



Artificial Intelligence Inspection System

AI HAYABUSA

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Automated inspection capability that combines artificial intelligence (AI) and machine learning solves problems experienced with visual inspections and conventional image processing applications.

The visual inspection process is automated by artificial intelligence (AI) and image processing.

The conventional image processing inspection is optimized through machine learning by the cutting-edge AI technology.

This system solves a variety of problems by using our proprietary AI-based platform that enables high-accuracy, high-speed image processing, character shape recognition, and big data analytics.

Also, since it can be customized for all types of work site, the system can offer optimal solutions to problems that you experience with your existing visual and image inspections.

Problems with visual inspections

- ☐ Inspection results are prone to vary.
- ☐ Non-conforming products can flow into the succeeding process.
- ☐ Some inspections require skilled inspectors.
- ☐ Developing skilled inspectors takes time.

Problems with conventional image inspections

- ☐ Most inspections use pattern matching.
- ☐ Acceptance and rejection criteria are simple but not adaptable.
- ☐ Image unevenness can occur depending on the conditions of the optical system, lighting, etc.
- ☐ Automatic correction of irregular reflection and defocusing cannot be done accurately.

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This system overcomes the existing problems by integrating image processing technology and AI. It enables more advanced, faster inspections while at the same time offering savings in labor.

Basic image processing performance

- 1. Image processing accuracy : 1/50 – 1/100 sub-pixels**
0.4 – 0.8 m when a pixel is set to be 40 m
(Workpiece travel speed: 200 mm/sec)
- 2. Image processing speed: 5 msec or less**
(CPU: Single-core processor that uses less than 100 MB of memory)

Differentiation technologies that enable high-accuracy, high-speed image processing

- ① Cutting-edge core image processing technology
- ② AI and machine learning

About artificial intelligence (AI)

AI capability proves useful when a user is to recognize or judge a target object. The user chooses the part of the object that is to be recognized or judged and determines the initial amount of features. The AI capability then selects an amount of features based on various machine learning and MT methods and automatically determines the method whereby the combination of techniques and the combination procedure are the most robust. The method used when determining the initial amount of features is not necessarily optimal for every machine learning method. The AI capability of this system automatically determines the feature amount setting conditions most suitable for the selected machine learning or MT method. Using a feedback mechanism, it automatically optimizes the intensity of lighting, the positional relationship between the object and the lens, and image processing conditions. These numerous experiments are conducted at high speed, and machine learning keeps the optimal processing method evolving constantly.

Our system solves problems with visual and image inspections.

It also offers cost reduction and other benefits by improving quality and inspection efficiency and achieving savings in labor.

Quality improvement

Human errors and differences in inspectors' judgment criteria result in variation in quality.



Inspection efficiency improvement

It takes time to recognize subtle differences in color, fine scars on shiny objects, etc.



Savings in labor

A large number of skilled inspectors are required.



Automation



Human errors do not occur any longer and clear judgment criteria are in place, leading to less variation in quality.

High-speed processing



Many different image recognition tasks can be performed at high speed with high accuracy, allowing objects to be recognized quickly.

Automation



Labor cost can be reduced! Human resources can be utilized effectively.

All kinds of inspection environment are supported.

We are prepared to offer a unit or system that is best suited to your inspection application, including offline, online, and device mounting.

Offline

An offline system is ideal for use in departments in charge of receiving inspections of parts and quality inspections and control of products. It can be used in laboratories as well.

Online

An online system can be installed over a production line in a factory. It quickly and accurately inspects workpieces carried on the production line.



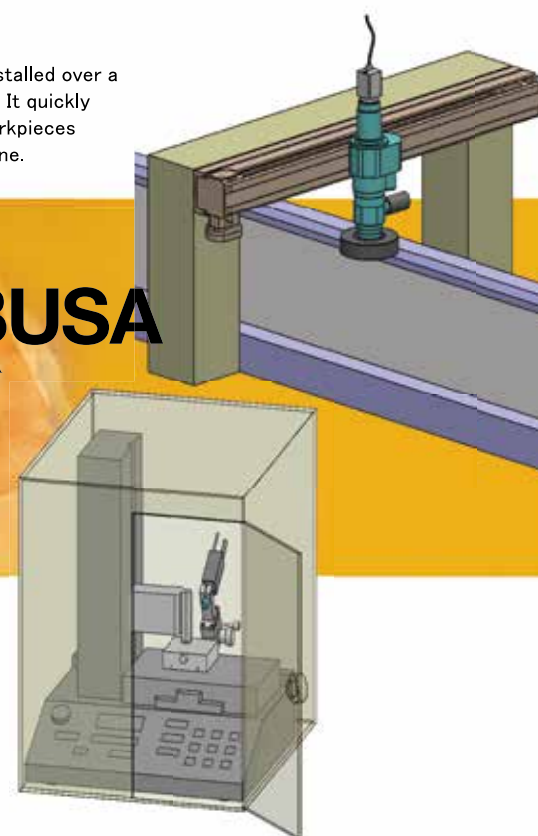
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Device mounting

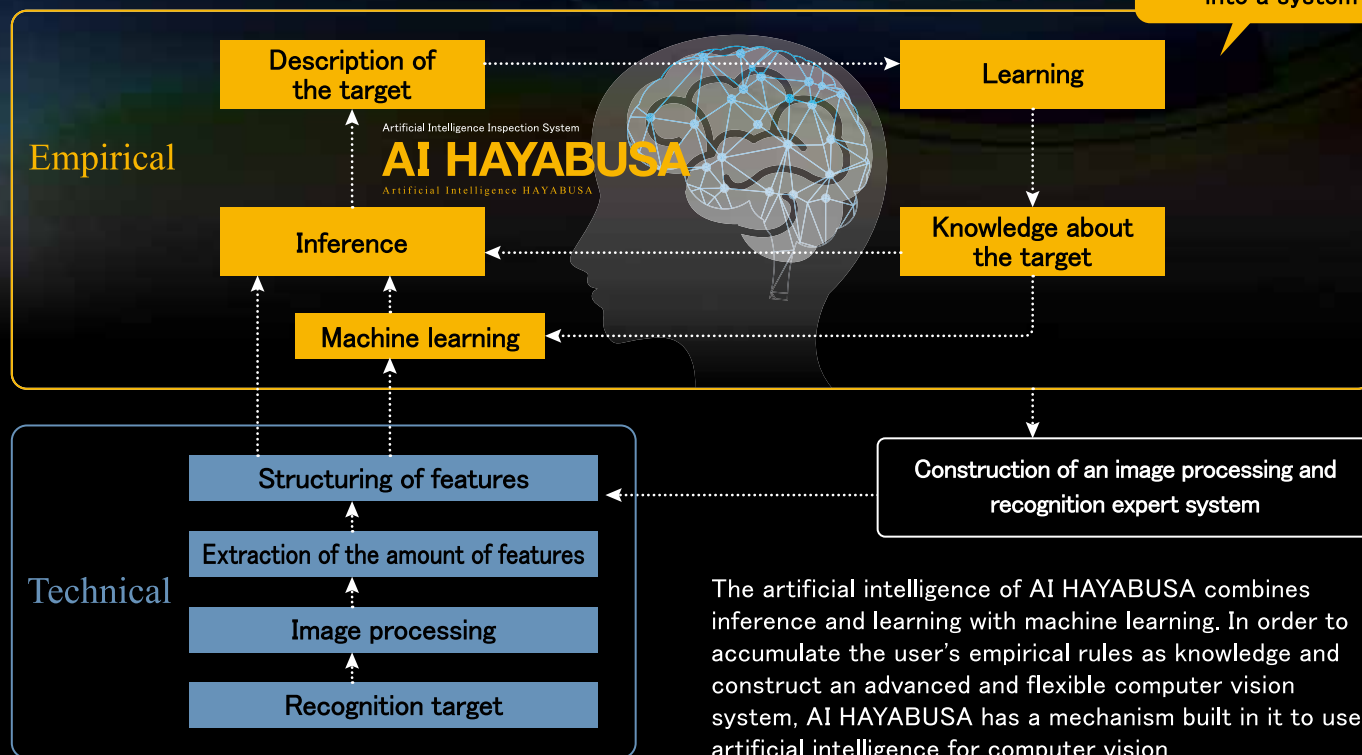
When you need to conduct inspections that are more accurate and more flexible than those available with the conventional image processing system, the supervised learning capability optimizes the recognition level in order to cope with problems.



AI HAYABUSA keeps evolving by experiencing and learning.

It features a groundbreaking tool that allows a high-accuracy image processing system to be built with ease through artificial intelligence (AI).

AI HAYABUSA integrates the empirical processes into a system



The artificial intelligence of AI HAYABUSA combines inference and learning with machine learning. In order to accumulate the user's empirical rules as knowledge and construct an advanced and flexible computer vision system, AI HAYABUSA has a mechanism built in it to use artificial intelligence for computer vision.

Examples of an image processing system

Flat surface measurement

Through integrated shape recognition involving edge processing (division, junction, classification, and approximation) and flat surface measurement, the system can recognize basic shape elements such as arcs and lines. Moreover, by recognizing the shape (circle, line, triangle, rectangle, etc.) from the spatial relative positions of the recognized basic shape elements, it can measure the shape base with sub-pixel accuracy.



Blob analysis/morphology

In addition to dynamic thresholding that is resistant to brightness unevenness, a rich set of thresholding functions, functions for connected region extraction, division, and integration, and shape feature value calculation functions is supported to enable high-speed and robust blob analysis. As for morphology, operations such as expansion/contraction and opening/closing can be performed at high speed for binary images and gray images.

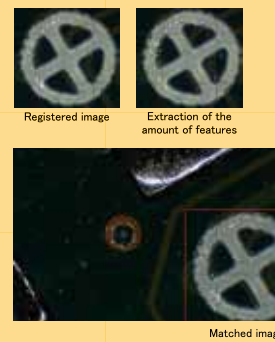


Matching

In addition to high-speed template-based matching that supports rotation, robust shape-based matching capability is provided to respond to changes in shape such as rotation, scaling, lighting change, and local concealment. Moreover, a matching scheme based on feature points of the target object allows robust matching for rotation, scaling, and distortion.

Pattern matching

Pattern matching is done using various matching technologies including pixel-based normalized correlation, histogram-based matching, and shape matching insusceptible to the impact of rotation, scaling, concealment, etc. Moreover, a function is supported that performs matching by extracting the amount of features from a part of the image.



Character recognition/character collation

Image processing capability to learn and recognize characters of all fonts allows you to build a unique character recognition and collation engine, which enables high-speed, high-accuracy character recognition and collation.

Machine vision (shape recognition)

Shapes made up of a combination of geometric shapes, such as lines, arcs, triangles, and rectangles, can be recognized.

Functions of the basic unit

Function name	Description	
Filtering and conversion	Image enhancement	Contrast, shading correction, scaling, and histogram normalization
	Smoothing filter	Edge data retention, Gaussian, average, noise removal, and rank
	Edge filter	Canny, Prewitt, Sobel, Laplace, Gaussian, and Cross
	Image inpainting	Image restoration using Inpaint
	Arithmetic operation	Scaling, four arithmetic operations, absolute value, maximum, minimum, square root, triangular, exponential, logarithmic, and power
	Color conversion	Transformation of color spaces
	Fourier transformation	Ultra-high-speed FFT, bandpass, low pass, high pass, energy, and phase
	Hough transformation	Lines and circles
	Other filters	User-defined filter, PCA, and Gaussian pyramid
Shape feature amount calculation	Dimensions, center of mass, angle, roundness, compactness, contour length, elliptical shaft, moment, eccentricity, and outline (polygon, circle, or rectangle)	
Flat surface measurement	Combined shape recognition involving edge processing (division, junction, classification, and approximation) and flat surface measurement, recognition of basic shape elements such as arcs and lines, calculation of the shape base with sub-pixel accuracy, and recognition of the shape (circle, line, triangle, rectangle, etc.) from the spatial relative positions of the basic shape elements	
Blob analysis	Thresholding	Local, hierarchical, and automatic
	Region processing	Connection, intersection, differential, sum/difference/complement set, contour inclusion, padding, and region generation
	Gray value processing	Maximum, minimum, average, dispersion, histogram, entropy, and moment
	Region shape features	Various types of statistical processing for the shape feature amount
Segment	Threshold processing	Color threshold processing and automatic threshold processing
	Region expansion	Gradient, average, color, and texture
	Clustering	Neural network, support vector machine, and k-nearest neighbor algorithm
	Graph cut	Segments according to graph identity on the image
Morphology	Operations such as expansion/contraction and opening/closing for binary images and gray images	
Geometric transformation	Rotation, scaling, parallel movement, mirroring, clipping, affine transformation, transparent transformation, and polar coordinate expansion	
Matching	Template-based, shape-based, and feature point-based	

Functions of the advanced unit

Function name	Description	
Image enhancement	Focus	Focus synthesis across the entire region
	Visual field range	Image connection and Pixelization
	Dynamic range	High dynamic range synthesis
3D image processing	3D image construction using multiple images having different focal positions, height measurement, thresholding, labeling, blob analysis, volume measurement, pasting, and shape comparison	
Image discrimination	Base classifying tool, k-nearest neighbor algorithm, support vector machine, decision tree, boosting, random tree, EM algorithm, MT method, and neural network	
Artificial intelligence capability	Optimization of shooting conditions, selection of the image feature amount, and automatic determination of the image judgment method	

※Subject to change or revision without prior notice.

3D shape measurement

This function measures the 3D shape of an object at high speed and high resolution. The high-speed processing of the micron image of the object enables highly accurate measurement. The edges of a line or arc can be detected with sub-pixel accuracy.

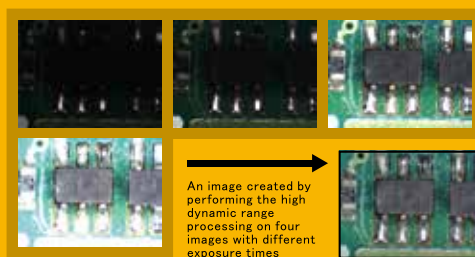
① Focus enhancement

From multiple images of an object with an irregular surface, each having a different focal position, an image can be synthesized that is in focus across all the regions.



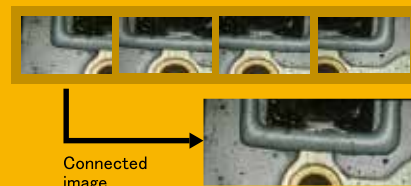
② Dynamic range enhancement

By constructing a high dynamic range image from multiple camera images with different exposure times, an image of an object that is excellent in color and contrast can be provided even when the reflectivity of the object greatly differs.



③ Visual field enhancement

This function connects multiple images while maintaining their continuity. To create an image of a wide range at high resolution requires connecting multiple images. In this case, the image processing for maintaining the continuity of the image boundaries is performed to provide a sharp connected image.



Automatic judgment function

This function examines and compares various feature amounts with workpieces that are preregistered as conforming and non-conforming products. It implements automatic judgment of workpieces with high accuracy, based on criteria equivalent to those used when a human operator performs a visual inspection, by using the MT method of quality engineering and AI capability.

Barcode reader

1D and 2D barcodes printed at multiple locations can be read at the same time automatically. The AI capability enables barcodes to be read quickly with high accuracy.

AI HAYABUSA can be customized to suit diverse applications. You can use this system in any way that meets your needs.

Our system can be applied to accommodate a vast range of needs in various fields of industry including electrical manufacturing, electronics, machinery, metal processing, auto, healthcare, food, textile, security, and services.

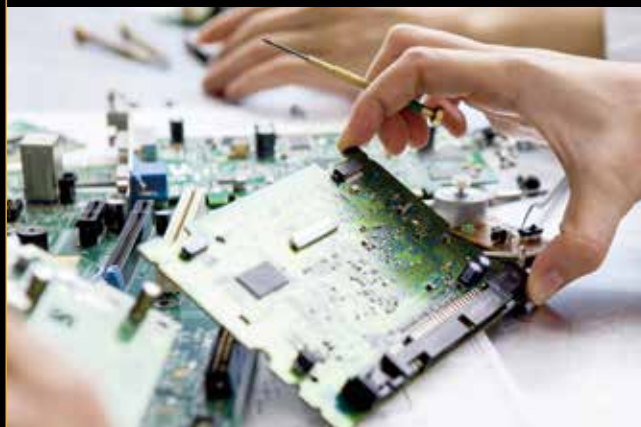
Judgment acceptance system for electronic parts

The shapes of and characters on discrete parts, SMT parts, parts having special shapes, etc. can be recognized and judged at high speed with high accuracy.



Board tester unit

A variety of parts, from very tiny parts to tall ones, can be inspected to see whether there are any missing parts, wrong parts, displaced parts, unsoldered parts, etc. as well as to check inversion, polarity, etc.



Automatic abrasion measurement for cutting tools

The change in the abrasion loss over time relative to the cutting time is measured to estimate the lives of cutting tools, etc. The abrasion condition of the tip of the tool can be checked without stopping the machine.



Automobile production line

Fine scars and coating defects such as uneven coating can be detected reliably.



Drip container packaging bag label inspection line

The barcodes and characters printed on a curved, irregular, or diffusely reflecting surface can be recognized and collated accurately.



Blood cell sorter

The positions, numbers, and shapes of various cells and organisms such as viruses are detected and classified and their information is displayed, stored, and transmitted.



Foreign substance removal line

In the food industry, for example, the system can be used to detect such foreign matters as wood chips, stones, hairs, lint, bits of plastic, paper, and metallic objects.



Food container inspection line

The main body, cap, label, and other parts of each food container are checked to detect attached foreign matters, scars, and dirt.



Fabric and textile inspection line

Defects such as attached foreign matters, dirt, protruding threads, missing threads, and displaced threads are detected reliably.














Suspicious individual/license plate analysis unit

In the field of security, the system can be used to analyze suspicious individuals and license plates. In the service industry, the past information can be retrieved instantaneously to obtain analysis data.



The number of possible combinations is unlimited. AI HAYABUSA offers an ever-expanding potential.

The system can be customized flexibly as appropriate for the application, regardless of the type of industry.

Auto industry 	Semiconductor industry 	Electric industry 	Metal processing industry 	Film industry 	FPD industry 
Food industry 	Healthcare industry 	Pharmaceutical industry 	Printing industry 	Lumber industry 	etc...

Examples of application for reference

The system can handle any type of workpiece.

- ☐ Visual inspection of workpieces prone to human errors, calculation of areas in X-ray images, etc.



•LCD panels •Film •LCD glass
•LCD glass components
(Polarizing film, light guide panel, diffuser panel, color filter, etc.)



•Compresses,
etc.



•Sealants,
etc.



•Syringes,
etc.

- ☐ Automotive parts, cold forged parts, pipes, etc.

Inspections of burrs, scratches, indentations, cracks, uneven coating, white spots, dark spots, units, panels, edges, etc.

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