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Machine Vision Solutions

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Machine Vision Introduction

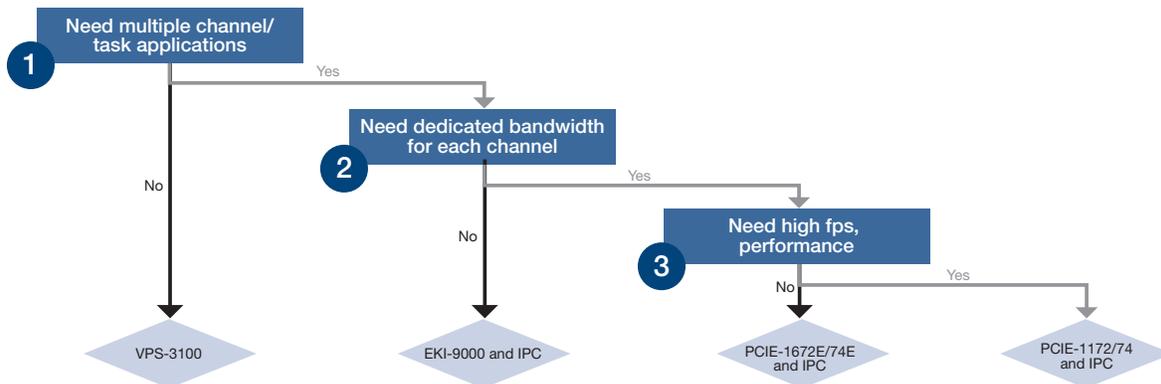
Introduction

Machine vision is used in all kinds of manufacturing, from food beverage, pharmaceuticals, automotive, semiconductor, to general manufacturing. Human inspection is too slow and unreliable for today's demanding manufacturing processes, so replacing human inspection with machine vision can go a long way to automating factory operations. Major applications are quality assurance, production automation, and identification.

The scope of the factory will change dramatically, not only in its the ability to produce, but the ability to produce with the most flexibility and efficiency. Machine vision plays an important role in achieving 100% quality control in manufacturing, reducing costs, increase flexibility, and ensuring high levels of customer satisfaction.

A move from analog to digital is necessary, and GigE Vision has become the most used interface in this market. Advantech provides high performance GigE Vision solutions, an open PC-based architecture that includes industrial cameras, computing platforms, and frame grabbers for the traceability, alignment, identification and inspection to fulfill all the requirements for versatile machine vision applications.

Selection Guide



Application Stories

Backend semiconductor packaging inspection machines

The semiconductor industry has some of the most demanding applications, requiring a combination of extreme accuracy and precision combined with high throughput. Fast progress towards greater densities and finer dimensions are pushing the limits of optical vision systems for product packaging machines. Advantech offers an intelligent GigE Vision frame grabber, DSP-based multi-axis motion control card, and compact modularized system for direct integration in space limited machines to accomplish high-precision, high productivity IC packaging inspection. The solution uses Advantech's PCIE-1174, a 4-port PCI Express Intelligent GigE Vision Frame Grabber industrial grade computer. PCIE-1174 includes a dedicated FPGA (Field Programmable Gate Array) chip to reconstruct images before transmitting them in real time to the host PC via DMA (Direct Memory Access). This frees up the host PC's processor and ensures there are no frame or packet losses during image acquisition.

Improving fabric quality in textile industry

Textile manufacturing is a very complex process. Weaving is the most basic process which involves interlacing a set of vertical threads (called the warp) with a set of horizontal threads (called the weft). This new optical web inspection system could detect warp and weft thread breaks in than less one second. Advantech provided UNO-3283G, an Intel i7 Fanless Automation Computer with 2 x GbE, 2 x mPCIe, HDMI, and DVI-I. We also provided PCIE-1172, a two channel intelligent GigE Vision frame grabber which included a dedicated FPGA (Field Programmable Gate Array) to reconstruct images before transmitting them in real time to the host PC via DMA (Direct Memory Access). To further aid installation and maintenance, the series included PoE (Power over Ethernet) and the Ad Hoc protocol which, like DHCP, doesn't require a specific IP address and enables System Integrators (SI) to simply plug their cameras in and start recording.

Implementing product traceability in food & beverage

As the market demand for food safety increases, traceability is getting more attention, as well as product packaging. One of the world's leading providers of beverage containers wanted to identify the bar codes, characters, and numbers on the ink-jet printing labels at a 7 unit per second run rate. Advantech provided multiple cameras linked to a PC-based automated optical identification system that could identify the bar code, data code, and characters on the beverage container. The system consisted of: AIIIS-1240, a 4-ch PoE compact vision system with Intel® Core™ i7 CPU; Inspector Express, a graphical user interface machine vision application software specifically designed to simplify the design and deployment of automated inspection on the factory floor; and QCAM-GM0640-120CE, 0.3 Megapixel industrial camera with the PoE (Power over Ethernet) to simplify installation and maintenance.

Vision system and robotics ensure finished product quality in automotive industry

In the automotive industry, quality control is an extremely important issue. Most of time, there are engineers to verify vehicle interiors and exteriors, including dashboards, doors, seats, engines, and paint finishes. In one of the largest global automotive groups, there are over 100 items in the finished product check list and this client was looking for a quality checking system that could perform automatic inspection. To automate quality checks on different parts in different vehicles, a flexible and extensible system had to be created.

System integrators designed an AOI (Automated Optics Inspection) system with multiple-cameras and robots for high flexibility and efficiency. For this project, Advantech offered PCIE-1674E, a four channel GigE Vision frame grabber and QCAM-GM2500-014CE, a 5.0 Megapixel industrial camera including PoE (Power over Ethernet) function to simply installation and maintenance. Besides these, there were other products to help provide the client with their desired functionality: UNO-3283G, which is an Intel i7 Fanless Automation Computer with 2 x GbE, 2 x mPCIe, HDMI, DVI-I; and PC-1756, a 64-ch Isolated Digital I/O PCI Card.

Vision at the Edge

One-Stop Solution Simplifies Your Vision System Deployment

Even though machine vision is superior in terms of accuracy, reliability, and efficiency when compared to a manual approach, some manufacturers still hesitate to adopt these kind of applications. There are several reasons for this: long system development times; compatibility issues integrating hardware components; and issues with maintenance and inspection that cannot be customized to specific needs. So companies are reluctant to make a move due to these concerns—causing them to miss out on opportunities.

Advantech's solution uses an intelligent inspection system which integrates an industrial camera, processing unit, and application software. This total solution integrates the entire process—from image sensing, image acquisition to application software—to simplify the project development process and allow for the rapid completion of machine vision inspection, without any coding, via an easy-to-use program. This significantly reduces system implementation time and subsequent maintenance costs. In doing so, Advantech helps users effectively realize the automated inspection of production lines.

Advantech Machine Vision Edge Solution Architecture

Applications	 Traceability Trace & Trace	 Efficiency Guidance	 Flexibility Gauge	 Accuracy Inspection	 Quality Identification																												
Application Software	<h2 style="color: green;">VisionNavi</h2> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th colspan="2" style="background-color: #008000; color: white;">Algorithm</th> <th colspan="2" style="background-color: #008000; color: white;">Script</th> <th colspan="2" style="background-color: #008000; color: white;">Image Preprocessing</th> </tr> <tr> <td> <ul style="list-style-type: none"> Alignment Code reading OCR & OCV Recognition </td> <td> <ul style="list-style-type: none"> Measuring Comparison Inspection </td> <td> <ul style="list-style-type: none"> Conditional operator Arithmetic Logical operator </td> <td> <ul style="list-style-type: none"> Conditional operator Comparison operation String operation </td> <td> <ul style="list-style-type: none"> Filtering Color extraction Color conversion Mirroring, rotation </td> <td> <ul style="list-style-type: none"> Scaling Calibration Shape correction </td> </tr> <tr> <th colspan="2" style="background-color: #008000; color: white;">G.U.I</th> <th colspan="2" style="background-color: #008000; color: white;">Communication</th> <th colspan="2" style="background-color: #008000; color: white;">Database & Storage Services</th> <th colspan="2" style="background-color: #008000; color: white;">Image Aca.</th> </tr> <tr> <td colspan="2"> <ul style="list-style-type: none"> Graphical, flow chat Development & run-time </td> <td colspan="2"> <ul style="list-style-type: none"> Ethernet PLC </td> <td colspan="2"> <ul style="list-style-type: none"> CSV Image archive </td> <td colspan="2"> <ul style="list-style-type: none"> GigE vision USB vision </td> </tr> </table>					Algorithm		Script		Image Preprocessing		<ul style="list-style-type: none"> Alignment Code reading OCR & OCV Recognition 	<ul style="list-style-type: none"> Measuring Comparison Inspection 	<ul style="list-style-type: none"> Conditional operator Arithmetic Logical operator 	<ul style="list-style-type: none"> Conditional operator Comparison operation String operation 	<ul style="list-style-type: none"> Filtering Color extraction Color conversion Mirroring, rotation 	<ul style="list-style-type: none"> Scaling Calibration Shape correction 	G.U.I		Communication		Database & Storage Services		Image Aca.		<ul style="list-style-type: none"> Graphical, flow chat Development & run-time 		<ul style="list-style-type: none"> Ethernet PLC 		<ul style="list-style-type: none"> CSV Image archive 		<ul style="list-style-type: none"> GigE vision USB vision 	
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Edge Computing	HMI  TPC-B500 / PPC-6151C		Industrial PC  MIC-770		 AIIS-3410		 UNO-2484G		Automation Controller  AMAX-5580																								
Sensing	 QCAM, 2.0MP, Mono		 QCAM, 5.0MP, Mono		 QCAM, 2.0MP, Color		 QCAM, 5.0MP, Color																										

👉 VisionNavi

Advantech VisionNavi is a programmable machine vision software that facilitates development of menu-driven user interface and helps deploy multiple tasks. It supports a wide range of Advantech industrial PCs and cameras, provides easy system installation and project development while reducing maintenance costs. It is suitable for automated applications aimed at defect inspection and quality assurance which need different conditional branches, steps or loops to complete each task. Any programmer can easily configure each process and determine the next action depending on the results, while the results can be inherited to the next step and become the reference or parameters for that process.

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- 7 DAO and Communication Gateways
- 8 Industrial Communication
- 9 Remote I/O, Wireless Sensing Modules and Converters
- 10 Intelligent Motion Control Solutions
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Machine Vision Solutions Selection Guide

Intelligent Inspection Systems



Model Name		AIIS-1200P	AIIS-1200U	AIIS-5410P
Form Factor		Compact	Compact	Compact
Processor System	Chipset	-	-	QM170
	CPU	Intel Braswell N3160/N3710 SoC	Intel Braswell N3160/N3710 SoC	Intel Core i7-6822EQ/i5-6442EQ
	Core	4	4	4
	Cache	2 MB	2 MB	8MB
Graphics	Memory	DDR3L 1600 Onboard 8 GB	DDR3L 1600 Onboard 8 GB	Dual Channel DDR4 1866/2133 MHz SODIMM (non-ECC) Max. 32 GB
	Graphics controller	Integrated Intel HD Graphics	Integrated Intel HD Graphics	Integrated Intel HD Graphics
Expansion	VRAM	Shared system memory is subject to OS	Shared system memory is subject to OS	Shared system memory is subject to OS
	PCIe x16	-	-	-
	PCIe x8	-	-	1
	PCIe x4	-	-	-
	PCI*	-	-	1 x riser card
	mini PCIe	1	1	1
Storage	HDD Bay	1 x internal 2.5" HDD bay	1 x internal 2.5" HDD bay	2 x internal 2.5" HDD bay
	mSATA	1	1	1
	CFast	-	-	1
	RAID	-	-	RAID 0/1
Ethernet	Ethernet interface	10/100/1000 Mbps	10/100/1000 Mbps	10/100/1000 Mbps
	Controller	1 x Intel I210	1 x Intel I210	2 x Intel I210
Machine Vision Connector	Interface	2-ch PoE	2-ch USB 3.0	4-ch PoE
	Controller	Intel I210	Renesas uPD720202	Intel I210
Front I/O	Display	VGA	VGA	VGA + DVI-D
	LAN	1	1	2
	USB	2 x USB 3.0	2 x USB 3.0	8 x USB 3.0
	COM	1 x RS-232/422/485 1 x RS-232	1 x RS-232/422/485 1 x RS-232	-
	PS/2	-	-	-
	Audio	-	-	Line out/mic in
	Digital I/O	8 channels (isolated)	8 channels (isolated)	8 channels
Rear I/O	Display	1 x DP	1 x DP	-
	LAN	-	-	-
	USB	2 x USB 3.0	2 x USB 3.0	-
	COM	-	-	2 x RS-232/422/485
	PS/2	-	-	-
	Audio	Line out/mic in	Line out/mic in	-
	Digital I/O	8 channels (isolated)	8 channels (isolated)	8 channels
Watchdog Timer Output	Output	System reset	System reset	System reset
	Interval	Programmable 1 ~ 255 s/min	Programmable 1 ~ 255 s/min	Programmable 1 ~ 255 s/min
Power Supply	Output Wattage	-	-	-
	Input Range	9 ~ 36 V _{DC}	9 ~ 36 V _{DC}	9 ~ 36 V _{DC}
	Remote Power Switch	1	1	1
Cooling	System Fan	-	-	-
	Air Filter	-	-	-
Physical Characteristics	Dimensions (W x H x D)	137 x 58 x 118 mm (5.39" x 2.28" x 4.65")	137 x 58 x 118 mm (5.39" x 2.28" x 4.65")	235 x 88 x 188 mm (9.25" x 3.46" x 7.4")
	Weight	1.1 kg	1.1 kg	2.9 kg

✓ : supported, - : not supported, △ : optional



Model Name		AIIS-3400P	AIIS-3400U	AIIS-3410P	AIIS-3410U
Form Factor		Compact	Compact	Compact	Compact
Processor System	Chipset	H110	H110	H110	H110
	CPU	Intel 6th/7th generation Core i CPU (LGA1151)			
	Core	Max.4	Max.4	Max.4	Max.4
	Cache	Max. 8 MB	Max. 8 MB	Max. 8 MB	Max. 8 MB
	Memory	Dual channel DDR4 1866/2133 MHz (non-ECC) SODIMM Max. 32 GB	Dual channel DDR4 1866/2133 MHz (non-ECC) SODIMM Max. 32 GB	Dual channel DDR4 1866/2133 MHz (non-ECC) SODIMM Max. 32 GB	Dual channel DDR4 1866/2133 MHz (non-ECC) SODIMM Max. 32 GB
Graphics	Graphics controller	Integrated Intel HD Graphics			
	VRAM	Shared system memory is subject to OS			
Expansion	PCIe x16	-	-	-	-
	PCIe x8	-	-	1	1
	PCIe x4	-	-	-	-
	PCIe x1	-	-	-	-
	PCI*	-	-	1 x riser card (optional)	1 x riser card (optional)
	mini PCIe	-	-	1	1
Storage	HDD Bay	1 x internal 2.5" HDD bay	1 x internal 2.5" HDD bay	1 x internal 2.5" HDD bay	1 x internal 2.5" HDD bay
	mSATA	-	-	-	-
	CFast	1	1	1	1
	RAID	-	-	-	-
Ethernet	Ethernet interface	10/100/1000 Mbps	10/100/1000 Mbps	10/100/1000 Mbps	10/100/1000 Mbps
	Controller	LAN1: Intel i219LM LAN2: Intel i210			
Machine Vision Connector	Interface	4-ch PoE	4-ch USB	4-ch PoE	4-ch USB
	Controller	Intel I210	Renesas μPD720202	Intel I210	Renesas μPD720202
Front I/O	Display	VGA + DVI-D	VGA + DVI-D	VGA + DVI-D	VGA + DVI-D
	LAN	2	2	2	2
	USB	4 x USB 3.0			
	COM	2 x RS-232/422/485	2 x RS-232/422/485	2 x RS-232/422/485	2 x RS-232/422/485
	PS/2	-	-	-	-
	Audio	Line in/line out/mic in			
	Digital I/O	8 Channels (isolated)	8 Channels (isolated)	8 Channels (isolated)	8 Channels (isolated)
Rear I/O	Remote switch	Yes	Yes	Yes	Yes
Watchdog Timer Output	Output	System reset	System reset	System reset	System reset
	Interval	Programmable 1 ~ 255 s/min			
Power Supply	Output Wattage	-	-	-	-
	Input Range	19 ~ 24 V _{DC}			
	Remote Power Switch	1	1	1	1
Cooling	System Fan	1 (6cm / 27.7 CFM)	1 (6cm / 27.7 CFM)	1 (8cm / 57 CFM)	1 (8cm / 57 CFM)
	Air Filter	-	-	-	-
Physical Characteristics	Dimensions (W x H x D)	230 x 70 x 175 mm (9.06" x 2.76" x 6.89")	230 x 70 x 175 mm (9.06" x 2.76" x 6.89")	240 x 97 x 190 mm (9.45" x 3.82" x 7.48")	240 x 97 x 190 mm (9.45" x 3.82" x 7.48")
	Weight	1.8 kg	1.8 kg	2.4 kg	2.4 kg

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Frame Grabber Cards



Model Name		PCIE-1174	PCIE-1672E	PCIE-1674E	PCIE-1182
Power Requirements	Input Voltage	12 V _{DC} direct from PCIe slot, total Max. 18W or AT/ATX system power input			12 V _{DC} direct from PCIe slot, with optional 12 V _{DC} AT/ATX
	Overload Current Protection	Present			
	Connection	AT/ATX Power Jack			
	Output PoE Power	48 VDC PoE Power output, total Max. 18W (total Max. 60W with AT/ATX system power input)			2 port
Environment	Operating Temperature	0 ~ 50°C (32 ~ 122°F)			0 ~ 60°C (32 ~ 140°F)
	Storage Temperature	-20 ~ 80°C (-4 ~ 176°F)			
	Operating Humidity	V _{DC}			
Mechanics	Dimensions (W x D)	185 x 110 mm (7.3" x 3.9")			167 x 68.9 mm, PCIe low profile
GigE Vision	Compatibility	IEEE802.3af			FCC CE Class A
	Speed	1000 Mbps	10/100/1000 Mbps		10,000/5,000/1,000 Mbps
	No. of Ports	4	2	4	2, 10GBASE-T MAC and PHY
	Port Connector	8-pin RJ45			8-pin RJ45 Copper
	Bus Interface	PCI Express® x 4			PCI Express x4 compliant
	Jumbo Frame	9KB			
	GigE Vision Offload Engine	✓	–	–	–
Safety	ESD	8KV (air), 4KV (contact)			8KV (air), 4KV(contact)
	EFT	2 KV			
	Surge Protection	1 KV			
	Isolation Protection	2.5 KV			
Digital Input/Output	No. of Channels	4 input and output	–	–	–
	Input/Output range	0-30V opto-isolated	–	–	–
	Max. frequency	1KHz	–	–	–
	Digital input interrupt	Falling and rising edge, normal and invert	–	–	–

Smart Cameras



Model Number	ICAM-7000
Sensor	<ul style="list-style-type: none"> 1.2MP@54fps , Global shutter, C-mount, Monochrome/Color 2.0MP@60fps or above, Global shutter, C-mount, Monochrome/Color 5.0MP@14fps, Global Rolling shutter, C-mount, Monochrome/Color
Processor	INTEL E3930, Cyclone V5CGTD5
RAM/Storage	4GB LPDDR4/3264GeMMC
Display	DP (USB Type C connector)
LAN, Serial Port	1 x 1000BASE-T (M12 connector)
USB	USB 2.0 (USB Type C connector)
Digital I/O	2 x isolated inputs, 2 x isolated outputs (M12 connector)
Lighting control	PWMx1 (M12 connector)
Power input	12-24V _{DC} (M12 connector)
Dimensions (W x H x D)	95 x 63 x 40.5 mm
Environment & certification	0-50 °C, 5Grms, CE/FCC class A /KCC, IP67
Software	OS: Windows 10 IoT

Industrial Cameras (GigE)



Model Number	QCAM-GM0640-121CE	QCAM-GM0720-290CE	QCAM-GM1300-030CE	QCAM-GM1300-060DE	
Resolution	659 x 494	720 x 540	1294 x 966	1280 x 1024	
Frame rate	134	291	30	60	
Pixel size (µm)	5.6 x 5.6	6.9 x 6.9	3.75 x 3.75	5.3 x 5.3	
Mono/ color	Mono	Mono	Mono	Mono	
Sensor	Company	SONY	SONY	e2v	
	Model	JCX618 replacement	IMX287	ICX445	
	Shutter	Global	Global	Global	Global
	Size	1/4"	1/2.9"	1/3"	1/1.8"
	Type	CMOS			
Input	1				
Output	1				
Power Requirements	PoE or 12 V _{DC}				
Power consumption	2.7 W	2.9 W	2.2 W	2 W	
Lens mount	C				
Size(L x W x H)	42.0 x 29.0 x 29.0 mm				
Weight	90 g				
Operating temp.	0°~50°C				



Model Number	QCAM-GM1600-060DE	QCAM-GM2500-014DE	QCAM-GM3800-010CE	QCAM-GM5400-005CE	
Resolution	1600 x 1200	2590 x 1942	3840 x 2748	5472 x 3648	
Frame rate	60	14	10	5	
Pixel size (µm)	4.5 x 4.5	2.2 x 2.2	1.67 x 1.67	2.4 x 2.4	
Mono/ color	Mono	Mono	Mono	Mono	
Sensor	Company	e2v	Onsemi	SONY	
	Model	EV76C570	MT9P031	MT9J003	
	Shutter	Global	rolling	rolling	rolling
	Size	1/1.8"	1/2.5"	1/2.3"	1"
	Type	CMOS			
Input	1				
Output	1				
Power Requirements	PoE or 12 V _{DC}				
Power consumption	2.1 W	2.2 W	3.3 W	2.6 W	
Lens mount	C				
Size(L x W x H)	42.0 x 29.0 x 29.0 mm				
Weight	90 g				
Operating temp.	0°~50°C				

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Industrial Cameras (USB)



Model Number	QCAM-UC0640-750CE	QCAM-UM0640-750CE	QCAM-UM0720-520CE	QCAM-UC1300-200CE
Resolution	640 x 480	640 x 480	720 x 540	1280 x 1024
Frame rate	751	751	525	203
Pixel size (µm)	4.8	4.8	6.9	3.75
Mono/ color	Color	Mono	Mono	Color
Sensor	Company	Onsemi	Onsemi	SONY
	Model	PYTHON300	PYTHON300	IMX287
	Shutter	Global	Global	Global
	Size	1/4"	1/4"	1/2.9"
	Type	CMOS		
Input	1			
Output	1			
Power Requirements	Via USB3.0 interface			
Power consumption	2.8 W	2.8 W	3 W	3 W
Lens mount	C			
Size (L x W x H)	29.3 x 29.0 x 29.0 mm			
Weight	80 g			
Operating temp.	0°~50°C			



Model Number	QCAM-UM1440-220CE	QCAM-UM2440-035CE	QCAM-UM4000-029CE	QCAM-UM5400-017CE
Resolution	1440 x 1080	2488 x 2048	4024 x 3036	5472 x 3648
Frame rate	227	35	31	17
Pixel size (µm)	3.45	3.45	1.85	2.4
Mono/ color	Mono	Mono	Mono	Mono
Sensor	Company	SONY	SONY	SONY
	Model	IMX273	IMX 264	IMX226
	Shutter	Global	Global	rolling
	Size	1/2.9"	2/3"	1/1.7"
	Type	CMOS		
Input	1			
Output	1			
Power Requirements	Via USB3.0 interface			
Power consumption	3.3 W	2.5 W	3 W	2.9 W
Lens mount	C			
Size (L x W x H)	29.3 x 29.0 x 29.0 mm			
Weight	80 g			
Operating temp.	0°~50°C			