.

C-Mount

C-mount lenses provide a male thread which mates with a female thread on the camera. Most common standard, used with VGA resolution (640x480) up to 5 Megapixel cameras.

F-Mount

F-Mount lenses feature a three lug bayonet mount with a 44 mm throat and a flange to focal plane distance of 46.5 mm. Mainly used for high resolution cameras.

Conventional Vs Telecentric Lenses
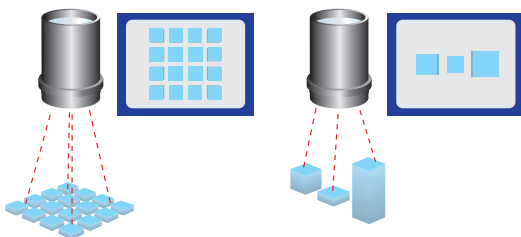
Conventional Lenses view in a conical shape and generally produce magnification errors in radial bands about its center, thus producing magnification errors when viewing objects at different distances.
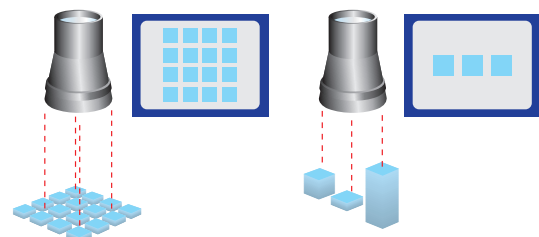
Telecentric Lenses offer constant magnification with change in distance. These lenses are used for high-precision measurement of objects at different depths.

UNDERSTANDING VISION SYSTEMS

Basic concept

Lighting main goal: transfer information from object surface to camera

Light interactions

In vision systems the main goal is to optimize the contrast between the features that must be inspected and their background. In order to do so,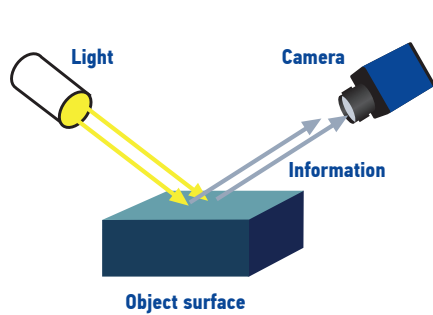 light interaction principles must be taken into consideration and properly exploited. The characteristics of an object will determine how light is reflected or absorbed.
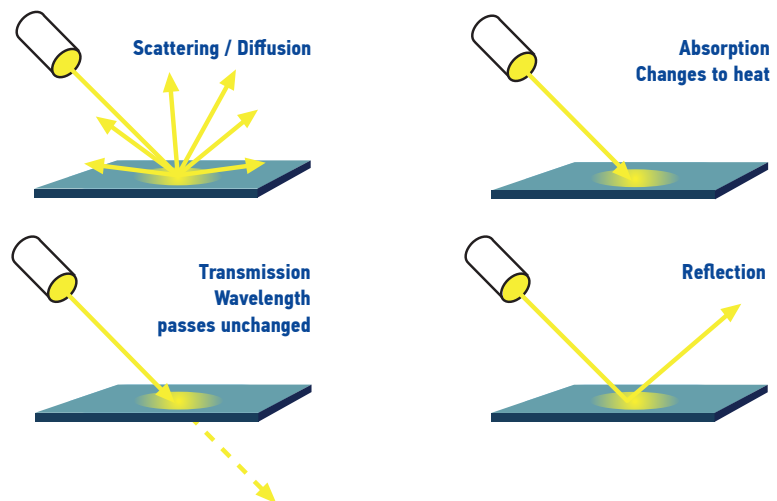
The importance of materials

Material and surface finishing are important as well. Surface reflectivity difference between the machined aluminum and cast aluminum (direct vs. scattered light)

Copper & Silver terminals: red illuminator (on the left), blue illuminator (on the right)

Lighting techniques

| Bright field | Dark field | Back lighting | Diffuse dome | Coaxial |
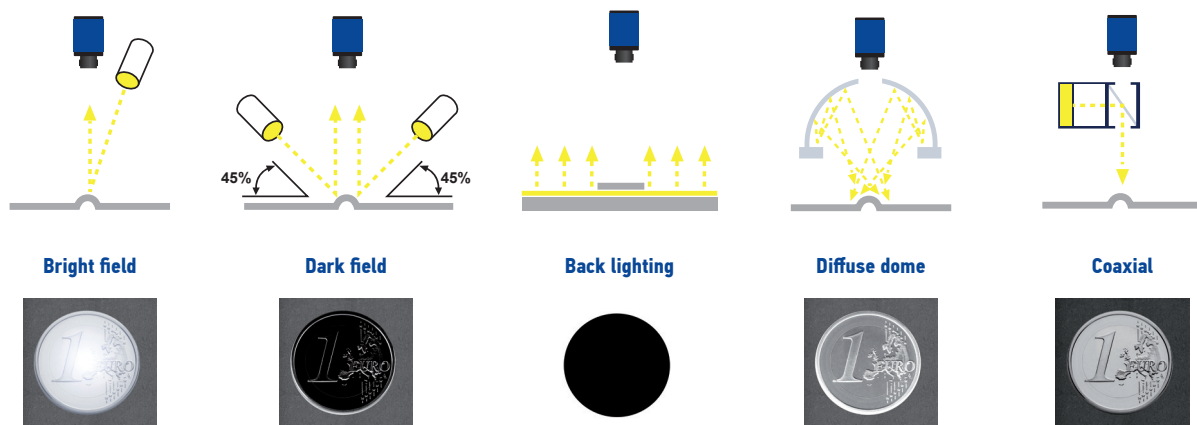
The importance of colors

Colors affect acquired images even when monochrome cameras are used. Rule of thumb:
- In order to brighten, use same color lighting as compared to the object
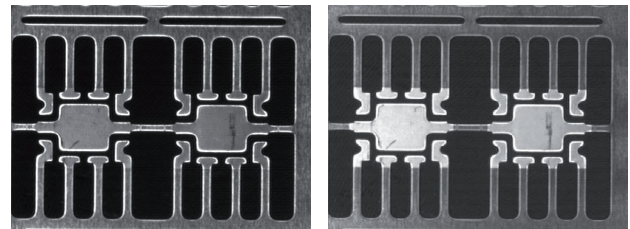- In order to darken, use opposite color lighting as compared to the object

Lighting color

White Light on Color Camera

Red Light

Red + Green Light

Green Light

White Light

Blue Light
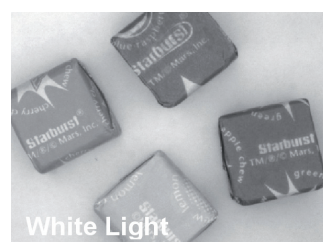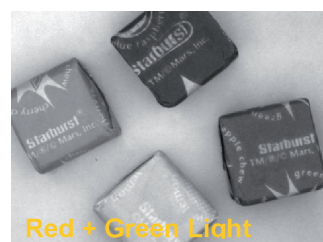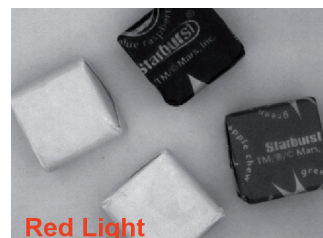
Constraints

When evaluating a vision systems application, mechanical constraints must be carefully evaluated and considered since they may limit the lighting and lensing solutions.

Space (volume) constraints
• What space is available for lighting?

Speed of inspection
• Limits what lighting (strobed or static) and what inspection tools can be used

Environmental issues
• Specific IP rating requirements?

Camera

FOV: 2.5" x 2.0"

WD
110 mm

LWD
45 mm

SMART CAMERAS

P-SERIES

The P-Series is an ultra-compact cost effective smart camera offering advanced vision systems functionalities in a fully embedded stand-alone device. The P-Series is available with gray-scale or color CMOS image sensors with two different resolutions: VGA and 1.3MP. Lenses and illuminators are fully interchangeable and can be mounted and replaced by the user. Five focal lenghts and nine lighting options result in 90 different combinations delivering outstanding installation flexibility while offering superior image acquisition capabilities. The P-Series is powered by the IMPACT LITE software package. With more than 25 inspection tools, IMPACT LITE revolutionizes device programming by making the inspection configuration quick and intuitive.step by step.
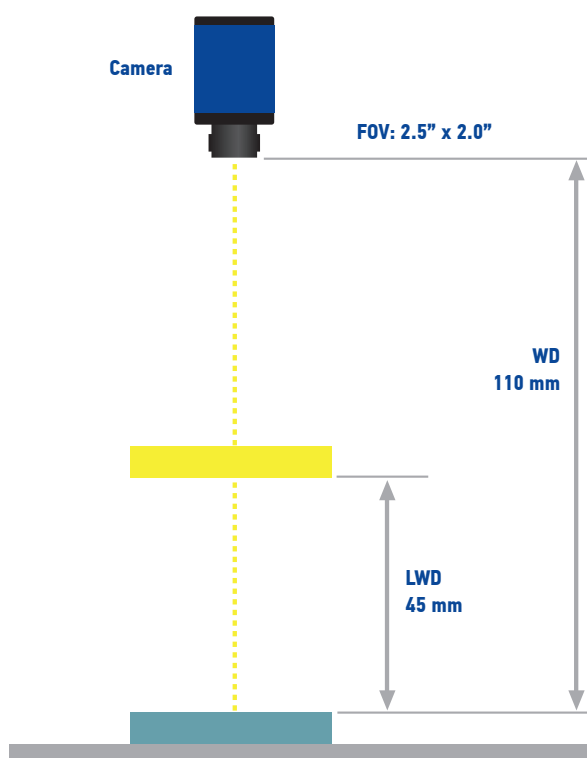
- Cost effective compact Smart Camera Series
- Right-angle IP67 rated enclosure with rotating connectors
- VGA (640x480) or 1.3 MP (1280x1024) with color or grey-scale imagers
- Embedded interchangeable lenses and illuminators
- Built-in digital I/Os, Serial and Ethernet interfaces

A-SERIES

The A-Series is a stand-alone, general purpose and cost effective Smart Camera that can be installed even in harsh industrial environments thanks to its IP67 rated housing. The A-Series features a VGA (640x480) CCD imager, built-in discrete I/Os as well as Ethernet and Serial interfaces. Thanks to the ultimate programming flexibility offered by Impact software, the A-Series represents the answer to every vision systems need.

- Mid-range Smart Camera
- Right-angle IP67 rated enclosure
- VGA (640x480) grey-scale imager
- Built-in digital I/Os and Serial interface
- Gbit Ethernet Port

T-SERIES
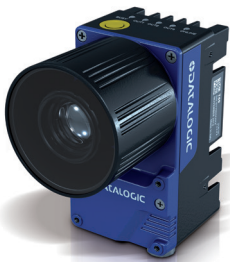
The new T-Series smart camera provides customers with outstanding performance in an industrialized and compact package. Equipped with a powerful 1.1 GHz processor, the T-Series performance is exceptional in value and functionality. The T-Series comes in 3 different camera resolutions, VGA, 2 Mega-Pixel and 5 Mega-Pixel all in a sealed, industrially hardened enclosure for maximum protection. Combined with Impact software, the new generation T-series delivers the most rugged and versatile smart camera solution in the market today.

- High performance Smart Camera series
- Right-angle IP67 rated enclosure
- Up to 5Mpix grey-scale imager
- Built-in digital I/Os and Serial interface
- Gbit Ethernet Port

SMART CAMERAS

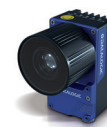|	P-SERIES	A-SERIES	T-SERIES
Format	Right angle (with rotating connectors)	Right angle	Right angle
Imager	• 640 x 480, 1/4" CMOS, 120 fps • 1280 x 1024, 1/1.8" CMOS, 60 fps	• 640 x 480, 1/3" CCD, 60 fps	• 640 x 480, 1/3" CCD, 60 fps • 1600 x 1200, 1/1.8" CCD, 15 fps • 2448 x 2048, 2/3" CCD, 15 fps
Image	8 bit gray-scale 24 bit color	8-bit gray-scale	8-bit gray-scale
Lens Mount	Embedded lenses	C-Mount	C-Mount
Processor	660 MHz DSP	800 MHz DSP	1.1 GHz DSP
On-Board Image Buffering	Up to 16	Up to 16	Up to 16
On-Board Program Storage	256 MB flash	256 MB flash	256 MB flash
Dedicated On-Board Optically Isolated I/O	1 IN	1 IN / 1 OUT	1 IN / 1 OUT
Configurable On-Board Optically Isolated I/O	1 IN / 3 OUT	1 IN / 2 OUT	1 IN / 2 OUT
Rs-232 Serial	•	•	•
Ethernet	•	•	•
External Button	•	•	•
Power Required	10 ... 30 Vdc 0.7 ... 0.2A	10 ... 30 VDC 1 ... 0.33 A	• T40 10 ... 30 VDC 1 ... 0.33 A • T47 10 ... 30 VDC 1.05 ... 0.35 A •T49 10 ... 30 VDC 1.2 ... 0.4 A
Dimensions	95 x 54 x 43 mm (3.7 x 2.1 x 1.7 in.) Connector @ 0° 75 x 54 x 62 mm (3.0 x 2.1 x 2.4 in.) Connector @ 90°	123 x 60 x 86 mm (4.84 x 2.36 x 3.41 in)	123 x 60 x 101 mm (4.84 x 2.36 x 3.98 in)
Mechanical Protection	IP67	IP67	IP67
Operating Temperature	0°C ... +50 °C	0 °C ... +45 °C	0 °C ... +50 °C
Humidity (Non-Condensing)	0 ... 90 %	0 ... 90 %	0 ... 90 %
Certifications	CE, CSA	CE, CSA	CE, CSA

VISION PROCESSORS

MX-E25/45

Two different MX-E models are available, each featuring the ultimate Intel® multi-core chipsets: the entry-level cost effective MX-E25 supporting two PoE cameras and the mid-range MX-E45 supporting two or four PoE cameras. All the MX-E series models are available either with PNP or NPN digital I/Os delivering extended connectivity to any PLC brand. Two processor models covering different performance levels, two or four GigE camera ports and two digital I/O options result in six different hardware configurations covering even the most challenging applications in Automotive, Electronics and Food & Beverage.
Powered by IMPACT, the MX-E Series is the ideal solution for highly demanding multi-camera vision inspections.

- Multi-camera vision processors
- GigE Vision camera connectivity
- Two models with different processing capabilities
- Windows 10 IoT Enterprise®

MX-E90

The MX-E90 industrial vision processor provides the performance needed for the most demanding machine vision applications. With faster processing, more RAM, and up to 8 POE camera ports, our customers will be able to solve more inspection applications.
The total cost of ownership is reduced by having one processor able to connect to 8 inspection points. Integration, set up, and maintenance costs are lower since less cabinet space, less power consumption, fewer cables, fewer I/O blocks, and fewer spares are needed.
The MX-E90 is a part of a portfolio of industrial vision processors to address processing needs beyond the capability of smart cameras. The industrial vision processors can run a customer's application faster or process higher resolution images which will increase the range of applications that can be solved.
Powered by IMPACT Software, the MX-E90 has the same intuitive drag and drop interface as Datalogic's other industrial vision processors and Smart Cameras. IMPACT makes it easy to generate a vision program and create a custom user interface in minutes. Built with performance in mind, our customers can rely on this industrial vision processor for years to come.

- Multi-camera vision processors
- GigE Vision standard connectivity
- 8 USB 3.0 ports for connecting external devices (i.e keyboard and mouse)
- Windows 10 IoT Enterprise®

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VISION PROCESSORS

	MX-E SERIES		
	MX-E25	**MX-E45**	**MX-E90**
CPU	Intel Celeron 1.7 GHz – dual core	Intel Celeron 2.4 GHz – dual core	Intel® Core i7-7700T up to 3.80 Ghz – quad core
System Memory	8 GB DDR4 RAM		32 GB DDR4 RAM
Storage	128 GB SATA SSD (MLC)		128 GB SATA SSD
Graphics	Intel® HD Graphics 510 (1920x1200 resolution) - DisplayPort, DVI		Intel® HD Graphics 630 (1920 x 1200 resolution) - VGA, DVI
Camera Interface	2x 1000 Mbps Base-T, PoE camera ports (Up to 7 W per channell)	2x o 4x 1000 Mbps Base-T, PoE camera ports (Up to 7 W per channell)	2x, 4x or 8x - 1000 Mbps Base-T, PoE camera ports (Up to 7W per channel)
Camera Imager Limit	5Mpix or lower	None	
Network Interface	2x LAN ports - 10/100/1000 Mbps Base-T		
Serial Communications	1x RS-232 serial port		2x RS-232 serial port
Keyboard/Mouse	4x USB3.0 ports		8x USB 3.0 ports
Comm Connectivity	Supports EtherNet/IP, Profinet, Modbus TCP and OPC		
I/O	16 in -16 out, PNP card or NPN card, 200μs response time		16 in-16 out - single I/O card configurable PNP/NPN
Operating System	Windows 10 IoT Enterprise		
Power Requirements	24 VDC +/- 25% (5.5 A @ 24 VDC)		
Dimensions	270 (H) x 130 (W) x 255 (D) mm 10.6 (H) x 5.1 (W) x 10 (D) in.		145 (H) x 192 (W) x 230 (D) mm 5.7 (H) x 7.56 (W) x 9.05 (D) in.
Operating Temperature	0 to+50 °C / +32 to +122 °F		
Humidity	5 to 95% (non-condensing)		
Mechanical Protection	IP20		
Certifications (Safety Compliance)	CE/FCC, c-UL-us, KCC		

DIGITAL CAMERAS

E100 SERIES GIG-E CAMERAS						
GRAYSCALE MODEL	COLOR MODEL	RESOLUTION	IMAGER	SHUTTER	FRAME RATE (FPS)	PoE
E101	E101C	640 x 480	1/4" CMOS	Global	300	•
E151	E151C	1280 x 1024	1/22" CMOS	Global	75	•
E181	E181C	1920 x 1200	2/3" CMOS	Global	50	•
M197	M197C	2592 x 1944	1/2.5" CMOS	Rolling	14	•
E198	E198C	2448 x 2048	2/3" CMOS	Global	20	•

M-SERIES LINE-SCAN GIG-E CAMERAS						
MODEL	RESOLUTION	MAX. LINE RATE	PIXEL SIZE	C-MOUNT	F-MOUNT	M42-MOUNT
M565	2048	48 KHz	7x7 µm	•	•	
M570	4096	24 KHz	7x7 µm		•	
M575	6144	17KHz	7x7 µm		•	•
M580	8192	12KHz	3.5x3.5 µm		•	•
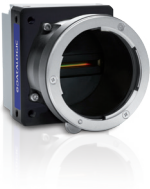
⊕DATALOGIC

TRAINING & SUPPORT

WWW.DATALOGIC.COM

FREE full-feature trial software
FREE download product literature, technical specifications and drawings
FREE online training material to do at your own pace
FREE IMPACT application videos and sample programs
FREE Vision Systems initial application evaluation

Basic – 1.5 Days

- What is vision systems
- Vision products overview
- Application examples and proven solutions
- DataVS training
- I/O wiring of the hardware - basics
- VPM basic training

Intermediate – 2 Days

- VPM intermediate training
- CPM basic training.
- Application Specific training – attendees are requested to bring their parts to work on them

On-Site Training

- Customized for Your Application, Location and Schedule
- Contact our Training Department for pricing

NOTES

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NOTES

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EMPOWER YOUR VISION

www.datalogic.com

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