Industrial Equipment Manufacturing Success Cases

- Electronic Manufacturing
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- Components
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- Test and Measurements

ADVANTECH

Enabling an Intelligent Planet

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Founded in 1983, Advantech is a leader in providing trusted, innovative embedded and automation products and solutions. Advantech offers comprehensive system integration, hardware and software, customer-centric design services, as well as global logistics support, all backed by industry-leading front and back office e-business solutions. We cooperate closely with our partners to help provide complete solutions for a wide variety of applications across a diverse range of industries. Advantech has always been an innovator in the development and manufacturing of top-quality, high-performance computing platforms, and our mission is to continue to drive innovation by offering trustworthy automation products and services. With Advantech, there is no limit to the applications and innovations our products make possible.

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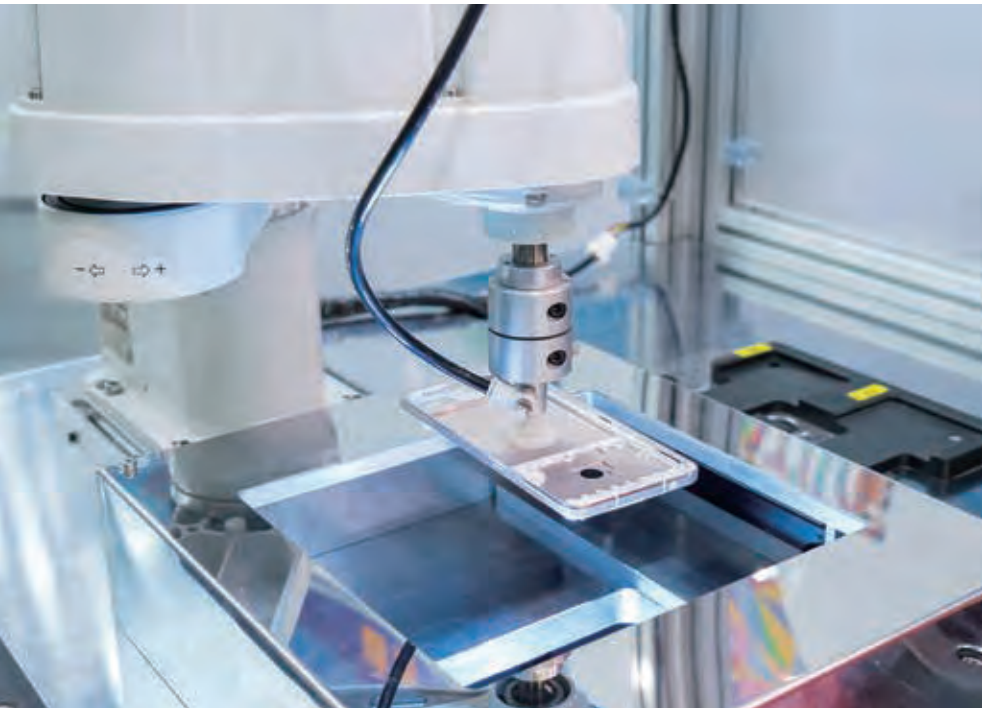
Production Line Solution for Mobile Phone Ceramic Covers



Location: **China**

Background

Ceramic covers have been developed as a new and innovative material for mobile phones. Their production requires complete automation in order to prevent defects during such processes as loading/unloading, polishing, and laminating. Concurrent automated visual machine inspection is also necessary to maximize yield. Demand and production standards are exceptionally high for this market, and thus fully automated around-the-clock production is essential to ensure both production quantity and quality.

System Requirements

Ensuring a highly efficient ceramic cover production system necessitates rapid motor control response. In this case, server request–response times had to be in the microsecond range to support the multi-axis robotic arms in the production line. Because development cycles are short, simple connections were needed in order to reduce assembly times.

With the automated loading/unloading system comprising many cylinders, sensors, and electromagnetic valves, it was essential to have stable, high-speed data acquisition cards with multi-I/O support. Specifically, the system required 108 digital inputs and 96 digital outputs while still conserving PCI slots for the controllers. Because defects are difficult to prevent during production and transportation, machine visual quality inspections are critical for this high-speed production environment, thus requiring high-performance data acquisition cards in addition to cameras with a high frame rate.

Finally, the controls needed to be simple so that operations could be managed via a single platform, thus ensuring efficient development, testing, adjustment, and on-site maintenance. To meet these requirements, the system had to support at least four PCI slots and two PCIe slots, have a high-mid tier processor, and perform reliably over long periods of operation.

Project Implementation

ACP-4020

4U Short Depth Intelligent Rackmount Chassis

AIMB-786

LGA1151 8th/9th Gen. Intel® Core™ i7/i5/i3/Pentium®/Celeron® ATX with Triple Display, DDR4, USB 3.1, SATA 3.0

PCI-1203

2-Port EtherCAT Universal PCI Master Card

PCI-1758UDIO

128-ch Isolated Digital I/O Universal PCI Card

PCIE-1674E

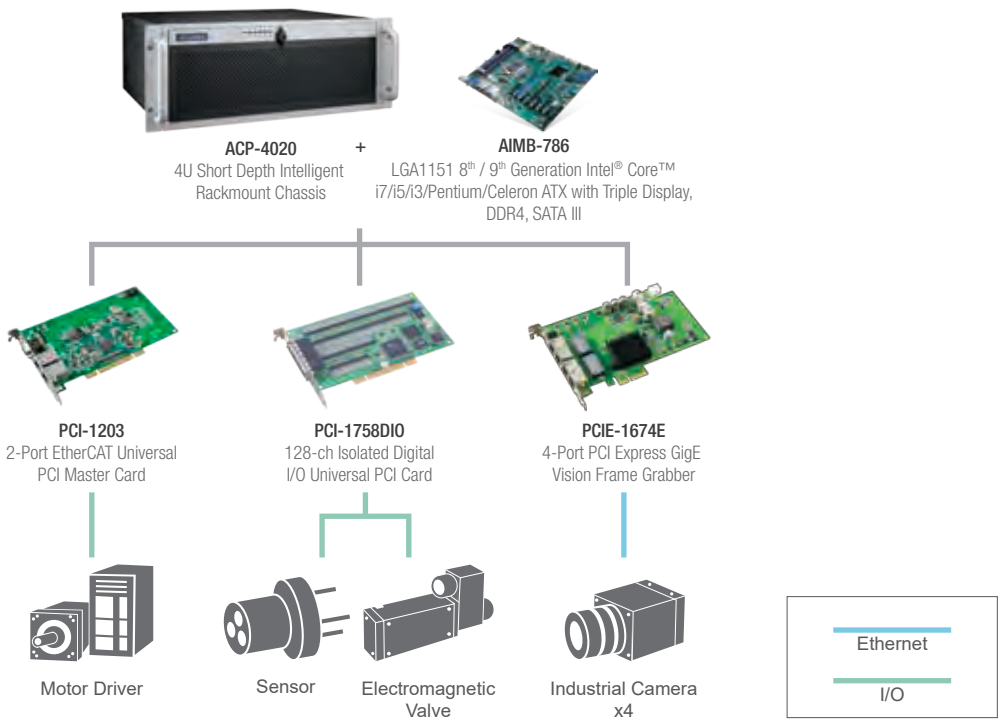
4-Port PCI Express GigE Vision Frame Grabber

System Description

Workflow for the loading/unloading system primarily comprises material loading, visual inspection, and material unloading stages. Upon completion of each process, automated visual inspection is performed to profile the workpieces. Using data signals, the system controls the motors to adjust the workpieces so that they are within the camera range of the next visual inspection machine.

During visual inspection, workpieces are checked for defects, and the corresponding motor control mechanisms are initiated according to whether the results are OK or NG, with OK workpieces proceeding to the next process and NG pieces being removed. The data from visual inspection are later used to generate statistical reports on such parameters as produced quantity, throughput yield, and efficiency. At the material offloading stage, workpieces that meet specification move rapidly along the production line for final packaging.

System Diagram



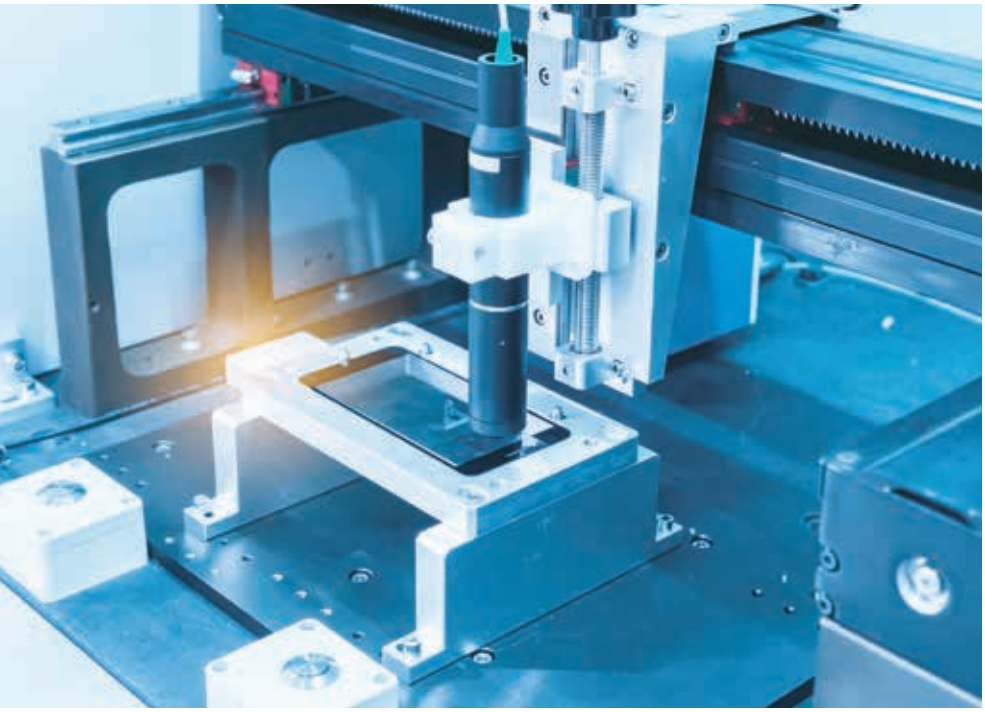
Why Advantech?

Our dedicated research team's extensive experience with motor control applications allowed us to provide professional support for pre-evaluation, sample development, and on-site adjustment.

For motor control, Advantech's PCI-1203 2-port EtherCAT master card was selected because it supports 16 axes that can be assigned to up to five groups, thus enabling automatic operation of the robotic arms on the production line. The card's onboard dual-core 650-MHz Arm® processor makes it optimal for real-time diagnostics, record control, and error management, all of which have made production line maintenance more convenient. Common Motion SDK support also makes it an effective EtherCAT control development platform for accelerating present and future project development. Control of the stack lights, stop buttons, valves, cylinders, sensors, and other auxiliary devices in the production line was achieved with the PCI-1758UDIO digital I/O card. In addition to providing 128 independent channels, this card also offers a high level of ESD protection, digital filtering, and message processing functions, thus providing a high level of control with only a limited number of cards. For image acquisition, PCIE-1674E image acquisition cards were adopted to link cameras for high-speed multi-angle monitoring, and their compatibility with commercial GigE Vision cameras allows for flexibility in camera selection.

Finally, system control was realized with the ACP-4020, which is the world's most popular choice for industrial PCs.

Motor Control Integrated Solution for High-Precision Dual-Channel Adhesive Dispensers



Location: **China**

Background

For manufactured products requiring the application of industrial adhesives, paints, and other liquids, high-precision dispensers are employed to accurately dispense, inject, smear, or drip the substance in specific locations, typically as a point or in a line, circle, or arc. Adhesive dispensers are widely used in electronics, lighting, automotive, power generation, and other industries; in fact, they are one of the most basic types of equipment found in product manufacturing.

However, this type of dispenser technology is far from mature in China, and international brands, whose products generally involve high purchase costs, have a clear monopoly. To help the Chinese market overcome this, Advantech has worked with local smart equipment manufacturers to aid them in realizing a technological breakthrough.

System Requirements

This client's dispensers had three servo motors and three stepping motors. This included an XYZ platform where the Z-axis is an XZ step axillary module and a step control feed axis where the key axis is geared to five other axes.

To accommodate different product heights, dislocation sensors were needed to scan the nozzle height via laser in order to establish dual Z-axis control of the nozzle height. Of particular importance, the dispensing rate and movement speed had to be consistent, thus requiring automated comparative triggers for the adhesive valves.

To meet high-standard industry requirements in terms of precision and speed, particularly given that products tend to be very small, sufficient control needed to be achieved to produce dispersion points as small as 0.15 mm in diameter, line application widths of 0.168 mm, and straight angle turn radius of 0.5 mm, all of which need to be applied at speeds of up to 200 mm/s.

Project Implementation

ACP-4340

4U Intelligent Rackmount Chassis with 4 Hot-Swap Drive Trays

PCE-5131 / PCE-5B12-07

PICMG 1.3 CPU card supporting 8th/9th Generation Intel® Core™ i Processor / 12-slot BP for 14-slot Chassis

PCI-1285

DSP-Based 8-Axis Stepping and Servo Motor Control Universal PCI Card

USB-4716

200 kS/s, 16-bit, 16-ch Multifunctional USB Module

PCI-1761

8-ch Relay/8-ch Isolated Digital Input PCI Card

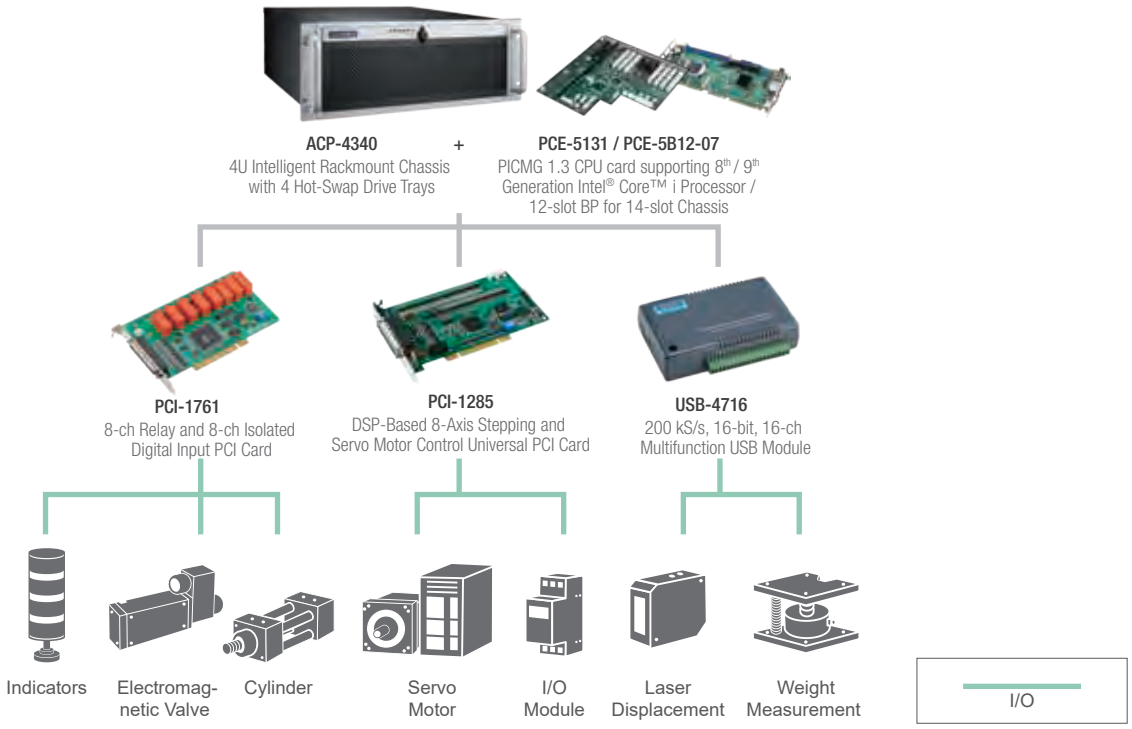
System Description

The workflow of the high-speed, high-precision dual-channel adhesive dispenser is divided into four stages: 1) material loading; 2) adhesive application; 3) weighing; and 4) completion.

At the material loading stage, the USB-4716 analog acquisition card and dislocation sensors are utilized for machine visual inspection, which involves calculating the PCB angle and height of the workpiece. These data are used as inputs to adjust the adhesive dispensers' valves, a process that is handled by the PCI-1285. At the dispensing stage, the adhesives are applied to the PCBs according to the programmed specifications, for which the PCI-1285 is again utilized to execute interpolation and various other functions aimed at axis control. At the weighing stage, the USB-4716 analog USB module determines whether the amount of applied adhesive meets the specified amount.

Finally, workpieces reach the product completion stage when the appropriate amount of adhesive is applied, at which point they are unloaded from the machine.

System Diagram

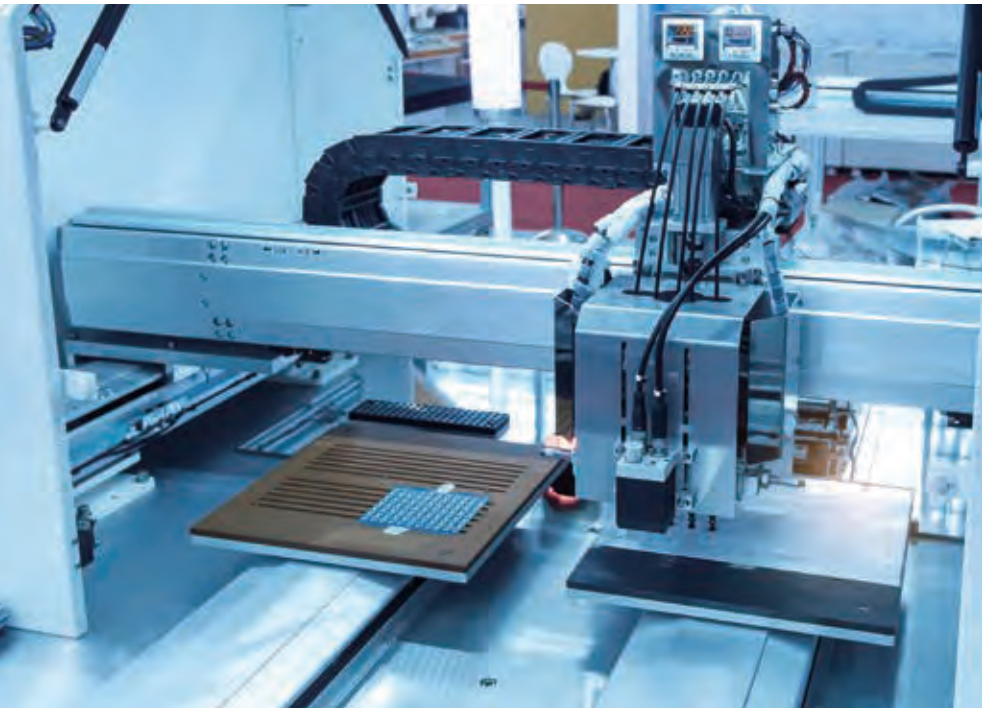


Why Advantech?

Of particular benefit to the customer, the PCI-1285's DSP structure allowed simplified system customization and control of the dual-channel adhesive dispenser. Furthermore, the PCI-1761 and USB-4716 ensured that high-speed and high-precision operation could be maintained in addition to allowing for future expansion while occupying minimal space.

This case shows that with the strong backing of a professional R&D team that is well versed in motor control algorithms and applications, Advantech can provide pre-evaluation, example code for development, and on-site adjustment for our customers.

A FOG Vision Control Solution for an LED Module Production Line



Location: **Korea**

Background

This manufacturer of LED module bonding machines was in the process of developing large vision machines that comprised 17 industrial PCs (IPCs) in a single machine. They had been testing several IPC brands to identify the ideal one that would improve the stability of their machines. Given the number of IPCs in each machine, having compact IPCs was a major priority for their project.

System Requirements

Most mobile devices, tablet PCs, and electric home appliances that use LCD panels are now being designed to use LED screens. In line with this trend, the new generation of mobile phones and tablet PCs produced by the world's most famous mobile phone manufacturer have been designed with LED panels produced by a Korean LED panel manufacturer. To accommodate the multitude of tasks that are typically performed in the manufacturing process, the customer needed to develop large FOG vision machines with 17 IPCs in a single machine. For this, there were several key considerations.

First, the machines required high-performance IPCs with high-end CPUs and four PCIe x4 slots to support up to 12 Ethernet cameras. Second, with 17 IPCs in each machine, it was critical to downsize as much as possible in order to maximize the number of machines that could fit within a limited space. Third, to meet the LED manufacturer's deadline, our customer had to be able to make a rapid transition to mass-production; thus, they preferred to use an IPC that had already been fully verified by their R&D and QC teams. Finally, because the display company had decided to expand their LED production lines in Vietnam for this project, our customer also had to establish factories in Vietnam to shorten the delivery time and reduce costs. Therefore, having access to local technical and RMA services was critical.

Project Implementation

IPC-7130

Intelligent Wallmount Chassis with Dual Hot Swap Drive Trays

ASMB-786

LGA 1151 Intel® Xeon® E & 8th/9th Generation Core™ ATX Server Board

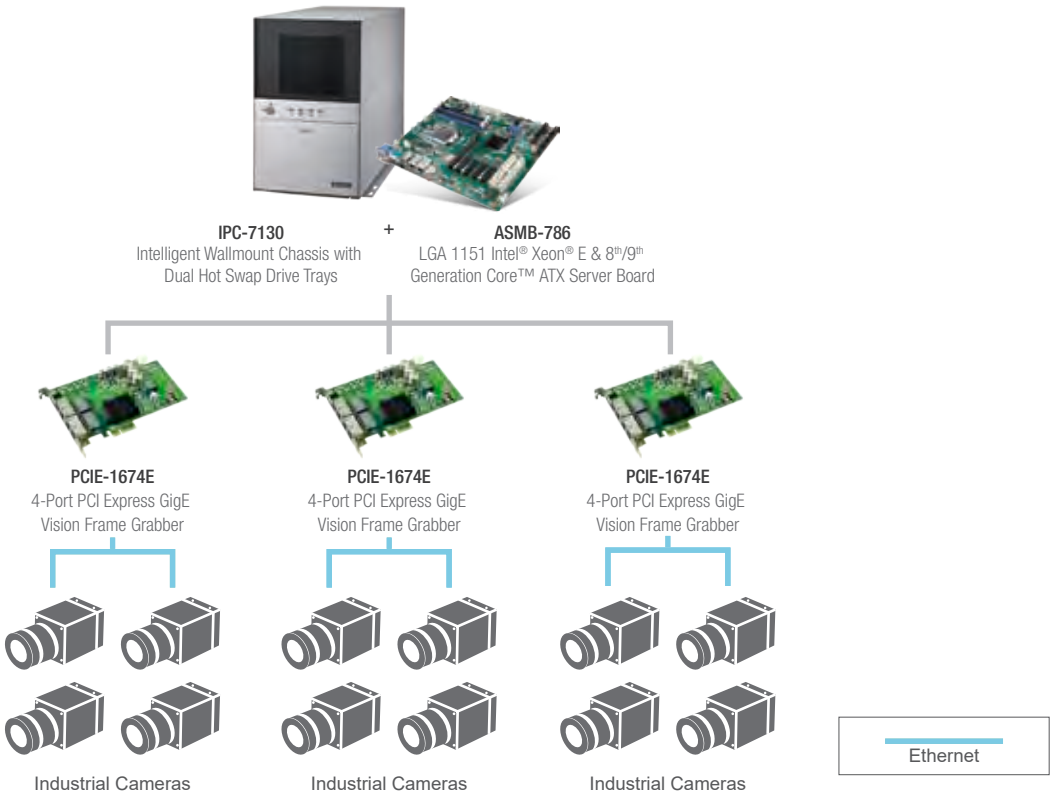
PCIE-1674E

4-Port PCI Express GigE Vision Frame Grabber

System Description

Of particular importance, the system had to be designed to support in-house software for visual analysis of acquired images. The IPC configuration was an ASMB-785 mainboard housed in an IPC-7130 chassis and fitted with a Xeon® E3 CPU. Each IPC had up to three PCIE-1674E PCIe cards, providing PoE for connecting up to 12 cameras for alignment monitoring and workpiece inspection. This design aspect further contributed to the compact design of the system.

System Diagram



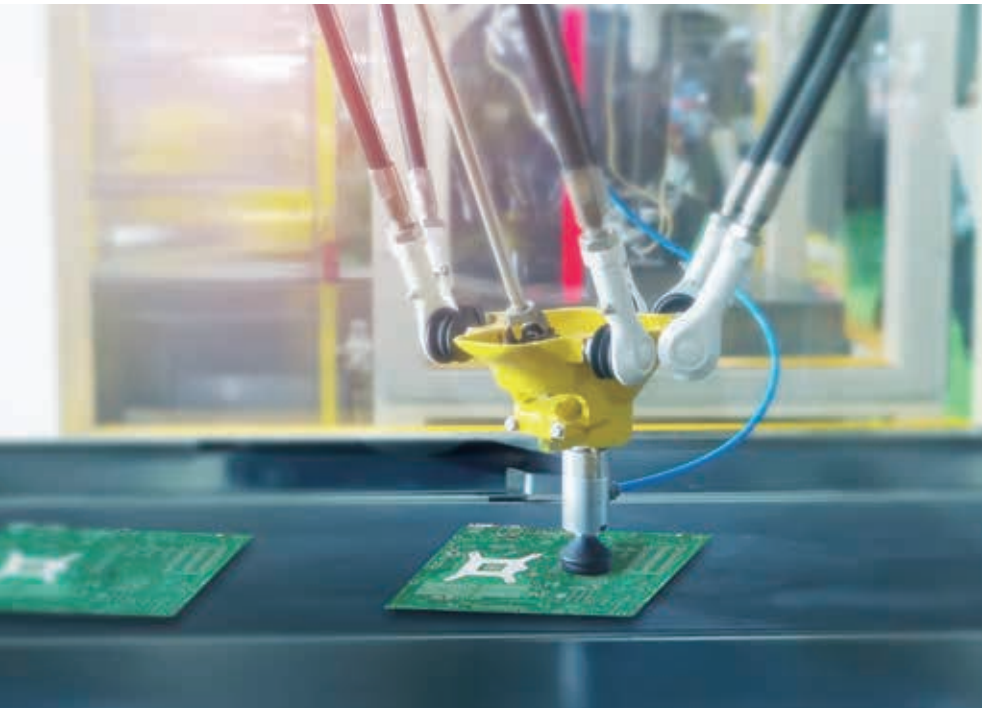
Why Advantech?

In addition to our position as the world's leading IPC manufacturer being a critical consideration in the customer's decision to adopt our system, our IPCs had already been verified by their R&D team and our extensive experience in this field enabled us to immediately offer them a total solution.

Furthermore, by adopting a system from a single manufacturer, the customer had high confidence in the system's compatibility and reliability. We were able to leverage our partnership with a channel partner in Vietnam to provide local technical and RMA services, which was a major factor for the customer's choice of IPC because of its impact in reducing maintenance costs.

Additionally, because of Advantech's aggressive support in maintaining inventory and immediate cooperation for CTOS, we were confident in being able to respond to their tight delivery deadline. For the bottom line, this compact system benefited the customer by providing a stable, high-performance machine at a reasonable price.

Advantech's Multi-Axis Mechanical Arm Control Proposal



Location: **Taiwan**

Background

The enterprise is a leading vendor in high-speed PCB. The automated machinery market has begun to introduce Advantech's high-speed motion modules and integrated visual inspection proposal to meet the growing need to upgrade to automated machinery in following market trend of Industry 4.0. Coupling this technology with secondary development platforms not only enhances the equipment's own operation efficiency but also ensure seamless connection via successful program development, thus solving the typical difficulties involved in multiple system integration and forming a cohesive manufacturing system that is both smart and efficient.

System Requirements

Prior to implementing any upgrades, the enterprise had been developing a controller proposal for over 10 years; however, the system control and function sensitivity had already reached a bottleneck. This was compounded by constant improvements in automated equipment in the industry, which, although offering higher precision and speed control for control systems, had created an ongoing task for integrated mechanical arm solution providers.

The enterprise aimed to redesign a control system, with the objective of at least doubling the original speed without having to extensively modify existing equipment or the control system structure.

Additionally, they sought to easily interface different motor components and integrate visual inspection in order to accommodate future IoT connectivity development opportunities.

Project Implementation

MVP-3245

4-Axis Embedded Motion Controller with 32-ch Digital I/O

QCAM-GM2500

Mega Pixel PoE Industrial Camera

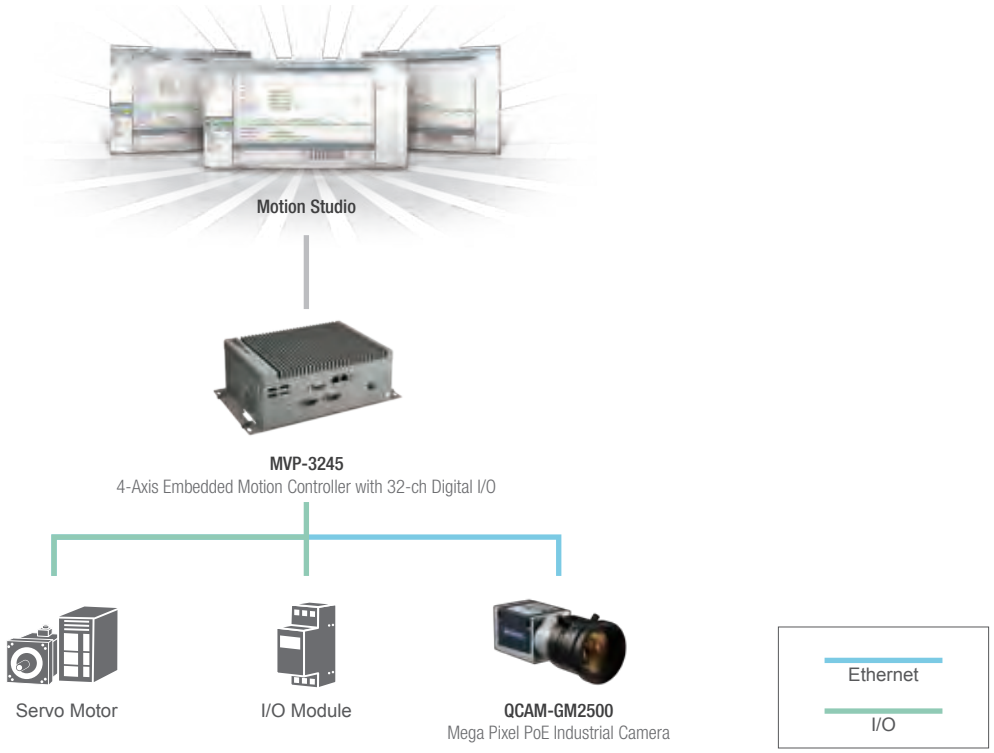
System Description

The MVP-3245 was employed as the interface between the Japanese P brand human–machine interface and Taiwanese/ Japanese system motor driver control. It was employed for system function setting, parameter adjustment, and equipment motion switching. Based on the Motion Studio post software development platform and soft motion control core, the MVP-3245 can realize precise real-time motion control applications in addition to delivering highly efficient development capabilities.

The complete system structure included the MVP-3245, human–machine interfaces, mechanical arms, and the corresponding controllers and camera modules. The MVP proposal enabled lateral connection of the three originally passive systems.

In addition to the value of integration, the derived data enabled the analysis of related program management and prediction of malfunctions, such that preventive diagnostics would be performed. Thus, the enterprise was accurately notified of not only which equipment required preventive maintenance or replacement but also when such actions were required, thus effectively achieving the goal of automated smart equipment.

System Diagram



Why Advantech?

For PCB-related industries, the high precision of Advantech's MVP-3245 programmable 4/8-axis controller can provide equipment vendors and system solution providers a simple and highly efficient programmable industrial management platform. This system allows traditional mechanical plants that use many traditional PLCs to integrate their system and implement Industry 4.0 practices in order to achieve complete integration, from monitoring surveillance to mechanical arm integration and system motor driver integration.

For users in the Network Computer market, Advantech provides basic commands for traditional coding, thus enabling enterprises to accelerate program development for post optimization. We can also provide exceptional compiling and execution speeds for various system structures in different fields.

Solution for Flatness Testing of Automotive Engine Components

Location: **China**

Background

Testing of surface flatness consistency for automotive engine components involves high-precision flatness testing and algorithm-based overall analysis. Utilizing product barcodes, test data are stored in a database for subsequent analysis, thus allowing for significant improvement in the surface flatness consistency of engine components.

Ultimately, this improves engine quality. Regarding the controllers in the desktop instruments used for data acquisition, crucial considerations include size, stability, and cost.

System Requirements

This client, a system integrator experienced with PLC-based devices, initially intended to use PLC-based controllers to develop this project. However, the client faced challenges with controller sensitivity, database access, and third-party device integration. With ongoing advancements in automation equipment, especially with Industry 4.0 and IoT technologies, the client also anticipated test instrument integration. This would allow test data to be uploaded to the cloud for big data analysis.

After several assessments, the client opted for a PC-based architecture over PLC-based controllers. However, unlike PLCs, which use ladder diagrams for programming, PCs use high-level programming languages, which the client was unfamiliar with. Thus, the greatest challenge facing the client was how to apply a PC-based solution to develop testing instruments within the shortest possible time.

Project Implementation

MAS-3245

4-axis Embedded Motion Controller with 32-ch Digital I/O

ADAM-3956

100-pin SCSI DIN Rail Wiring Board

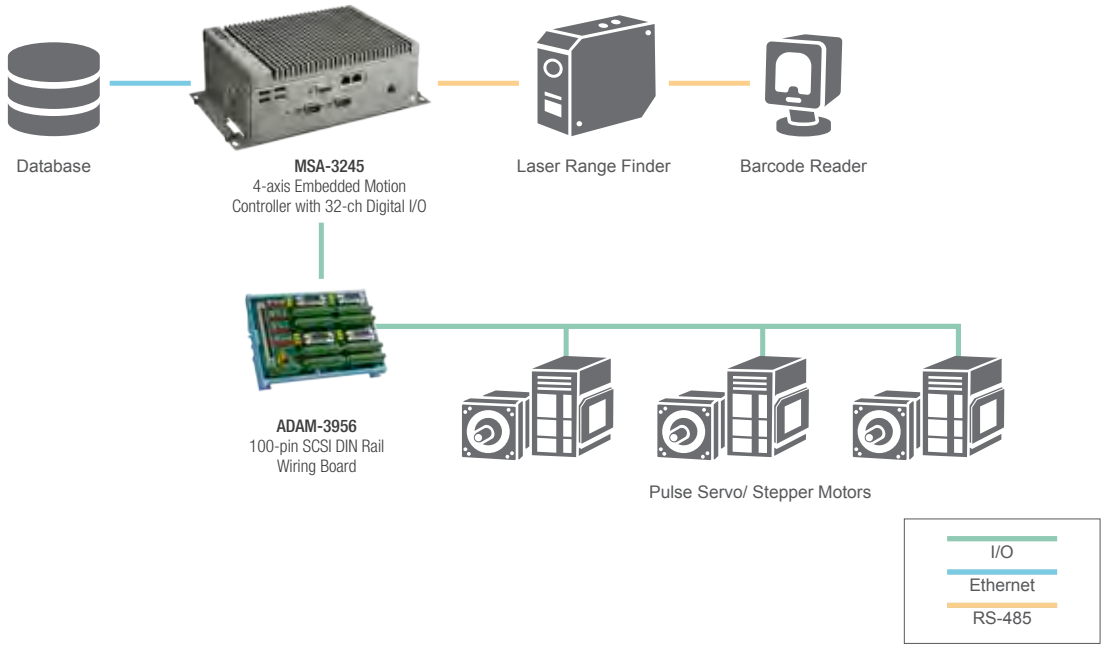
System Description

Advantech's MAS-3245 controller comes embedded with Softmotion Core, which gives the user complex motion control. It utilizes a PC-based open architecture that enables perfect integration of motion control, I/O control, and big data access. Furthermore, the MAS-3245 supports Motion Studio software for automation equipment development, which uses the simple BASIC language in place of more complex high-level programming languages. This means that inexperienced users can still adopt a PC-based solution. Moreover, the MAS-3245 supports by a graphical development environment with detailed instructions for users to rapidly develop automation equipment within a limited time.

Three advantages of using the MAS-3245 are as follows:

1. PC-Based Open Architecture
   PC-based controllers demonstrate high performance in data processing and storage. The MAS-3245 supports small databases, recording of workpiece flatness, and integration of a laser range finder with a barcode reader.
2. Two-Axis Position Comparison Trigger
   The MAS-3245 provides two-dimensional position comparison triggers, which enable on-the-fly testing by triggering the laser range finder set coordinates.
3. Rapid Project Development
   Motion Studio provides a datasheet module for point and data acquisition settings, thus enabling the client to complete this project within two weeks.

System Diagram



Why Advantech?

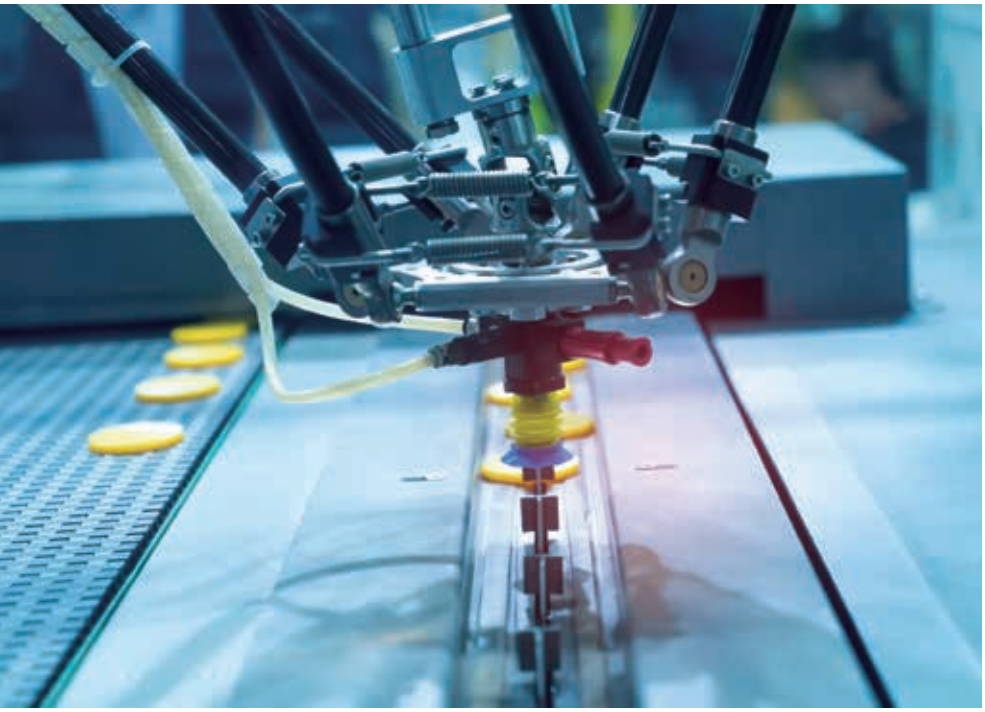
For desktop measurement instruments, the MAS-3245 is small enough (250 x 160 x 85 mm) to be easily placed into a cabinet. The MAS controller provides various communications modules (e.g., series, Modbus RTU/TCP, and TCP/TP) that enable rapid integration with third-party devices such as barcode readers and laser range finders. The MAS solution has specific modules on offer for a wide array of industries and fields. Its two-dimensional position comparison trigger module can trigger the laser range finder in real time to realize on-the-fly testing and enhance the overall UPH.

In addition, the MAS-3245 controller allows users to access databases, record the information and parameters of the components, and connect the controller with the cloud through internet communications, bringing the equipment a step closer to Industry 4.0.

For the desktop measurement instruments, the MAS-3245 is small enough (250 x 160 x 85 mm) to be easily placed into a cabinet. The controller supports various communications protocols (e.g., serial, Modbus RTU/TCP, and TCP/TP), thus enabling rapid integration with third-party devices (e.g., barcode readers, laser range finders).

The MAS solution has many modules on offer for a wide array of industries and fields. Its two-dimensional position comparison trigger module can trigger the laser range finder in real time to realize on-the-fly testing and enhance the overall units per hour. In addition, the MAS-3245 controller allows users to access databases, record the component information and parameters, and connect to the cloud, thus realizing Industry 4.0 in the automotive industry.

Automated Inspection and Sorting



Location: **Singapore**

Background

The client for this project was an American electronics component manufacturer with decades of industry experience that produces magnetic components and inductors widely used in electronic products, medical equipment, and automobiles. With a global customer base, the company relies on production facilities spread across the U.S., Mexico, Scotland, Taiwan, Singapore, China, and Malaysia to rapidly fill new orders. To improve production speed and product quality, automated inspection and sorting systems were recently introduced. The aim was to reduce issues related to manual operations, such as errors and low efficiency, while accelerating inspection speeds to prevent workpiece bottlenecks at inspection points.

System Requirements

The company deployed the first automated inspection and sorting system at its Singapore plant. The new system automatically records inspection data and conducts sorting operations according to the inspection results. Non-defective, degraded, and defective products were routed to different workstations for subsequent handling. To complete the automated processing, the production line integrated with an industrial computer equipped with a signal acquisition card.

The card was used to receive signals from encoders and sensors on the conveyer belt, and transmit trigger signals to the sorter.

Although the company is capable of developing hardware and software solutions, the process of automating operations is quite complex. Therefore, the company required a supplier that would be capable of providing the relevant software and technical support to address multiple function and sequencing issues.

Project Implementation

ACP-4000

4U Rackmount Chassis with Visual and Audio Alarm Notifications

AIMB-785

LGA1151 6th / 7th Generation Intel® Core™ i7/i5/i3/Pentium/Celeron ATX with Triple Display, DDR4, SATA III

PCI-1784U

4-channel, 32-bit Encoder-counter PCI Card with Multi-channel Isolated Digital I/O

DAQNavi

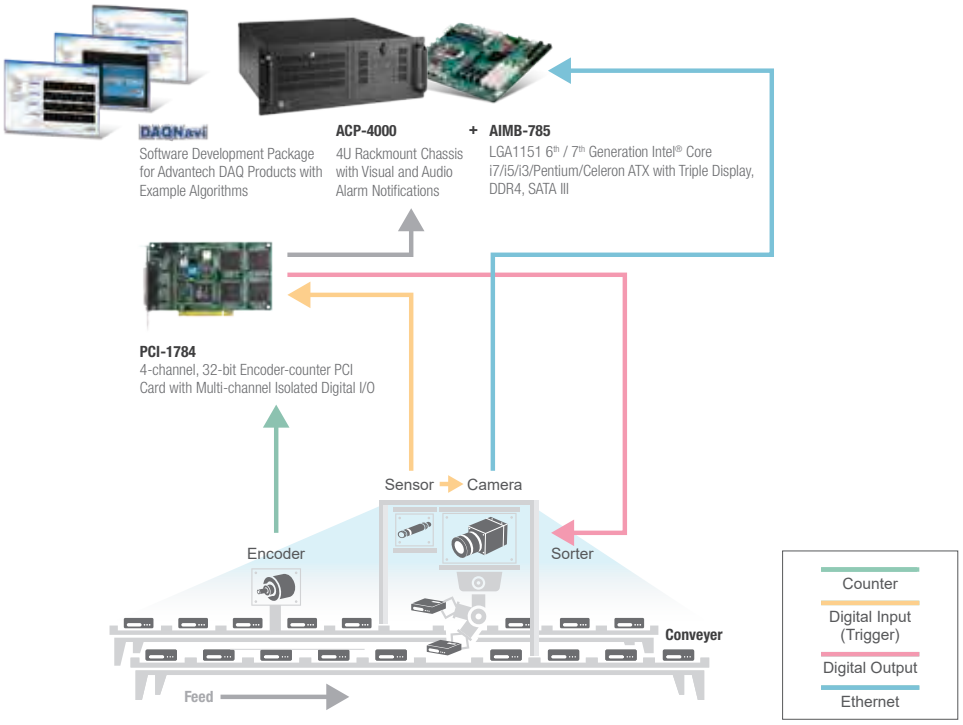
Software Development Package for Advantech DAQ Products with Example Algorithms

System Description

The key components of Advantech's solution were the PCI-1784U card and accompanying DAQNavi software development kit. Regarding the hardware specifications, the PCI-1784U card features a four-channel encoder with corresponding four-channel digital input and four-channel digital output (which enables data from four conveyer belts to be processed simultaneously); input/output signal isolation to protect against interference; a large-volume, 32-bit, 8-MHz counter for recording data at rapid speeds; and input interrupt capabilities. Using the interrupt function, encoder values can be transmitted immediately to the system for location comparisons when external trigger signals are received. This enables more rapid and precise location monitoring.

Regarding the software specifications, because the PCI-1784U card also features a continuous comparison function, a SDK, and example algorithms, it satisfied the functionality requirements for this project. Advantech's DAQNavi SDK contains numerous example algorithms that can be adopted according to specific application needs. However, to ensure easy and convenient implementation, Advantech also provides a set of algorithms related to sequence integration for users to import directly into the application. With these custom algorithms, systems developers only need to modify the parameters before application. Simple, convenient, and easily integrated, the algorithms reduced the time and effort spent on project development.

System Diagram



Why Advantech?

The essential functions of automated inspection and sorting systems include encoder signal receiving, locating, and unit triggering. For this project, Advantech offered a comprehensive integrated software-hardware solution that satisfied the manufacturer's usage requirements. Accordingly, the manufacturer did not incur high initial investment costs for unnecessary functions, nor have to worry that inadequate functions would render the system ineffective. Moreover, with Advantech's technical support, the company was able to cost-effectively develop an appropriate application system.

Advantech's PCI-1784U card and custom algorithms provide practical functionality and widespread applicability for diverse manufacturing facilities. System developers with similar requirements can easily modify the parameters to employ the same example algorithms. Advantech offers integrated solutions that allow companies to maximize production efficiency by automating the inspection and sorting process.

CNC Smart Manufacturing with Edge Solution-Ready Platform

Location: **Taiwan**

Background

Taiwan's machine tool industry ranks fourth in the world in terms of output value. However, the core components and "controllers," known as the brains, of machine tools have long been monopolized by foreign manufacturers. Each controller manufacturer has a unique communication interface, which are often not compatible with components from other brands. Moreover, open software is not available for user upgrades. However, as Industry 4.0 changes the production mode of factories, manufacturers hope to upgrade from automated equipment units to entire smart production plants. The integration of CNC machine tools has now become a major topic in the smart manufacturing field.

System Requirements

In the precision machining industry, CNC machine tools are crucial equipment. Although manufacturers want to produce more precise and complicated parts through automated processes, they often encounter the problem of managing abnormal conditions. In the past, system integration vendors and/or manufacturers had to obtain device information through external sensing devices. Unfortunately, this method requires both taking apart the machines and wiring the units. This frequently results in extended downtime for completing machine networking. In addition, production messages from the old equipment could not be retrieved. This leads to an information gap and spells trouble for the manager.

Customers expect that introducing smart manufacturing solutions allow managers to clearly oversee current production status, reduce uncertainty caused by manual operations or handwritten messages, and promptly respond to equipment conditions over the entire plant—enabling smarter management of production information.

Project Implementation

WebAccess/CNC

ESRP-CNC-UN01372

Equipment connectivity data gateway with WebAccess/CNC, 1 x HDMI, 1 x USB 3.0, 2 x LAN, 2 x COM

WebAccess/SCADA

ESRP-SCA-UN02484

Process Visualization with Modular Box Platform, 4 x GbE, 1 x mPCIe, HDMI, DP

EKI-2525

5FE Unmanaged Ethernet Switch

ADAM-6217

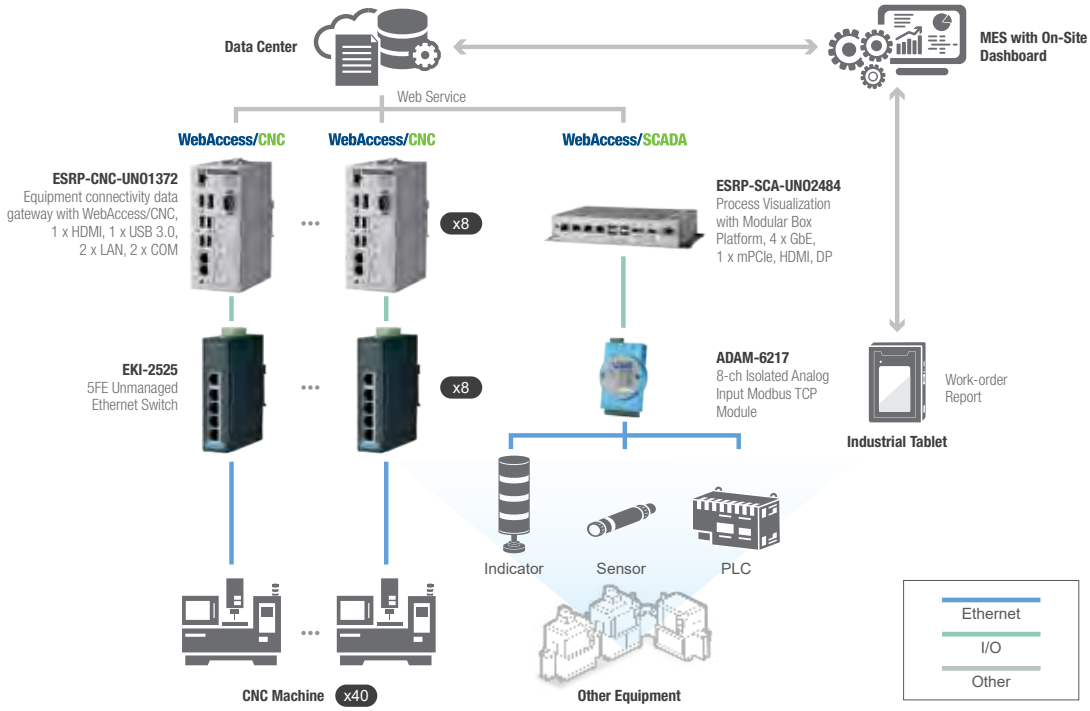
8-ch Isolated Analog Input Modbus TCP Module

System Description

According to the requirements of this project, Advantech's CNC smart manufacturing solution provided related software and hardware products for data collection for individual equipment and for equipment networking of the entire plant. In terms of job scheduling, customers needed mobile timesheets. Advantech used the industrial-grade AIM-65 tablet paired with the ERP vendor's timesheet APP to transmit data back to the MES system in real time to meet the customer's needs. At the equipment end, network protocol and the ADAM-6017 multi-channel isolated thermocouple module were used to collect lighting signal status from the machines. In terms of machine networking, the WebAccess/CNC software, which is preinstalled in edge platform, enabled system integrators to drastically shorten project development time and easily integrated various equipment messages into the entire plant, thereby creating an informative, visualized, and intelligent production management system. This was then integrated with the ERP software to provide on-site factory production status.

Moreover, UNO-1372G-J, the hardware platform, provided a number of excellent features to meet the needs of central machine equipment developers. The platform was compact, convenient, expandable, sturdy, and durable while proving dust and oil-proof. The unit operated effectively under harsh environmental conditions—fully embodying the operating characteristics of the machine tool industry.

System Diagram

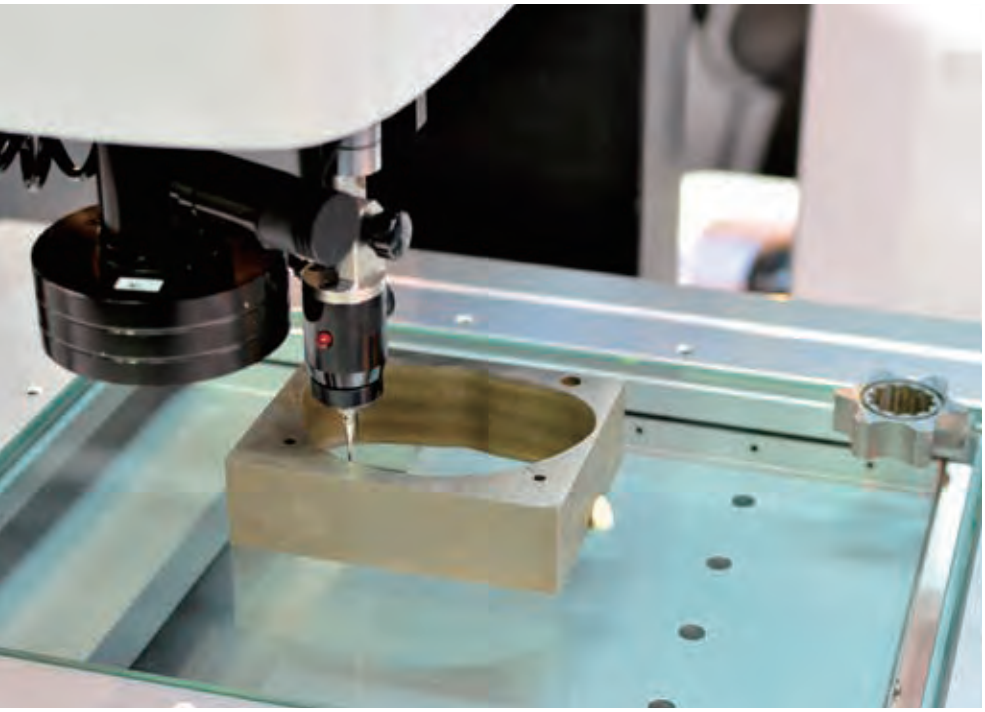


Why Advantech?

This project used the AIM-65 tablet to make mobile timesheets from the manufacturing front end. The CNC equipment was connected through EKI. For non-CNC equipment, the ADAM captured the three-color signal. This data was uploaded to UNO so that WebAccess/CNC could integrate the bottom end equipment, such as machine tools, the human-machine interface, and the I/O device and programmable controller (PLC) in a single remote monitoring platform for unified management. The project performed integration with large domestic ERP vendors to provide customers with complete production information.

Advantech's real-time and stable smart manufacturing solutions span from front-end timesheet equipment to back-end CNC machine data acquisition in order to provide optimal industrial-grade products and ensure normal operation throughout the entire plant. Our solutions improve not only factory management efficiency but also plant capacity and utilization rates. Moreover, traditional manual operation of the existing plant can be upgraded to a paperless and automated factory management mode. In doing so, Advantech is thereby achieving the goal of safe manufacturing while establishing a traceable electronic production history for the Industry 4.0 era.

Advantech Motion Control Solution for Active Alignment Machine



Location: **Shenzhen, Southern China**

Background

An equipment automation company is a well-known 3C non-standard equipment manufacturer in Southern China with primary customers including Apple & Foxconn, OPPO&VIVO, OFILM & Sunny Optical. Its products cover the fields of dispensing, testing, assembly, and precision module lamination; its equipment integrates core technologies of motion control and vision and equipment networks. Based on its accumulation technologies of precision alignment lamination assembly of mobile phone camera modules in recent years, the technical team of this equipment company has been dedicated to improving the two current problems of machine compatibility of existing domestic mobile phone camera module precision alignment lamination assembly equipment and the relatively poor processing efficiency. The plan is to develop the first high speed universal multi-functional mobile phone camera module precision alignment lamination assembly equipment in this industry.

System Requirements

This equipment company has always been willing to try the latest technologies in the industry, so the hope is to adopt the latest Advantech bus technology motion control card. Due to the differences between the field of non-standard equipment and that of universal equipment, the application of latest technology can produce equipment superior to that of a few other competitors, thus achieving the competitiveness of differentiation and the added value at the customer end. The field of non-standard equipment is significantly affected by the mobile phone market launch time and the market launch effect, so the quantity of orders can fluctuate. Every order requires extremely short delivery and debugging time, so the company urgently needs a solution for speeding up batch assembly at each assembly and debugging phase. The bus solution is equipped with the features of quick connection and high installation stability without the need for the thick cable in the original pulse solution.

The Advantech bus motion control solution is in the leading position in this industry, which can only be matched by a few competitors. The fact that the company is willing to use the Advantech bus control solution for such an important project is undoubtedly a recognition of Advantech's many years of accumulation of technology. The Advantech team needs to seize this opportunity to fully demonstrate its experience and compatibility in bus solutions.

Project Implementation

IPC-510

Economical 4U Rackmount Chassis with Front USB and PS/2 Interfaces

PCI-1203

2-port EtherCAT Universal PCI Master Card

AMAX-4856

32-ch Isolated Digital Input and 32-ch Isolated Digital Output EtherCAT Remote I/O Module

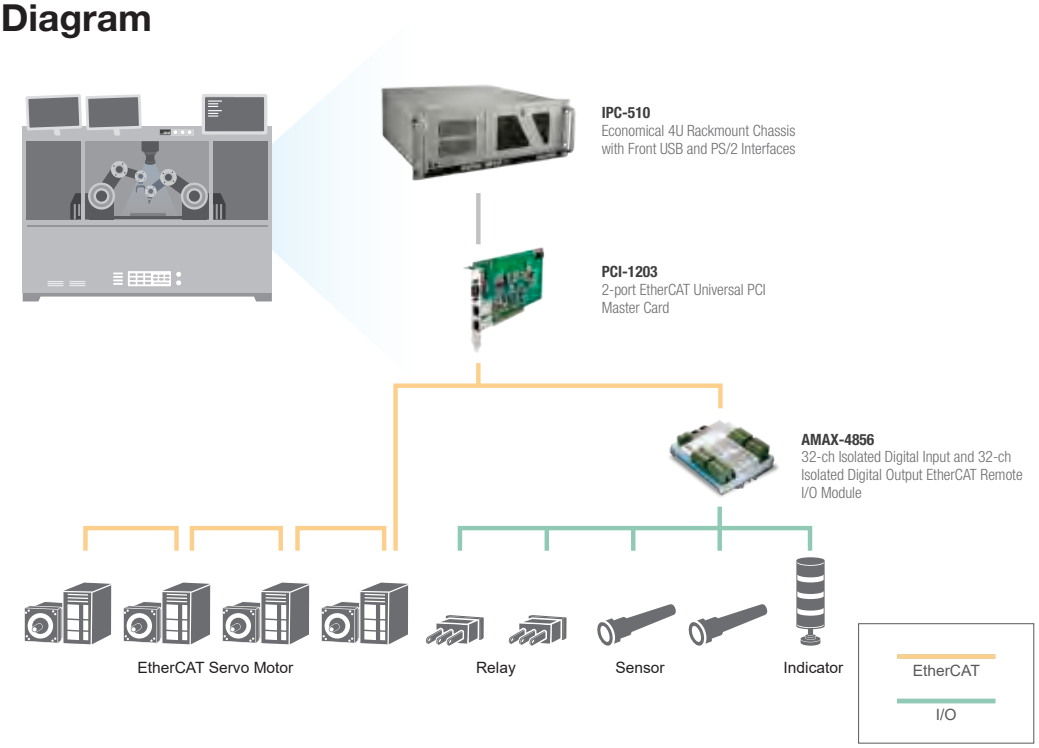
System Description

1. Multiple axes:The high-speed universal multi-functional mobile phone camera module precision alignment lamination assembly equipment is equipped with a complex internal structure with as many as 58 axes. Most production equipment at the customer end cannot allow equipment to have a huge volume. The advantage of a single bus card capable of controlling 32 axes can be fully demonstrated. With the conventional pulse solution, the customer will need to use two standard industrial personal computers plus 8 pulse control cards, which undoubtedly will consume a great deal of the equipment's internal space. The axial control of the bus solution only requires a single industrial personal computer and 2 control cards to solve the problem, and it can fully demonstrate the advantages of compact size and layout flexibility of I/O bus control module.

2. Anti-interference: The technical team of this equipment company has been perplexed by the problem of equipment interference during the years of the equipment manufacturing process. The advantage of the bus in terms of long distance transmission and strong anti-interference capability can perfectly dissolve the pain points of customers. At the site of this project there is a highly innovative brand of driver that results in severe electromagnetic interference, and the installation causes noise on the display screen. In the past, isolation measures had to be adopted for conventional equipment applications; but if the Advantech bus is used, there is no need to worry about such problems.

3. Simple layout that saves wiring: The adoption of the conventional pulse solution is bound to entail complicated routing tasks, especially for applications with multiple axes. In order to make the internal structure simple and neat, the motor drivers are often aligned in one row. The problem in which the connection approach between the thick pulse connection cable and the terminal block cannot be neatly arranged is even more prominent. In the Advantech bus solution, a row of drivers are connected in series. In addition to saving space occupied by the terminal block, the entire internal part of the machine can be quickly installed, making it exceptionally simple. In the conventional solution, the I/O controls are concentrated on the terminal block, so the position of I/O terminal block cannot be arranged anywhere one wants for a neat layout, thus the proximity connection of I/O cable cannot be achieved. The Advantech bus I/O module can easily achieve the routing and further simply the wiring while improving the equipment connection stability.

System Diagram



Why Advantech?

With the equipment technology level enhanced by Advantech bus solution, the customer can make the entire machine more neat and compact. The higher cost-performance ratio demonstrated by the Advantech bus in multi-axis applications can save one industrial personal computer. Advantech hopes to establish the benchmark and leading effect of the non-standard equipment industry of Southern China and the entire nation via the applications of this equipment company and other relevant industrial customers. In the meantime, Advantech also hopes to continue to develop this field and enhance the level and compatibility of control card by facing challenges of technology and project difficulty. And it hopes to expand the brand effect of the Advantech bus solution in this field by leveraging the influence of this equipment company in the 3C field. Secondly, Advantech is a leading brand in the entire automation field, and its products possess reliable certification and quality assurance. The technical service personnel of Advantech are widely distributed, meaning that it can quickly provide technical support to the machines of its customers all over the world, solving their problems and saving their time.

3D Glasses Automated Machine Vision System for Inspection

Location: **China**

Background

Intelligent 3D glasses are smart wearables with their own OS and embedded micro components like cameras and heads-up displays. They are highly integrated products that require new advanced manufacturing technologies and processes to produce. An intelligent equipment maker (machine builder) accepted a project to build machines, which could automatically inspect and overview the manufacturing and production quality of 3D glasses on the assembly line. The system comprised a machine vision system for inspection with motion control functions.

System Requirements

The customer required a solution that was compact in size and could easily deployed in the field without too much fuss. They wanted something that could replace their current legacy equipment, be easily upgraded with new functions by their own R&D team and would offer long-term component longevity support. Therefore, Advantech suggested offered its IPC-240 + PCE-GIGE4 + PCI-1245L combination IPC system, which delivered all the specifications required for motion and vision control.

Project Implementation

IPC-240

Compact industrial computer system with 7th Gen Intel® Core™ i CPU

PCI-1245L

4-axis stepping and servo motor control universal PCI card

PCE-GIGE4

4 Giga Ethernet card (PCIex4).

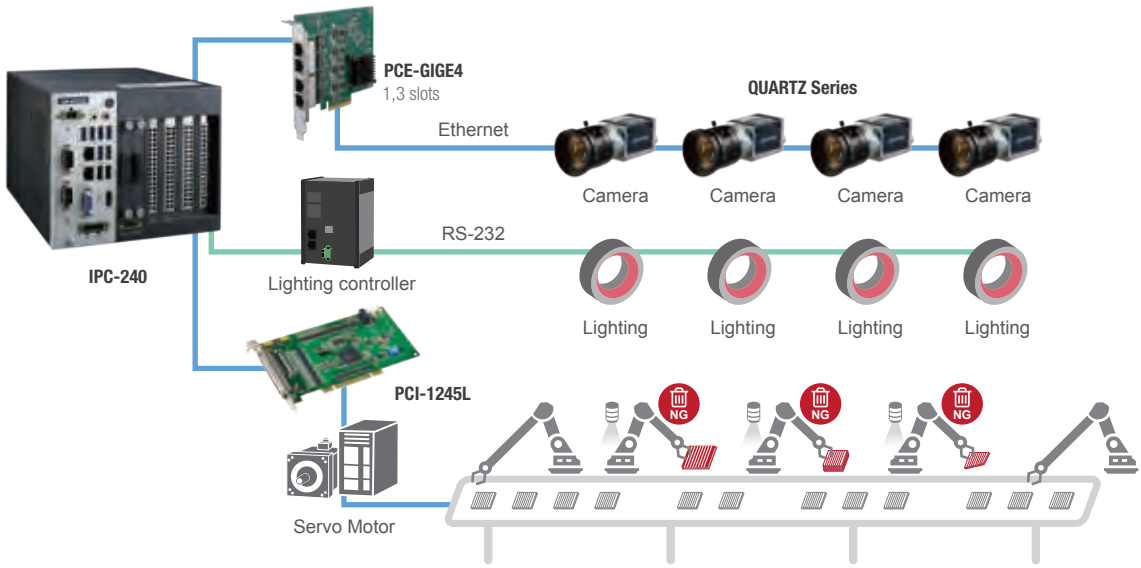
QUARTZ Series

0.3-20.0 Mega Pixel PoE Industrial Camera

System Description

Advantech's IPC-240 is an industrial computer system with ultra-compact (140 x 230 x 150 mm) equipped with 7th Gen Core™ i7-7700 CPU that delivers high performance computing. It also offers 4 PCIe/PCI slots for plug in cards and 2 x GigaLAN Ethernet interface to link with back end MES system. With the optional PCE-GIGE4 card installed, it could provide an additional 4 x Giga LAN ports which could link to 4 cameras for production line vision inspection. Also, the PCI-1245L 4-axis stepping and servo motor control universal PCI card can easily link several motor/servo devices to implement full motion control. IPC-240 also provides a dual front access 2.5" HDD tray, so the client can easily maintain/replace HDDs without opening the chassis.

System Diagram



Why Advantech?

After deployment, the machine vision system for inspection significantly reduced manufacturing errors. The customer reported a 30% improvement in production efficiency and a significant reduction in production line downtime. IPC-240's longevity support meant they did not have to change/replace parts so often and did not have the frequent worry of parts being phased-out.

What's more, for expandability the customer could easily upgrade the system, which meant they could focus more on new software development. The new solution also saved them a lot of effort getting certifications ready as the whole system was certified in advance.

5G Deployment in Heavy Machinery Manufacturing

Location: **China**

Background

5G is the next generation of wireless connectivity and is playing a key role in the Industrial Internet of Things (IoT) and business-to-business (B2B) markets. As 5G gradually deploys across vertical markets we will gradually see more and more uptake. For industries to enjoy the benefits of 5G, they will greatly need to improve the efficiency of their operations, of which 5G will be central.

System Requirements

A renowned heavy equipment manufacturing company headquartered in China, which is the 3rd-largest heavy equipment manufacturer in the world, is well-known for its concrete machinery. They are also a major supplier of excavators, cranes, wheel loaders and other heavy machines. However, in their factory, they were suffering operator errors, which as it turned out, was largely caused by discrepancies by operators incorrectly inputting work orders (WO) from the MES system. There were also issues with inconsistent signal quality throughout the factory, which prevented them upgrading to full automation.

Part of their manufacturing plant contained large CNC machines that made the various parts for assembly into heavy equipment by other parts of the factory. Their workflow consisted of dispatching and inputting each and every single WO into different CNC machines manually. Over time operators became more careless and accidently keyed-in the wrong information into the CNC machines. This meant that whenever the production process changed and incorrect orders were input, these errors usually caused reworks, meaning unnecessary parts needed to be dumped and new parts reworked at great extra cost.

The company did try to fully automate their factory and had deployed consumer-grade 4G/wireless devices throughout, but it couldn't deal with the problematic signals, which meant it couldn't accurately receive production data because of the interference. So the company decided to take a chance and transform their production factory from the ground up with 5G technologies.

Project Implementation

UNO-137

Industrial-grade integrated IoT edge controller

AIW-355

Highly-integrated 5G WWAN module with M.2 3052 Key-B interface

ADAM-6300

OPC UA Ethernet I/O modules

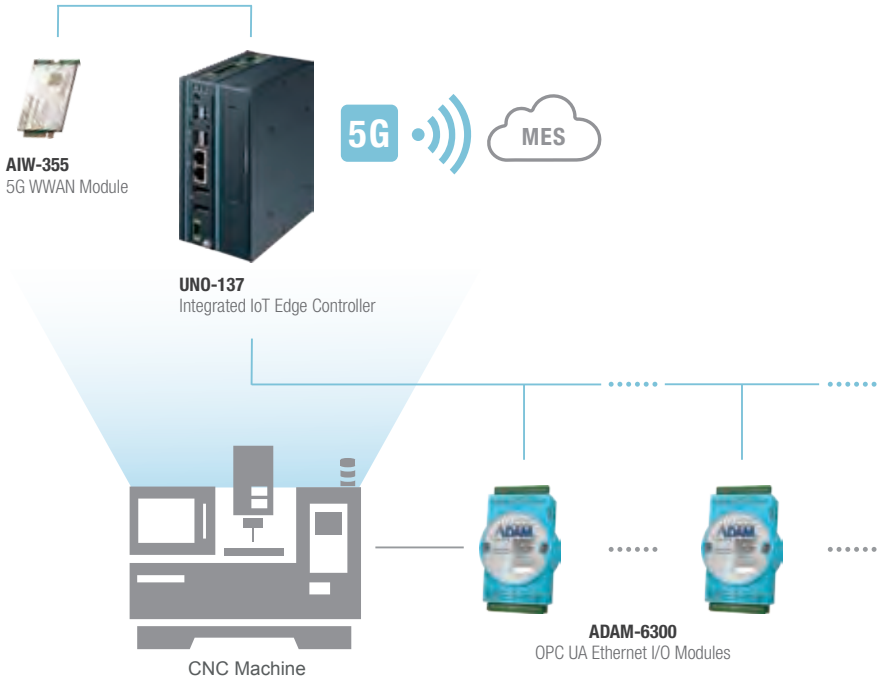
System Description

Advantech provided the UNO-137 industrial-grade integrated IoT edge controller which supports 5G. UNO-137 uses a built-in AIW-355 5G module placed in an overhead cabinet. The controller collects data from CNC machines and transmits it through a private 5G network provided by a telecom company.

UNO-137 was easily integrated with factory's own production platform, which transferred the CNC production data from CNC controllers (Siemens/MAZAK) to the MES or private cloud at the factory. UNO-137 acts as Ethernet gateway and has many functions all in one device, which helped the customer to quickly deploy 5G for full automation.

Advantech solution was extendable, so in the future, if the customer needs more analog/digital I/O to collect machine status data, ADAM-6300 series remote Ethernet I/O module with secured OPC UA protocol can be integrated for its seamless IT/OT convergence over 5G networks.

System Diagram



Why Advantech?

This successful 5G Industrial IoT manufacturing solution was chosen because:

- UNO-137 was a multi-function device, which saved investment on purchasing multiple gateways.
- UNO-137 Ethernet gateway with OPC-UA.
- Experience in China IIoT market.
- High-end specification, easy installation, and best data security.

In China, 5G is booming and infrastructure/stations are being built at a fast pace, but it is still relatively rare to see an edge system that supports 5G that is reliable and adequate enough to run the whole the operation. Because of the success of this project, the solution was chosen by the local government to be a showcase 5G site to demonstrate successful 5G Industrial IoT manufacturing. Overall, the customer was very satisfied with Advantech's professional service and fast shipping of products to their factory and they hope to work together again on other manufacturing projects.

Internet Solution for PCB Equipment

Location: **Taiwan**

Background

Urgent and customized orders are recurring trends in the PCB industry. To shorten production times, it is necessary for production lines to be highly flexible while still satisfying customer quality control requirements. Common to traditional PCB factories are systems for solder paste printing, sampling, reflow soldering, and so on, all of which store relevant information for each corresponding station. Low-level equipment information, such as that from PCs, PLCs, and sensors, is typically not integrated, thus limiting maintenance and management processes that require production data, leaving manufacturers unable to promptly clarify the root of any issues that arise.

Smart productions systems provide a solution to this problem, and these can be realized only by establishing equipment connectivity. The obvious advantages of such systems are that the complete production history can be recorded and yield tracing can be conducted while integrating the data in the control room.

System Requirements

This customer had a complete PCB production line and corresponding equipment, with management and maintenance of each station based on manual inspections and the handwritten records of onsite personnel. Problems with connectivity had arisen due to production line expansion and increases in the amount of equipment at different times and equipment from different brands being unable to communicate effectively. This compounded the demands of visual inspections and made it more difficult to integrate low-level PLCs.

In some cases, despite the soldering process being the most important stage in maintaining PCB production yield, the customer had different generation soldering technology (e.g., wave soldering and reflow soldering equipment) operating at the same time, which made connectivity even more difficult. As a result, the customer sought a suitable proposal to achieve interconnectivity at the soldering stage. The short-term goal was to realize motor control and visual application integration as well as the real-time acquisition of data from PLCs, indicators, and PCB material input sensors. This datastream could then be monitored and integrated into the customer's existing enterprise database.

Project Implementation

ACP-4020

4U Short Depth Intelligent Rackmount Chassis

PCE-3029 / PCE-3B12-08

LGA 1151 6th / 7th Gen Intel® Core™ i7/i5/i3 Half-size SHB / PICMG 1.3 Half-size Mainstream SHB Backplanes

PCI-1202U / AMAX-1240

2-Port AMONet RS-485 PCI Master Card / Open Frame Type 4-axis AMONet Motion Slave Module

PCIE-1674E

4-Port PCI Express GigE Vision Frame Grabber

ADAM-6250 / ADAM-4570

15-ch Isolated Digital I/O Modbus TCP Module / 2-Port RS-232/422/485 Serial Device Server

System Description

Advantech's equipment interconnectivity proposal comprised four sections: 1) wave soldering/reflow soldering process data acquisition; 2) automated PCB movement and visual system integration; 3) equipment-end computing platform and local information integration; and 4) uplink data to the cloud and connect to a database.

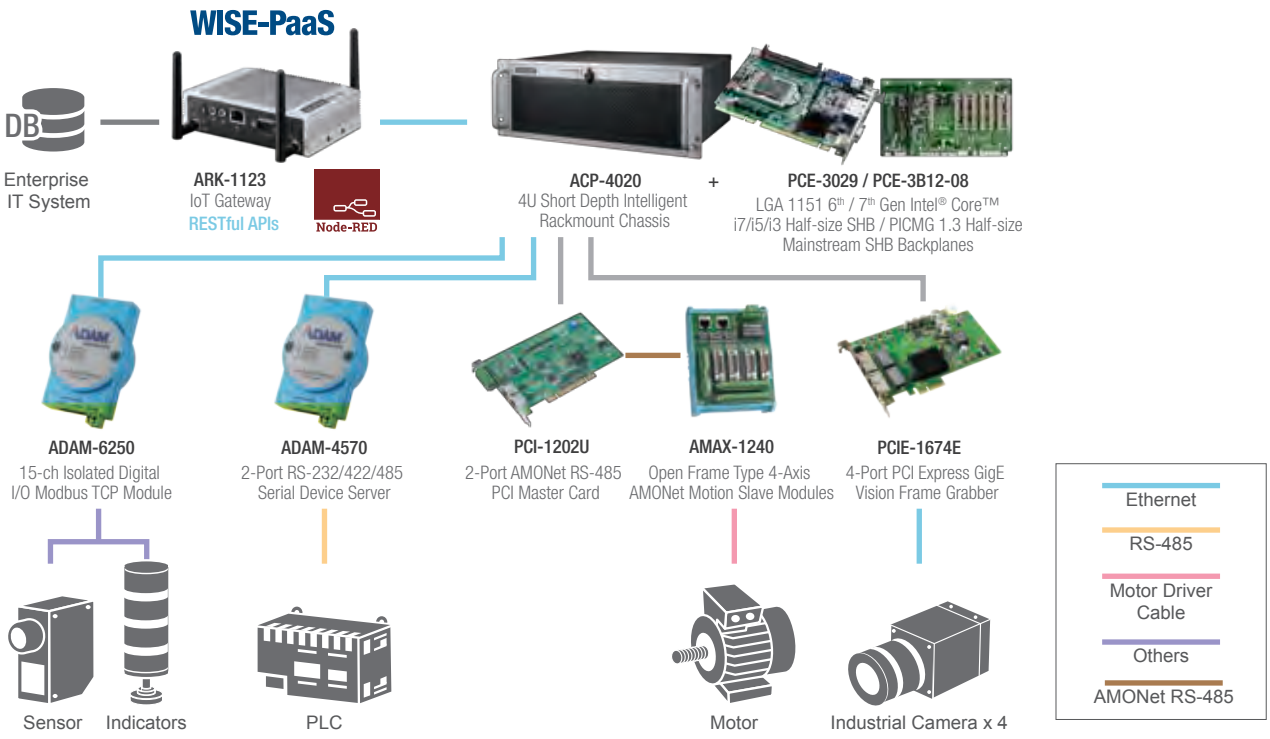
Data acquisition was achieved use the ADAM-6250 to acquire status records from spray sensors, flip machines, and the main equipment tower indicators (signals → TCP); and the ADAM-4570 to capture Mitsubishi PLC parameter data (RS-485 → TCP). Distributed movement and transport of PCB plates during paste soldering were achieved by connecting the equipment's driver/motor via a PCI-1202U/AMAX-1240 serial control module.

Additionally, visual location and image inspection were performed via PoE by utilizing a PCIE-1674E image acquisition card with data transferred to a ACP-4020 industrial computing platform for analysis.

Integration of local-end information obtained from the ADAM modules was enabled by installing the ACP-4020 industrial computer in the reflow smoldering equipment. The IPC also acted as the main control and visual computing platform, delivering orders to reposition PCB boards via the PCI-1202U/AMAX-1240, while simultaneously planning routes based on the image provide by the PCI-1674. Data uplink to the cloud was achieved using the ARK1123 IoT manager, which was connected to the ACP-4020. The system was developed using WISE-PAAS platform tools; specifically, WISE-Agent (for long-distance message acquisition), Node-RED Designer (for message management), and RESTful APIs (for data transformation).

Finally, the data were integrated with the customer's current enterprise databases.

System Diagram



Why Advantech?

This PCB equipment interconnectivity demonstrates the operation of Advantech's products as key components in each layer of the system, including data acquisition from the lower layers, transformation of various PLC data formats, and the distributed structure motor control and visual image acquisition; mid-layer computing platform and data integration; and the critical step of cloud data format management and enterprise database integration.

In addition to being mutually compatible, these layers were easy to develop. With particular regard to the computation layer, WISE-PAAS was invaluable in providing a flexible development platform, and Advantech's support in assisting with the development enabled the customer to work with each handler and the RESTful API data format, thus completing highly customized on-site information integration with the extant database.

The customer was able to complete a product demonstration in less than a year and then replicate this system in other mass production lines in Shanghai and Tianjin, thus increasing production efficiency via equipment interconnectivity.

High-Speed Adhesive Dispenser Solution

Location: **Taiwan**

Background

In manual electronics manufacturing processes that require the application of adhesives, it generally takes double the effort to complete in comparison to when automated dispensers are used. When traditional adhesive dispensers are used, the process involves using contact-type dispensers to apply adhesives to such surfaces as electronic components and LED packaging.

However, with the miniaturization of products, these traditional dispensers can no longer be used. High-speed automated adhesive dispensers that provide accurate flow control as well as high-precision and contactless application are instead required for the forming of often micro-sized points, lines, and other shapes.

System Requirements

The customer required an automated adhesive dispensing system comprising pneumatic machines, image processors, I/O modules, and Internet communication control modules.

Industrial computers were needed to integrate motor drivers, adhesive dispenser controllers, and high-speed cameras. The dispensing system had to maintain stable adhesive control and trajectory planning. During operation, this not only includes controlling the pneumatic cylinder but also monitoring the environmental temperature and signals from various sensors. Once dispensing is completed, the system needed to confirm that the adhesive had been applied correctly to the surface via machine visual inspection.

Project Implementation

IPC-240

Compact Industrial Computer System with 6th/7th Gen Intel® Core™ i CPU Socket

PCI-1756

64-ch Isolated Digital I/O PCI Card

PCI-1245

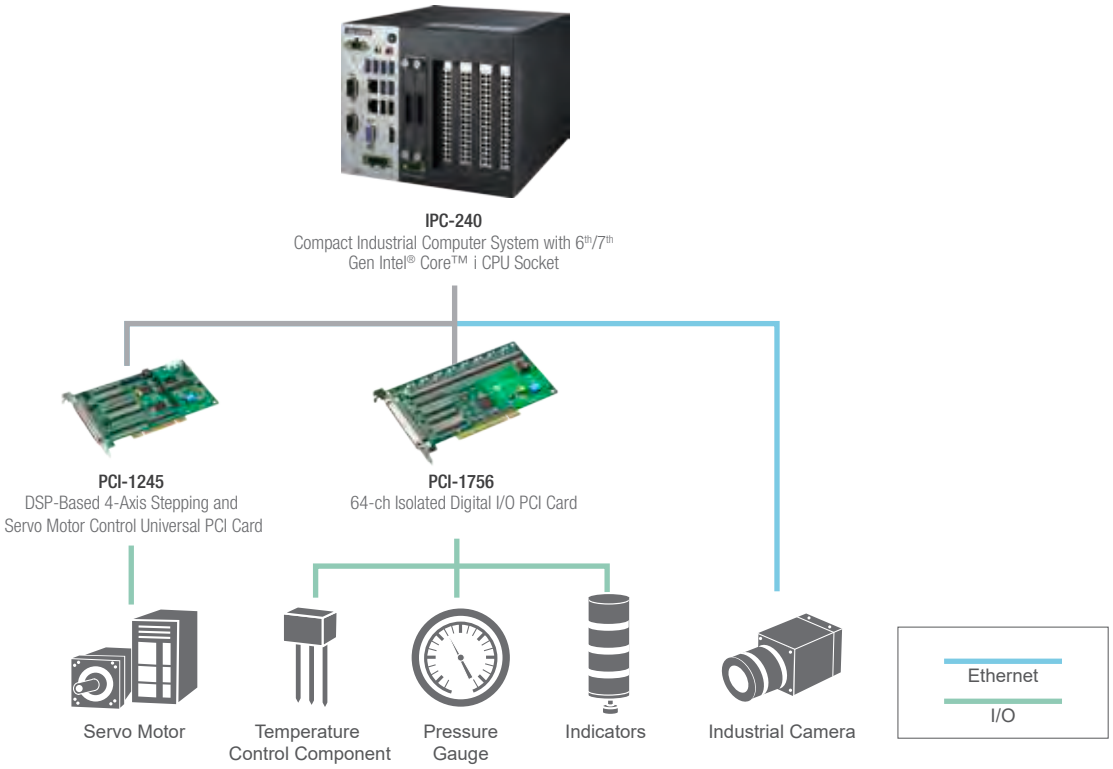
DSP-Based 4-Axis Stepping and Servo Motor Control Universal PCI Card

System Description

To ensure precise multi-task motion control and accurate image inspection, an IPC-240 ultra compact IPC with 6th/7th Intel® Core™ i processor, and a PCI-1756 high-speed I/O card was installed to connect to pneumatic components in order to control the electromagnetic valves and acquire signal data.

A PCI-1245 4-axis DSP-based motor control card was considered ideal for the server motor controllers because it has reserved memory for trajectory planning and a maximum pulse output of 5 Mpps. It also supports Advantech's Common Motion API, which enables the customization of trajectories with linear and arc functions while controlling the dispensing nozzles with PWM, thereby being able to set the output volume according to the nozzle cycle (referring to the time between opening and closing the nozzle). Intricate coating patterns could thus be achieved by controlling the distribution via speed limitations. Specifically, the dispenser valve and adhesive amount could be managed at jetting speeds of 100~200 Hz and the spacing could be controlled by adjusting the nozzle's movement speed.

System Diagram



Why Advantech?

Advantech was able to provide a total application solution for the customer's automated equipment, aided by our specialization in motion control systems, visual inspection systems, data acquisition, and industrial computers. For motion control solutions, we can develop customized functions that are specific to our customers' needs.

In addition to emphasizing the quality and stability of our industrial products as a professional brand, we also provide complete pre- and post-sales onsite service for our customers.

Advantech IC Test Handler Machine Automation Solution

Location: **Shanghai, East China**

Background

High-end testing and sorting machines in the semiconductor IC packaging sector, such as BGA, QFN, and QFP, have long been monopolized by foreign companies. This customer intended to embrace domestic production of such equipment to reduce order costs, fill the vacuum in the domestic market, and, eventually, advance into the competitive international marketplace.

The project adopted comprehensive Soft Motion control and an MVIP solution developed independently by Advantech. It was based on the EtherCAT Automation Protocol, which is the mainstream protocol in China's domestic market. Advantech's solution satisfied technical requirements and competed favorably against products from the United States, Europe, and Japan. It effectively controlled costs for system integrators while achieving domestic production for IC packaging test handler machines. Advantech's solution played a vital role in further developing China's industrial chain of integrated circuit production.

System Requirements

The customer required a highly stable computing platform with a minimum of 4-core and 4-thread CPU, H81 chipset, 4G, 128G SSD, 350W power supply, 5 slots, 2 PCIE and slots. A collection of 256 sets of IO signals and autonomous distribution of IO signals with data acquisition for 8 lines of USB simulation was also needed.

The customer demanded control over 14 Panasonic EtherCAT servo-motors + 14 EtherCAT RTA stepper motors. They needed a flexible cornering design for the velocity curve and z-axis servo torque control functions. Finally, an expansion for 1 PCIGPIB slot and compatibility with NI programs was required.

The system had to ensure stable and continuous operation, without failure, 24/7.

Project Implementation

ACP-4D00

Dual-Node 4U Chassis for Half-Sized Slot SBC

PCI-1203

2-port EtherCAT Universal PCI Master Card

PCIE-1753

96-ch Digital I/O PCI Express Card

PCI-1671UP

IEEE-488.2 Interface Low Profile Universal PCI Card

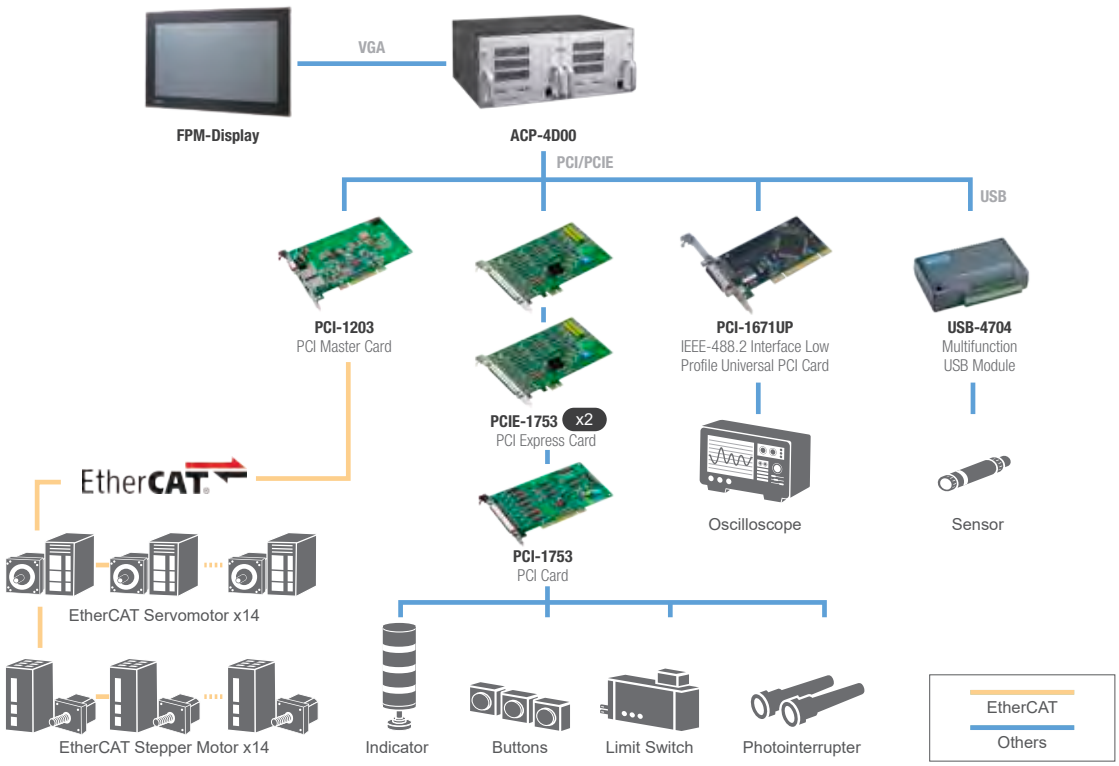
USB-4704

Multifunction USB Module

System Description

Advantech PCI-1203-32AE can control 32 axles and it responds instantaneously within 500us. The flexible design for the velocity curve satisfies customers' requirements for high efficiency in cornering without reduction in speed. The torque table control functions meet customers' requirements for core functions for the z-axis torque control and greatly improve the efficiency of the machinery and the yield rate of the products.

System Diagram



Why Advantech?

Advantech's hardware and software products are both stable and reliable, offering 24/7 continuous operations.

A variety of functional algorithms satisfy customers' requirements for core processes and customized services to ensure optimal performance. Cost-effective total solutions help customers break the monopoly of foreign technologies. Using Advantech, the brand brought added value to its customers.

Advantech Digitizer for PCB Laser Drill Pulse Signal Measurement

Location: **China**

Background

As electronic products require larger numbers and more intricate arrangement of electronic components on printed circuit boards (PCBs), the PCB development trend of high density wiring has brought about innovations and advances in drilling technology. Of these innovations, the non-contact laser process, requiring no blades, has become an important process instrument for high density PCB manufacturing. Besides precluding problems such as blade blunting and chipping, its pros include better performance on hole diameter accuracy, process speed, and quality consistency.

For PCB laser drills that are required to shoot many laser pulses per minute as "drill bits," the laser pulses must maintain a consistent waveform for the laser beam to make neat holes of the same shape and size. Therefore, to clearly acknowledge any variations in the waveform of this highly repetitive laser pulse application, IPC controlled devices are usually paired with a monitored laser pulse waveform measurement system to ensure drilling quality.

System Requirements

A Shenzhen high-tech company specializing in the development of laser equipment especially for the PCB industry offers equipment for PCB precise drilling and milling. The equipment manufacturer has always set high standards for their product quality, although they have been providing laser pulse monitoring features with their equipment long ago, the company would like to offer PCB laser equipment with higher efficiency, high precision, high stability, and low operation costs to take their products to the next level.

So they decided to replace the existing digitizers, which are only 14-bit resolution, costly, and non customizable, and first use CO2 laser drills as demonstration units, introducing the measurement system to other laser equipment later, while at the same time preparing for future offers of preventative maintenance services through relative collected information.

The new digitizer must be a product of high price-performance ratio, and be able to collect pulse signals with high speed as well as perform specialized computing (e.g., data accumulation, comparison with preset values, etc.) Therefore, besides the product itself providing at least 16-bit resolution and 100MS/s sampling rate, customized services should be available as per the company's requirements to help them undergo redevelopment more easily to complete new features faster and introduce the laser drill to the market as soon as possible.

Project Implementation

IPC-7120

Desktop/Wall Mount Chassis with Front I/O Interfaces for ATX/mATX Motherboards

AIMB-786

LGA1151 8th/9th Gen. Intel® Core™ i7/i5/i3/Pentium®/Celeron® ATX with Triple Display, DDR4, USB 3.1, SATA 3.0

PCIE-1840

16-Bit, 4-Ch, High-Speed (up to 125/80 MSPS) DSA Card

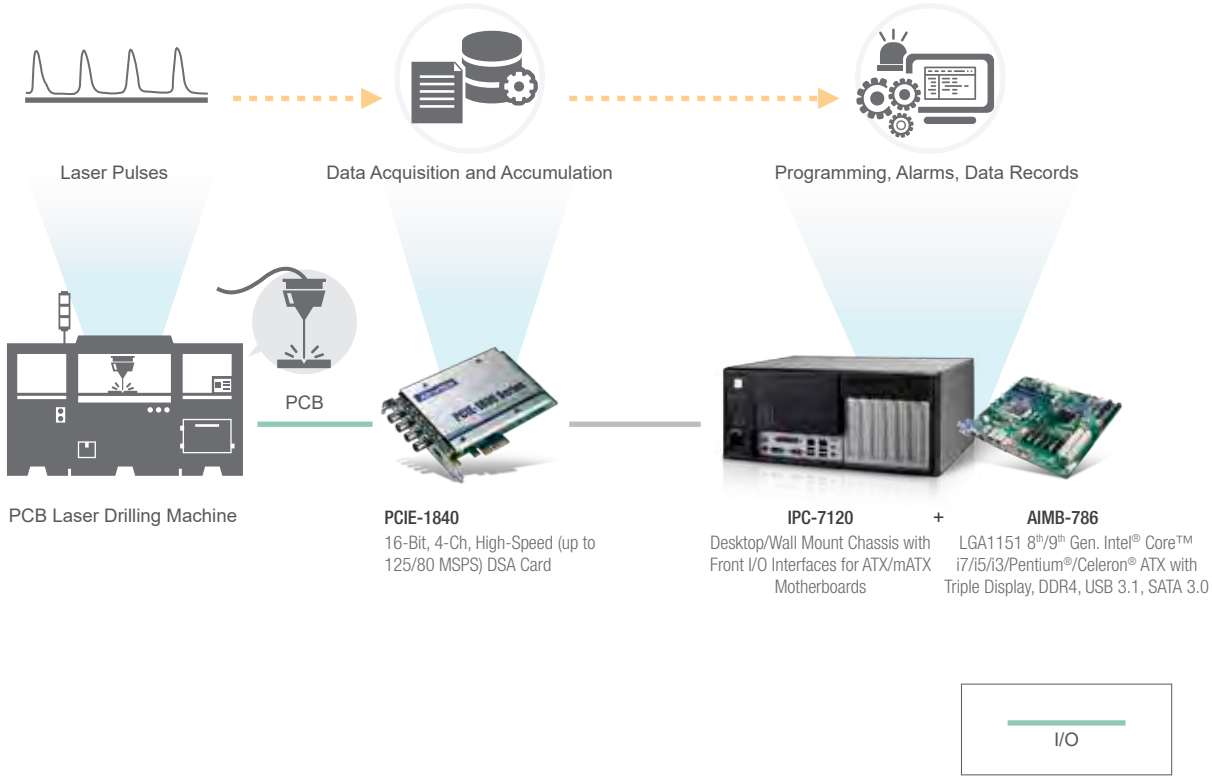
System Description

Advantech's laser pulse signal measurement solution includes a PCIE-1840 high speed digitizer for precise laser pulse signal collection, a customized FPGA for performing specialized computing, and a customized Windows driver for simple redevelopment.

The complete operation process for this solution is: First, set the laser pulse signal acquisition start point, acquisition stop point, and standard and error values via the customized Windows driver. Following set up, the PCIE-1840 installed in the IPC can automatically capture pulse signals. The collected data is accumulated on the FPGA embedded in the PCIE-1840 (similar to integration), and then the sum is compared with the preset standard and error values. Finally the analysis results are transmitted to the IPC. If the results are within the preset values, the data will be stored in the IPC hard disk for future tracking and searching. If the results are out of the preset range, a variation in the laser pulse is implied, and based on this data the IPC can send out a warning or perform emergency processes such as shutdown.

In contrast to the digitizers used by the laser equipment manufacturer before, the 4-channel PCIE-1840 increases the precision of laser drills fourfold with its 16-bit high resolution, and the 125 MS/s simultaneous sampling enables high speed continuous data acquisition. So for laser pulse signal measurement applications requiring high performance digitizers, the PCIE-1840 is a quality product with super high performance and a comparably reasonable cost.

System Diagram



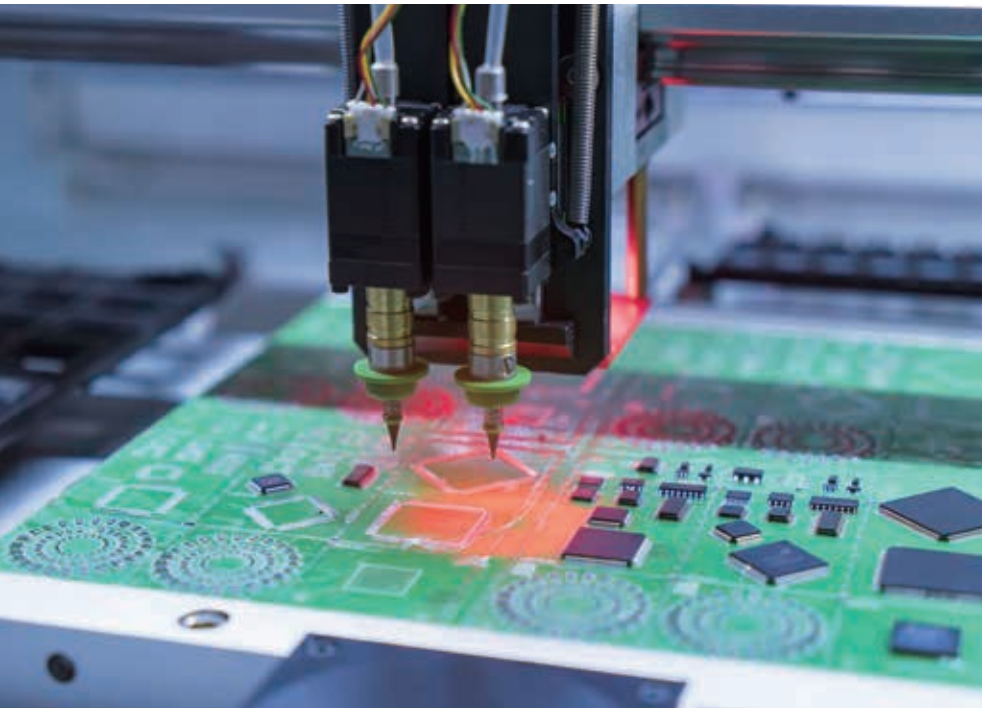
Why Advantech?

The digitizer is an indispensable pulse signal acquisition tool for laser drill pulse measurement system development. The digitizer's resolution and sampling rate determines whether the high speed and precise data acquisition requirements of the equipment are satisfied. Advantech's PCIE-1840 is the world's first PCIEx4, 125MSPS, 16-bit, 4-channel digitizer, extremely suitable for applications requiring high speed pulse signal collection, including laser drills.

At the same time, Advantech's highly experienced professional technological team is happy to develop innovative features together with clients. For this project, the customized FPGA and driver required were both able to quickly address the various problems met by the laser equipment manufacturer through prompt responses and fluid communications with Advantech.

Thanks to Advantech's high performance and economical PCIE-1840, the company's CO2 laser drill has effectively increased production yield and reduced scrapping rate, and the same laser pulse measurement solution will be gradually introduced to other models in the future.

Advantech Dispenser System Solution



Location: **Shenzhen, Southern China**

Background

A dispenser is an automated machine that specifically controls and applies fluid to the surface or interior of a product. Compared with ordinary dispensers, high-speed and high-precision dispensers require precision axis control. First, it is necessary to output through the DIO to control the valves and apply the glue at a high speed at the accurate positions during axis movement. At corner locations the mechanism reduces the speed and the axis card must have speed reduction functions for axial movements. An offset function is required due to flatness errors in the mechanism. With these three additional functions for the Advantech axis card, the glue track and weight control can be precisely measured.

System Requirements

One of Advantech's customers faced the following conditions in their dispensing machines: (1) The system occasionally crashed; (2) The position deviated after using the machine for a period of time, resulting in misalignment; (3) The actual machine running speed was relatively slow, which was different from the speed required by the manufacturers; (4) The load bearing capacity of the machine was relatively weak; (5) The customers had higher requirements for the response time of technical services and technical capacity of the supplier.

Advantech had been operating in the field of dispensers for many years and developed mature solutions with a team of qualified engineers. Drawing on this experience, Advantech was able to fulfil the urgent needs of this customers. For example, our motion control card solved various problems in the customer's current machines with built-in functions such as 3D circular interpolation, 2-axis position trigger, corner deceleration, and plane error compensation. Moreover, Advantech provided quality guarantees for the industrial computers, backward compatible programmable and function debugging axis cards, and prompt on-site guidance technical services; thereby ensuring timeliness of the services and facilitates for our customer in using Advantech's motion control cards in their current projects.

Project Implementation

IPC-510

Economical 4U Rackmount Chassis with Front USB and PS/2 Interfaces

PCI-1245

DSP-based 4-axis Stepping and Servo Motor Control Universal PCI Card

PCI-1285

DSP-based 8-axis Stepping and Servo Motor Control Universal PCI Card

QCAM-GM1300-060DE

0.3-15 Mega Pixel PoE Industrial Camera 1280 x 1024 60 fps

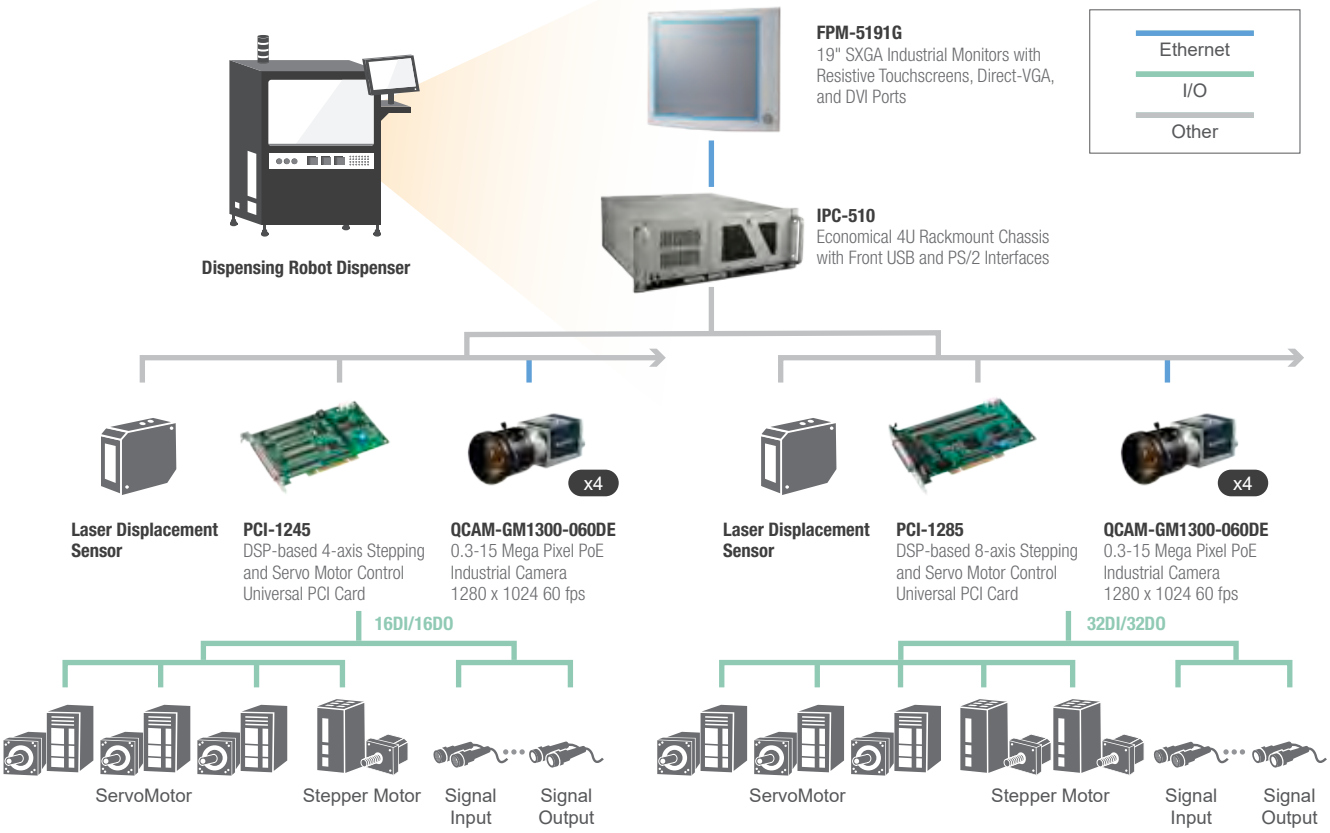
FPM-5191G

19" SXGA Industrial Monitors with Resistive Touchscreens, Direct-VGA, and DVI Ports

System Description

The dispensing equipment was divided into four independent working positions: two double-valve dispensing positions and two single-valve dispensing positions. The double-valve dispensing positions consisted of five axes: the X-axis, the Y-axis, the Z-axis, and the two axes that controlled the valve - the A-axis and the B-axis - controlled by Advantech's PCI-1285 motion control card. The single-valve dispensing positions included four axes: the X-axis, the Y-axis, the Z-axis, and the A-axis that controlled the valve, which was controlled by Advantech's PCI-1245 motion control card. In addition to the dispensing action of each working position, the customer used a PLC to control loading and unloading actions. Therefore, the dispensing positions had to communicate with the PLC through DIO to ensure that the dispensing process did not contain instructions for loading and unloading actions. The speed of the dispensing positions had to achieve a minimum of 800mm/s. This required corner speed reduction while navigating through the paths of the three XYZ axes. The trigger tip had to accurately dispense at the correct positions. Therefore, the two-axis high speed relative trigger function was required. Since the dispensing module of each working position was independently embedded and installed on the device, and the fixed product axis was PLC controlled and did not share the same system as the dispensing module, the dispensing control system and the product positioning system had a certain planar error. Because of this, the dispensing system required a flatness compensation algorithm.

System Diagram



Why Advantech?

PCI-1245 and PCI-1285 controlled the motor to move according to the required path with high-speed and high-precision. At the same time, the card had multi-axis high-speed relative position output, flatness error compensation, storage of 8000 paths for each group of path interpolation, and corner speed reduction functions to solve the problems of existing machines. Moreover, the built-in DIO of the motion control card satisfied the customer's needs for a general purpose DIO and provided reliable signal communication between the dispensing module and the PLC. Advantech's motion control card adopted the Common Motion API unified API call programming mode. Customers could use the same programming method to program different cards, which saved the customer's coding volume and programming time. Moreover, the customer no longer needed to change the coding in future upgrades to EtherCAT bus control cards, thereby providing a highly compatible choice for the customer. Advantech's IPC-510 industrial computer provided all the required control interfaces, and served as a reliable and smooth operation platform for the entire dispensing machine. The customer no longer complained about the usual system crash of the industrial computers. With a complete set of Advantech products for IPC and motion control cards, reliable operation was guaranteed, software programming became simpler, and the customer no longer had to contact multiple manufacturers due to its wide variety of products and issues. Moreover, Advantech provided comprehensive after-sales technical support for its easy-to-maintain products while the overall price remained very competitive.

Advantech Machine Automation Solutions: IC Wafer Prober and Tester

Location: **Taiwan**

Background

Wafer testing is a crucial step performed during semiconductor device fabrication. It is performed by a piece of testing equipment called a wafer prober. The process of wafer testing can be referred to in several ways: Wafer Final Test (WFT), Electronic Die Sort (EDS) and Circuit Probe (CP) are common.

This project demanded advanced data acquisition devices to activate wafers and measure their electronic characteristics. Advantech's solution included a high sampling rate, individual analog input cards, and a convenient software development kit that satisfied technical requirements.This comprehensive solution effectively controlled costs and shortened development time for IC wafer testing machines.

System Requirements

The customer required precise, accurate measurements for electrical characteristics on the wafer prober. To achieve this goal, the amount of peripheral limited switches/devices need to be controlled in time to precise positions. The tester needed analog outputs with 16-bit resolution to activate wafers and individual 8-ch analog inputs with a simultaneous 250KS/s sampling rate to accurately measure the electrical characteristics of the wafers.

Project Implementation

ACP-4D00

Dual-Node 4U Chassis for Half-Sized Slot SBC

PCIE-1812

250 kS/s, 16-bit, 8-ch, Simultaneous Sampling Multi-function PCE DAQ Card

PCIE-1824

16-bit ,32/16-ch Analog Output PCI Express Card

PCIE-1753

96-ch Digital I/O PCI Express Card

DAQNavi

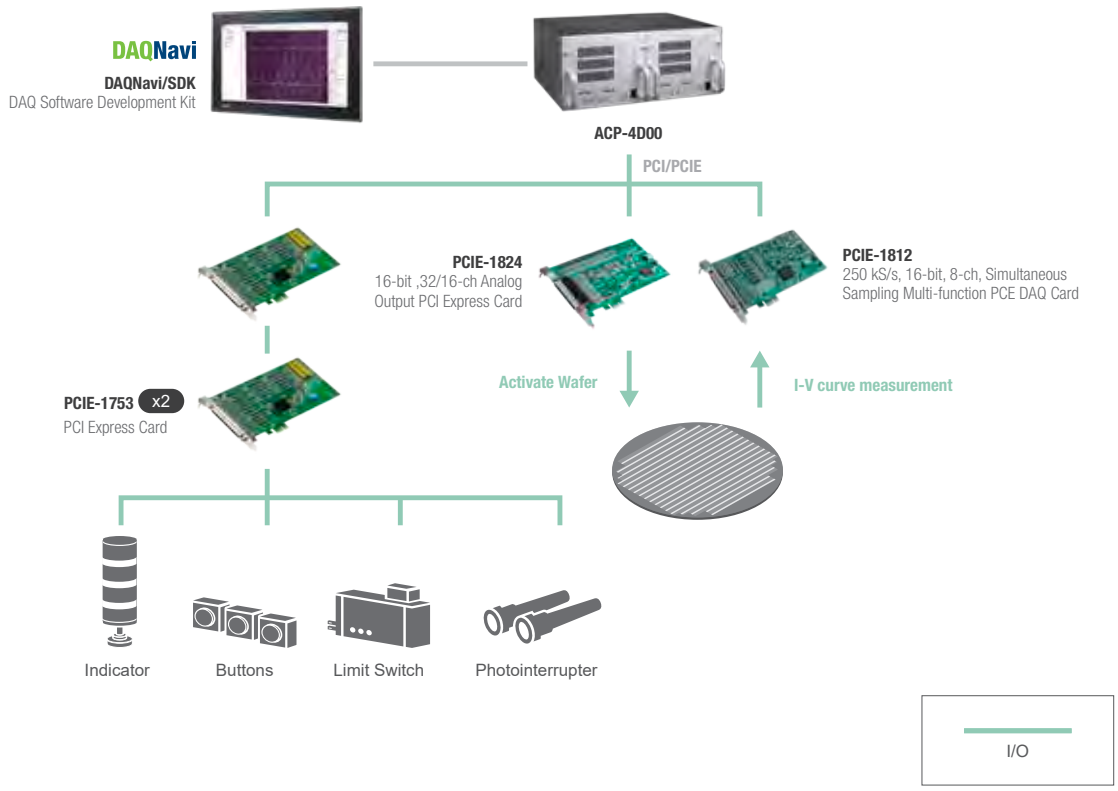
DAQNavi/SDK

DAQ Software Development Kit

System Description

PCIE-1753 controls up to 96 peripheral limited switches/ devices in time, while the high-density DIO card satisfies precise position requirements. PCIE-1812 and PCIE-1824 meet wafer tester needs for analog output to activate and accurately measure electrical characteristics. PCIE-1824 offers high-density analog output channels which can activate up to 16-point to be measured on the wafer. After wafer activation, PCIE-1812 can simultaneously measure eight-point electrical characteristics of the wafer in a short time span. With Advantech comprehensive solutions, customers can easily build up a wafer prober/ tester machine.

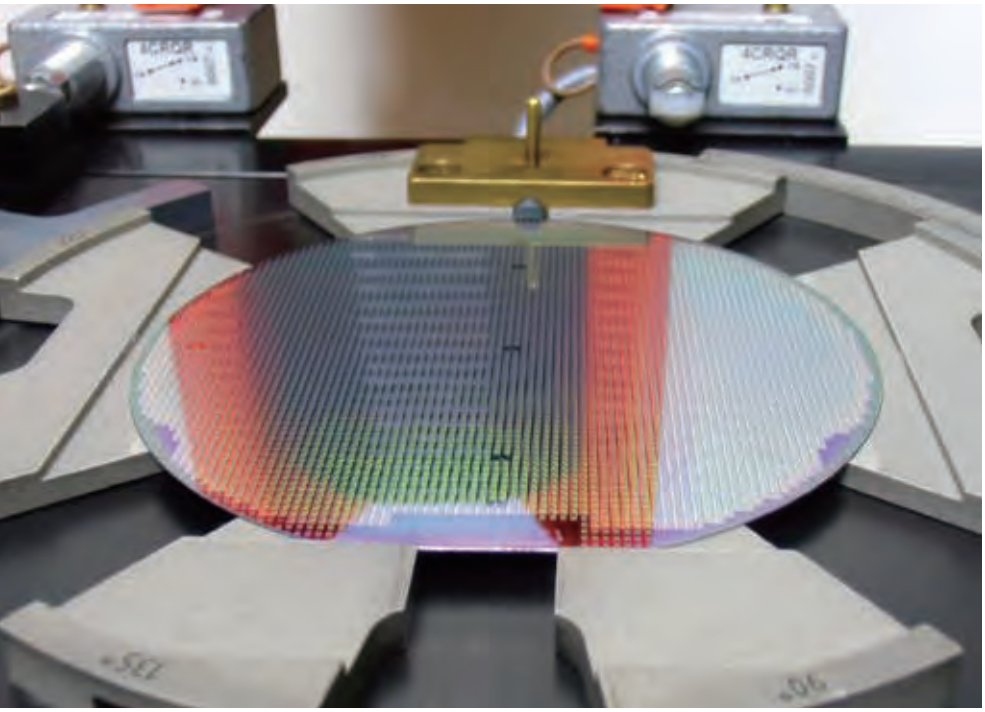
System Diagram



Why Advantech?

Advantech's DAQ series with the software development kit, DAQNavi, satisfies customer requirements for building a data acquisition (DAQ) and control/ test system that actually does what customers want

Wafer Optical Inspection Solution for Semiconductor Front-End Manufacturing



Location: **Taiwan**

Background

During semiconductor front-end manufacturing, the CMP (chemical mechanical planarization) process of smoothing surfaces with a combination of chemical and mechanical forces sometimes results in surface damage like cracks and scratch defects. Effectively addressing this risk requires a non-destructive, non-contact, wave-length sensitive vision inspection for surface purity and planarity.

Advantech offers a machine vision total solution covering industrial-grade image sensors, high-level computing, multiple core processor, and the VisionNavi application software—a user-friendly, flowchart-based interface that can simplify development and deployment, branch and loop functions for advanced vision applications, and support multiple tasks and cameras with a global shutter to deliver precise and efficient semiconductor production.

System Requirements

The customer is a leading wafer manufacturing company in the semiconductor industry who required an inspection system that could locate damage and defects during the CMP process. Due to the characteristic materials of the wafers, a non-destructive, non-contact, wave-length sensitive vision inspection for surface purity and planarity was essential. The vision inspection system needed to be synchronized with the automated robotic handling system in order to increase productivity. The goal of inline vision inspection equipment was to provide high-precision analysis while maintaining productivity levels. The customer was looking for a complete system capable of performing at speed, with highly accurate inline inspection. The customer also wanted to reduce installation/maintenance effort, since there were many different kinds of wafers and defect types.

Project Implementation

IPC-220

Compact Industrial Computer System with 6th/7th Gen Intel® Core™ i CPU Socket

PCIE-1674E-AE

4-port PCI Express GIgE Vision Frame Grabber

PCIE-1730H

32-Ch TTL, 32-Ch Isolated Digital I/O PCIe Card

QCAM-GM1440-073CE

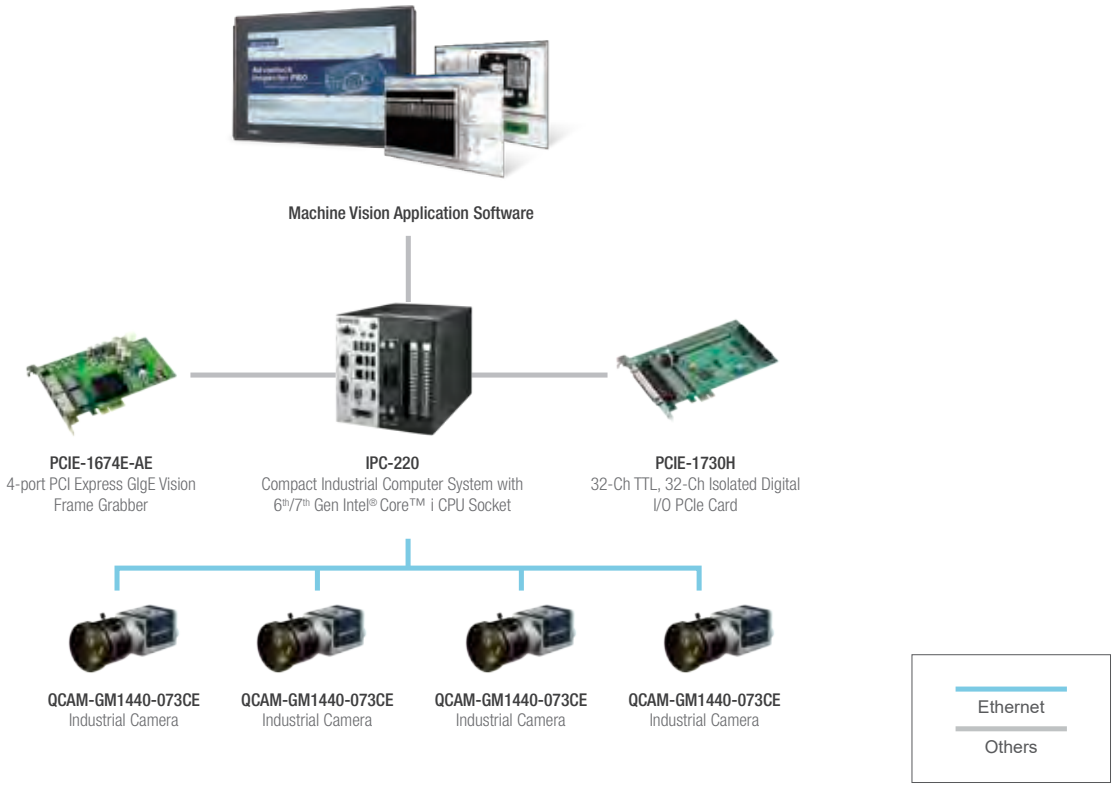
Industrial Camera

System Description

Advantech's machine vision edge solution was installed as the CMP system. The system included CMP machinery, robotic handling system, a vision inspection system, and uplink data for the IT database.

After the wafers were polished, the position sensor sent a triggering signal to the vision system. Multiple images from different camera angles were acquired and sent to the vision system, where VisionNavi software processed the images for defect inspection, then verified the wafers. The vision system sent out an "NG" signal to reject a wafer if a defect was detected or an "OK" signal to pick up the wafer for the next process. Image data was restored and integrated with the customer's current enterprise databases.

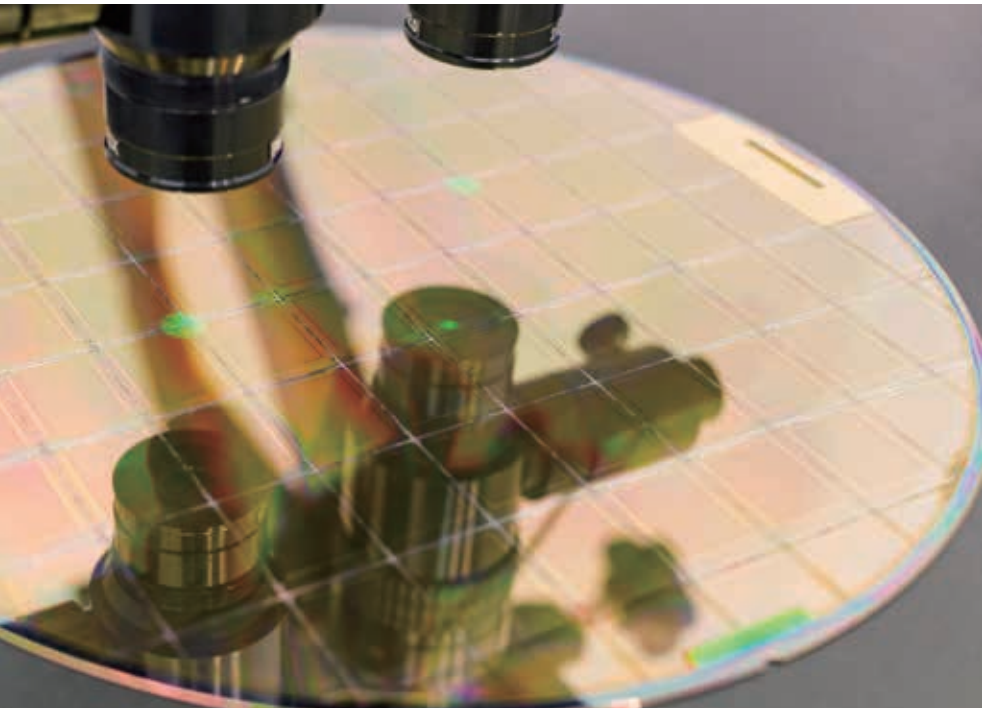
System Diagram



Why Advantech?

Advantech's Machine Vision Inspection System integrates the global shutter, high speed industrial cameras, a multi-channel computing platform, and vision software, so that users don't need to worry about how to select compatible products.
The VisionNavi software is designed with a graphical and flowchart-based interface, where users can easily complete the development and deployment of vision inspection applications without any programming skills.

Automated Inspection Machine for Semiconductor Manufacturing



Location: **Netherlands**

Background

To keep their competitive edge, a multinational company needed to upgrade their production efficiency. To do this, they were looking for a high-performance automatic inspection system with multiple backplane slots for their multiple SOM boards that could execute effective and efficient inspection. For this application, it was necessary to have an optimized thermal solution to ensure the whole application worked reliably without any issues.

System Requirements

The company already had a legacy system they used to control, collect, and manage production line data, so they were looking to upgrade their existing AI system without too much fuss or disruption to existing production. To do this, they decided they needed to integrate an Advantech IPC with multiple SOM boards into their own system. This would give them the extra capacity they needed and would not interfere with their existing infrastructure. For this upgrade the customer wanted to increase the accuracy and efficiency of the system and add frame grabber and graphic cards with higher data transfer speeds. However, the combined heat from all the cards, especially the FPGA card modules, might overwhelm the system so an optimized thermal solution was also required.

Project Implementation

Chassis

Customized 6U chassis with 1200W power supply

Backplane

Customized Gen3 PICMG1.3 backplane

PCE-7132

Single board computer

PCIE-1674V-CE

Frame grabber card

QUARTZ Series

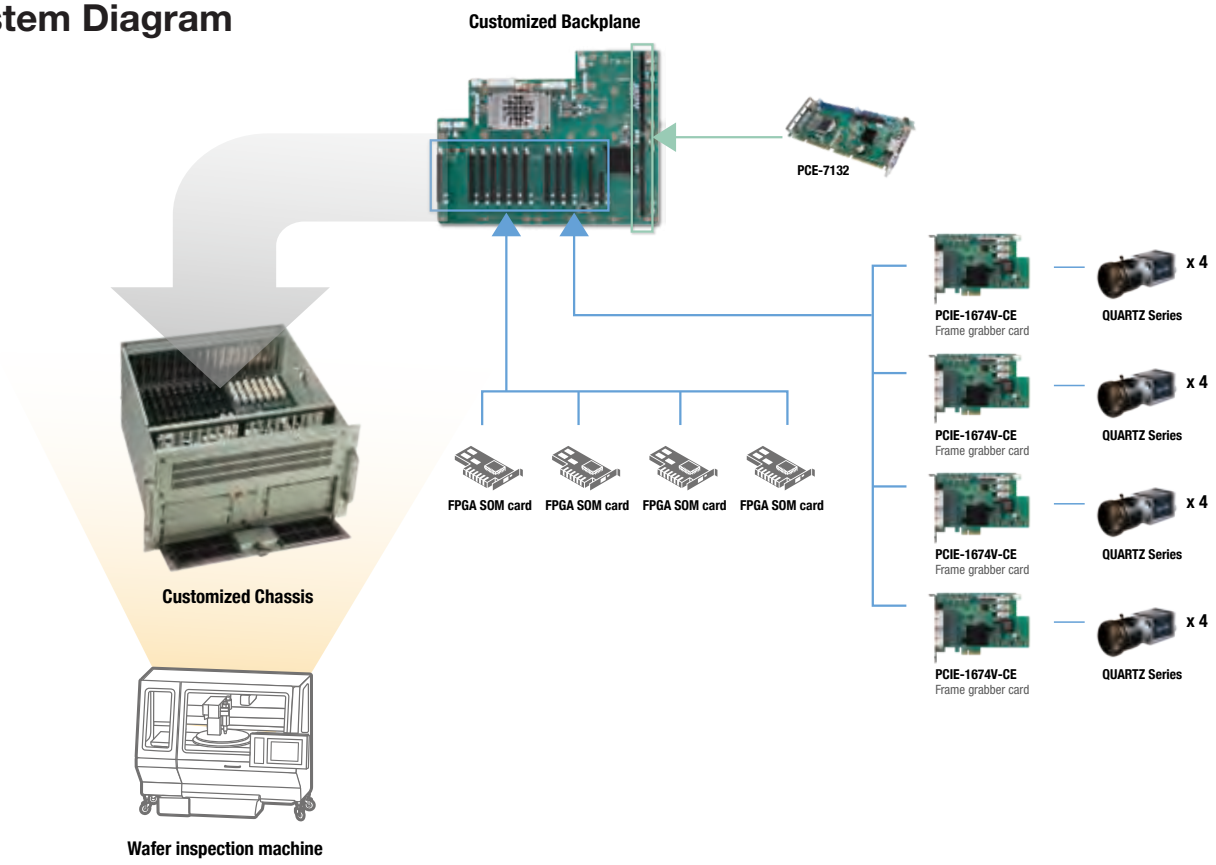
0.3-20.0 Mega Pixel PoE Industrial Camera

System Description

For this special application, Advantech helped to customize the chassis with a specially designed fan duct that matched the shape of the customer's SOM boards. This would concentrate the air flow from system fan through and across the boards to efficiently expel heat from system. To upgrade the system, the customer needs to have an industrial grade PCIe backplane with sufficient slots for multiple add on cards. And of course, a high watt power supply was needed to power everything. In addition, special cabling was required that assisted the air ducts in directing the thermal emission out of the system.

The final system incorporated a 6U chassis with 12 customized slots on a Gen3 backplane and a PCE-7132 SBC with Intel 10th Gen CPU. This provided a perfectly a stable and reliable environment for the customer's application. And, with a customized thermal solution in place, there was no need to add additional fans inside the system that would generate unwanted noise and create maintenance difficulties.

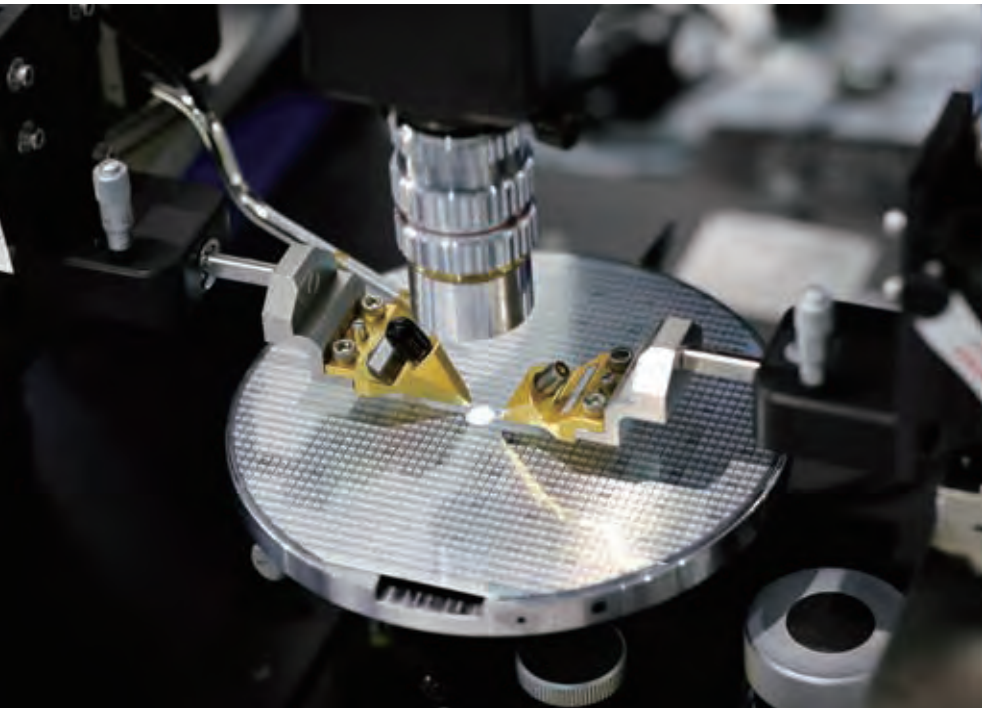
System Diagram



Why Advantech?

Advantech's flexibility and customization capability helped customer meet their goal for an effective, accurate, and high-performance automatic inspection machine upgrade. The system allows the customer to add additional extension cards for expanding performance in the future. Advantech was able to customize the solution for them, and their engineering team considered many design criteria and provided positive suggestions. Advantech IPCs already meet global certification levels, so when a customer applies for global certification, the whole process is completed within a short time.

Intelligent IPC System for Semiconductor Handler Equipment



Location: **Taiwan**

Background

At the back end of the IC manufacturing process, semiconductor handlers are used to sort products into different types of packages. The handlers have to perform sorting, picking, and placing, so their stability, precision, and reliability are crucial and as technology evolves, systems have to be upgraded accordingly to improve performance.

System Requirements

An IC packaging and test equipment machine builder based in Taiwan who sells high-end equipment to IC packaging and testing manufacturers was looking for a more reliable, highly scalable solution that could help them upgrade their performance of semiconductor IC handler equipment. The solution needed to support their legacy equipment but also be able to adapt to newer generation computing systems, as well as accommodate plenty of PCI expansion. Advantech already had a long-term partnership with the customer so our sales proactively reached out and offered them the most advanced Advantech solution.

Project Implementation

IPC-623

4U 20-slot rackmount chassis

PCE-7132

10th Gen. PICMG 1.3 single board computer

PCE-7B19-88B1E

19-slot backplane for 20-slot chassis

PCI-1285-AE

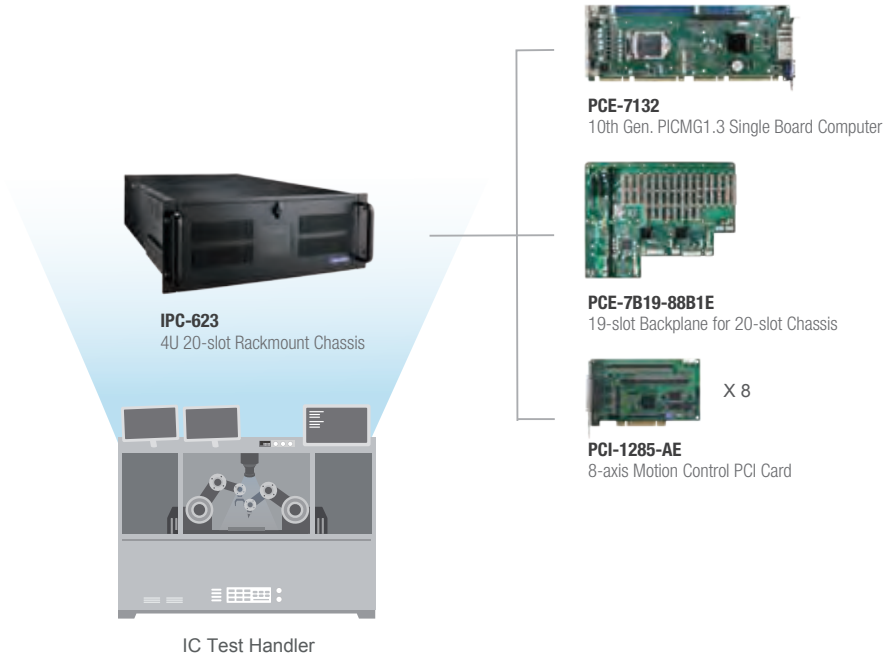
8-axis motion control PCI cards

System Description

The customer's current system was getting old and could not detect their motion cards very well, so they wanted to upgrade their equipment whilst supporting legacy equipment for an overall performance boost. Advantech's high performance PCE-7132,is equipped with 10th Generation Intel® Xeon®/Core™ i9/i7/i5/i3/Pentium® CPU and DDR4, SATA 3.0, USB 3.2, M.2, Dual GbE and triple display, was chosen to fulfill their application requirements.

The full solution included PCE-7132 system host board accommodated on PCE-7B19-88B1E, a 19-slot backplane with high PCI card expansion capacity, placed inside an IPC-623 4U 20-slot rackmount chassis. Furthermore, the IPC-623 chassis has three 12 cm / 150 CFM fans to cool the heat generated by multiple motion and LAN cards assembled inside. The PCE-7B19-88B1E backplane can accommodate 8 x 8-axis high-speed motion control boards for picking and placing, and an additional 2 x PCIe card slots can be used for future expansion and upgrades. Combined they perfectly met the expectations for the IC handler equipment.

System Diagram

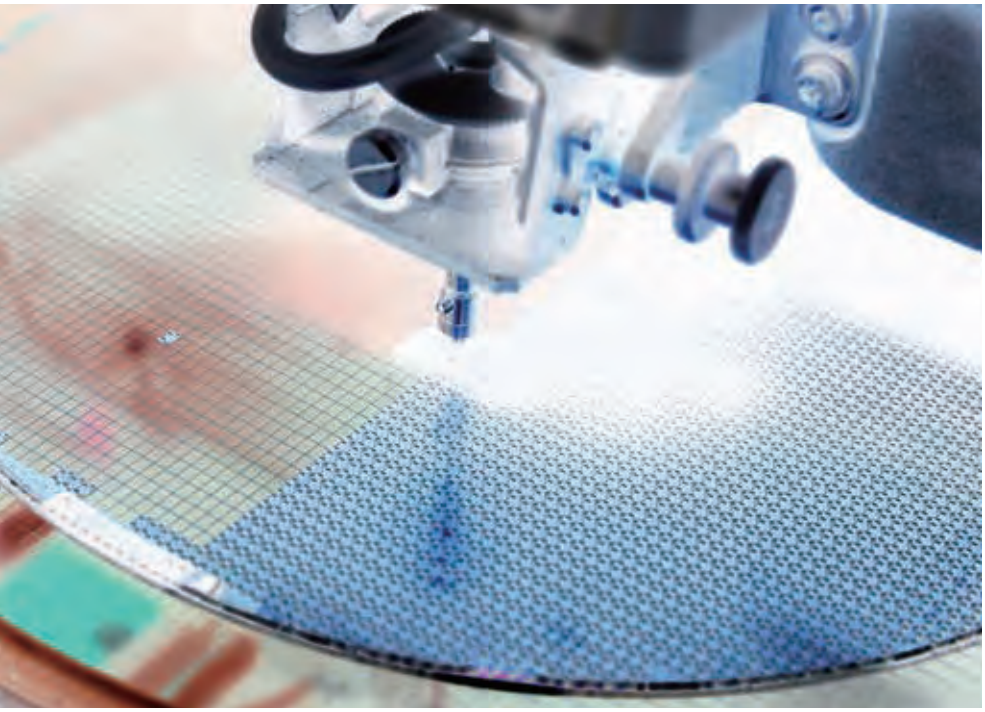


Why Advantech?

The IC handler solution for precise motion control and processing was based on Advantech's intelligent IPC solution, which met all system requirements as well as flexible expansion and longevity, and excellent thermal (3 x fans) performance.

There were several reasons that tipped the edge toward Advantech for the customer, such as our fast turnaround time, strong technical support, good after-sales services and high performance industrial-grade hardware that performs well in a harsh working environments with high vibration. With all these advantages, customers could upgrade their production lines and keep ahead of the competition.

Semiconductor Equipment Builder in Singapore



Location: **Singapore**

Background

The semiconductor equipment business produces a diverse range of machines from bonding and molding, trimming and forming, to the integration of all production lines into complete in-line systems for microelectronics, semiconductor, photonics, and optoelectronics industries. As such, equipment builders are themselves susceptible to global supply chains and commodities used in manufacturing these machines. Consumer-grade components and parts will not meet the strict benchmarks and reliability requirements for customers who purchase equipment, and equipment builders do not want to be inundated with products that keep needing RMA returns.

System Requirements

A world leader in the supply of semiconductor assembly and packaging equipment and surface mount technology solutions based in Singapore who produces high-quality equipment for all major steps in the electronics manufacturing process - from carrier for chip interconnection to chip assembly and packaging to semiconductor manufacturers. Initially they produced some of their equipment using consumer-grade components and parts but found they had problems with their customers who purchased their equipment but struggled with reliability and other issues. Being a long term partner with Advantech, they approached Advantech for an industrial-grade hardware solution.

Advantech noticed board damage issues when customers assembled their industrial motherboard within their own consumer grade chassis. Without a complete industrial grade solution, they noticed RMA rates were high as their customers complained of issues relating to product longevity, material changes, and revision control of both HW and SW. So, Advantech proposed a customized total solution that would avoid board damage and would also satisfy their customer's strict requirements.

Project Implementation

Customized 13" chassis with 300W - 500W PS2 PSU

AIMB-786

8/9th gen industrial ATX motherboard

PCI-1245

4-axis stepping and servo motor control card

PCE-USB4-00A1E

4-port USB 3.0 card (1-3pcs/ per unit)

PCI-1620

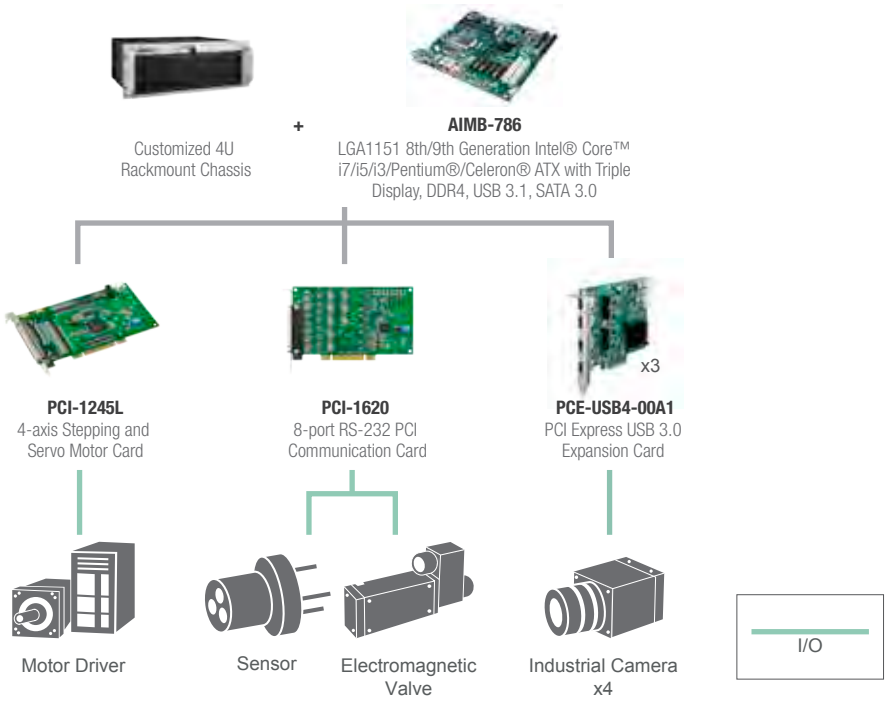
RS-232 communication card

System Description

Part of the solution included a customized 13” chassis with AIMB-786 Intel 9th Gen desktop core I3/I5/I7 industrial-grade ATX motherboard. Multiple expansion slots allow different external cards for different models. In the early stage of chassis customization, Advantech considered future potential spec/function expansions such as power upgrades that needed careful space and thermal flow considerations. For this project, the cable length and pin specs also needed to be customized and our mechanical design team also considered cable placement within the chassis, which helped facilitate air flow throughout the chassis and made assembly/upgrading easier.

Being a global semiconductor supplier, customers needs to be competitive in the field, Therefore, a reliable industrial grade specification with careful revision control management would ensure the customer spends less effort on hardware changes, and focuses more on software development. Plus, world-wide RMA and logistic support were two key points to improve their global business.

System Diagram

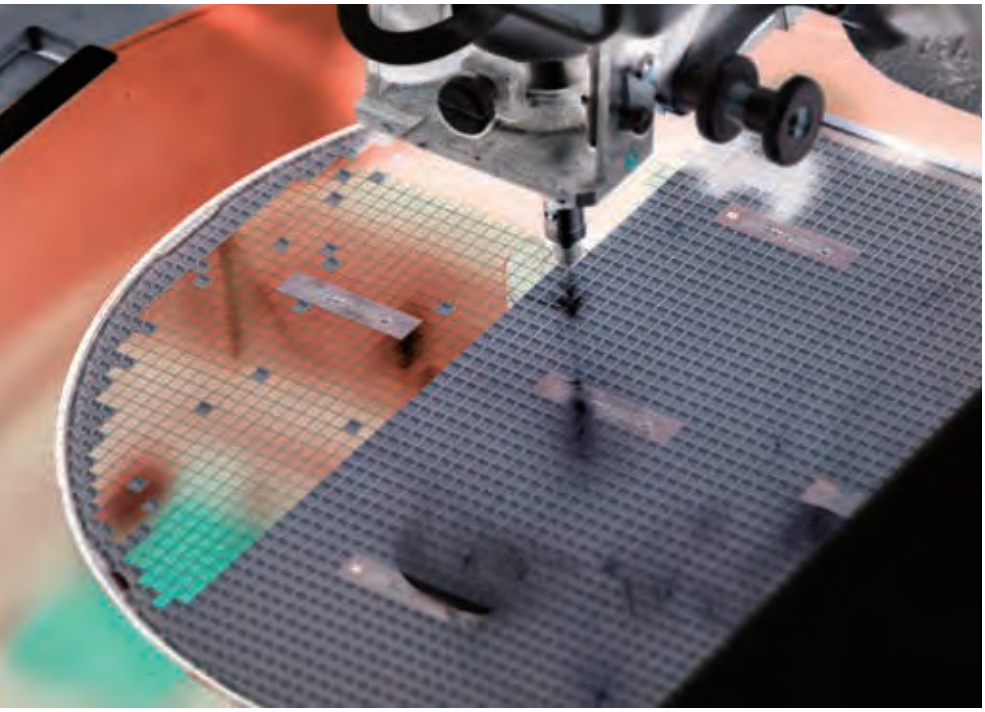


Why Advantech?

The target for the Advantech IPC team was to understand all the details about the actual issue and manufacturing background, then propose and design the most appropriate solution to fulfill customer’s requirements and deliver a highly reliable solution. Advantech works with 1st tier IC supplier (to provide the latest generation chipsets, so customers enjoy the latest technologies. Advantech’s global RMA service and logistics management, and worldwide after sales service helped secure the customer’s confidence and trust.

- Extensive system design experience.
- High quality industrial grade design.
- Longevity support and revision control.
- One shop service from design to certification.
- Global RMA and logistics support.

Vision Positioning Solution for Wafer Cleaning



Location: **Asia**

Background

Wafer cleaning is a crucial part of the semiconductor manufacturing process. The wafer cleaning process removes the photoresist, organic substances, metals, particles, and impurities. It then polishes the wafers using chemical solvents and water, which ensures a precise wafer yield rate. Wafers are cleaned before and after each process throughout the entire IC production line and takes up approximately 1/3 of the whole production time. In the highly competitive IC wafer production business, precision, efficiency, and optimization are what manufacturers look for.

System Requirements

Semiconductor manufacturers have strict criteria for material suppliers and equipment vendors, only certified system integrators/vendors are allowed in their supply chain. Advantech has a long-time partnership with a system integrator (SI) who serves a top tier semiconductor manufacturer in Taiwan who were looking for a solution to optimize and shorten wafer cleaning and positioning times.

Before the cleaning process there is a step called “wafer centering”, which sits after the wafer is picked up from the cassette. This is performed by a kind of mechanical gripper device used to re-center each wafer using a positioning algorism. Unfortunately this results in a slight decrease in cleaning efficiency as time is lost when wafers are carefully re-centered. In addition, there’s a small but significant risk of wafer cracking caused by the gripper tool contact, which could result in efficiency loss.

Advantech proposed using a machine vision solution to replace the mechanical positioning equipment and results show that each wafer can now be accurately re-centered in milliseconds rather than seconds—without wafer damage.

Project Implementation

IPC-7120

Desktop/wallmount chassis with front I/O interfaces

AIMB-787

10th Gen. Intel CPU motherboard

PCIE-1674

4-Port PCI Express GigE vision frame grabber

AIIS-3410P

Compact vision analysis platform

QUARTZ

20.0 Mega Pixel PoE industrial camera

VisionNavi

VisionNavi

Machine vision edge solution ready platform

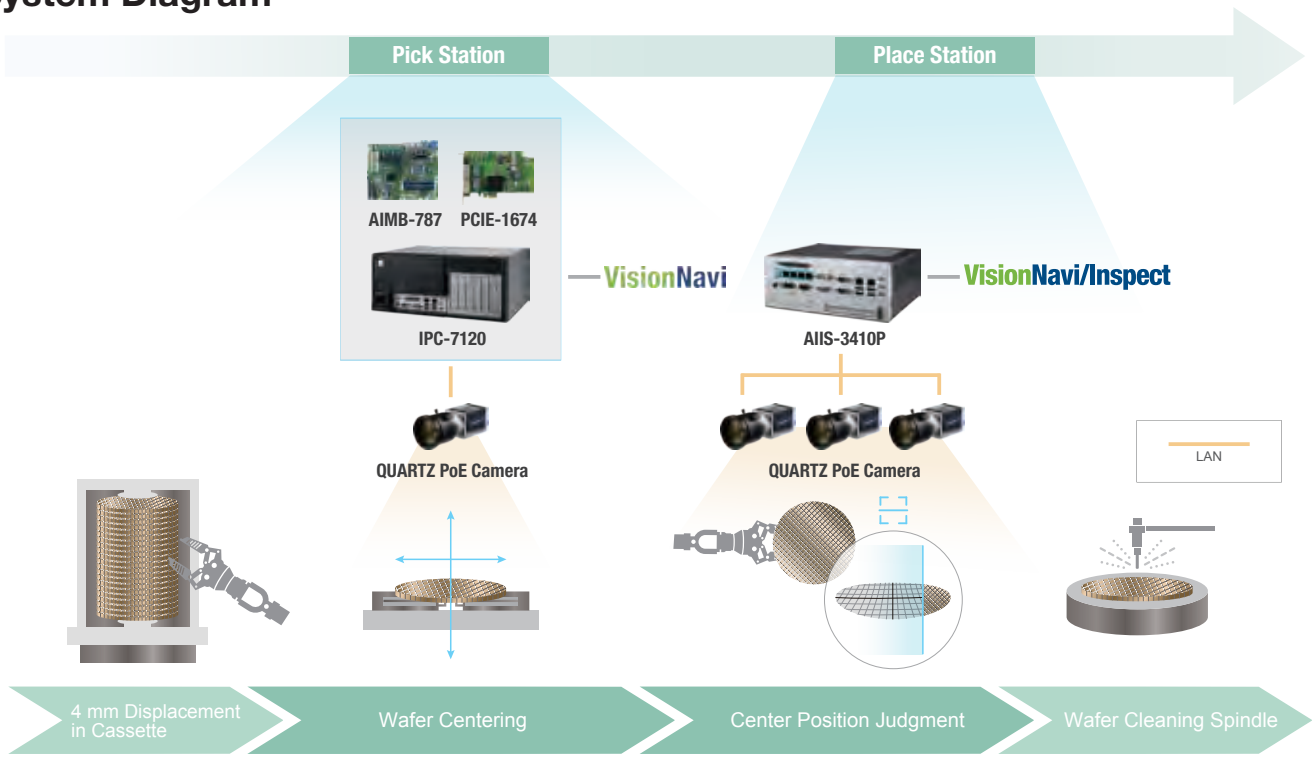
System Description

Because every process and mechanical movement causes a slight displacement from a wafer's original absolute position, the exact center position must be recalculated to allow the precise adjustments needed for the next step. There are two stations between a pick and place machine: the pick station—a location and process whereby the robot takes a wafer from the cassette carrier to the intermediate station for centering; the place station, a location and process whereby the robot measures the wafers position and transfers it to the spindle for cleaning. On the pick station, wafers in the cassette can typically have up to a 4 mm displacement error caused by the cassette carrier action. The grabber tool then picks each wafer up from the cassette and places it on an intermediate station for error correction.

For this project, the system integrator contractor integrated Advantech's IPC-7120 + AIMB-787+ PCIE-1674 with built-in VisionNavi and one Advantech QCAM mega pixel PoE industrial camera on an intermediate station to help with position correction. The QCAM was installed above the wafer to capture visual data, which is sent back to IPC-7120 + ASMB-787 and VisionNavi for analysis and action.

An AIIS-3410P compact vision system computer is used on the place station with VisionNavi and three QCAMs to judge the center position and any warpage before a wafer is moved to a wafer spindle for cleaning. Once the center position and warpage are calculated, the robot is notified and told to place the wafer onto a cleaning spindle in a precise position without imbalance or vibration to complete the final cleaning process.

System Diagram



Why Advantech?

Achieving a yield rate 99.9% across millions of wafers a year is very challenging in IC wafer production that involves complex physical interactions throughout the whole production. Advantech vision positioning solution greatly shortened the time for wafer cleaning from seconds to milliseconds (ms) and allowed precise pick and placement that avoided wafer damage.

The solution comprised of a high computing vision analysis platform for 20.0 megapixel PoE industrial cameras that performed high-speed wafer dimension calculations and center position measurements.

The intelligent vision analytic solution helped the IC manufacturer transform their wafer cleaning process into a smart optimized process. This helped them continuously manage and improve production yield rates and improve efficiency to maintain their premier position in the semiconductor manufacturing industry.

Automatic Vision Inspection Solution for Product Traceability in the Food and Beverage Industry

Location: **China**

Background

With greater market demand for food safety, traceability is receiving increasingly more attention in the food and beverage industry as well as the packaging industry.

Traceability refers to the ability to verify the history, location, and application of an item via documented recorded identification, thus enabling the recall of goods based on precise date/time and location information.

System Requirements

One of the world's leading providers of beverage containers required a system to identify bar codes and alphanumeric characters on ink-jet-printed labels at a run rate of 7 units and minimum 99.9% accuracy. Since there were few engineers in the factory, the customer sought to implement a reliable system with an easy-to-use GUI for workers with a less technical background.

Project Implementation

AIIS-3400P/U

Compact Vision System, Supports Intel® 6th generation Core i CPU, 4-CH Camera Interface for GigE PoE or USB 3.0

QCAM-GC2500-014CE / QCAM-UC2440-035CE

5.0MP Industrial Cameras with PoE / USB 3.0

Inspector Express

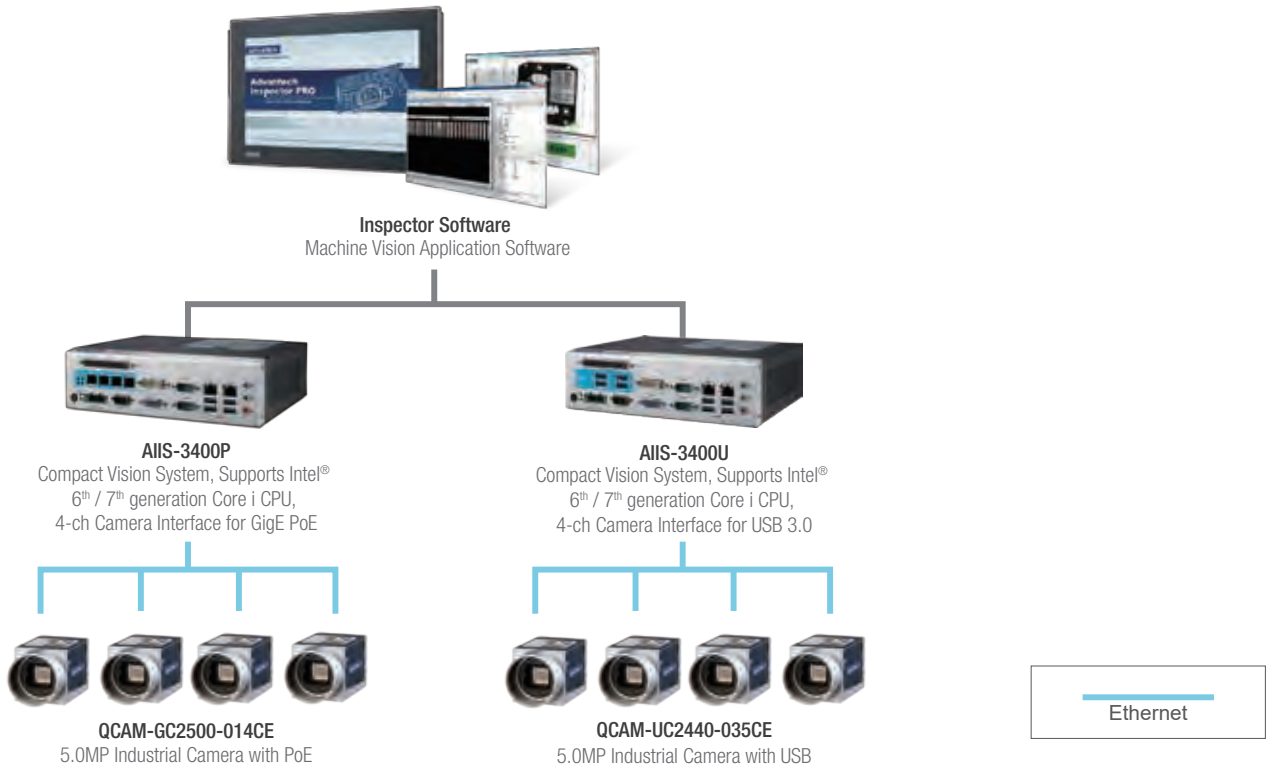
Machine Vision Application Software

System Description

Advantech provided a PC-based automated optical identification system with multiple cameras to identify bar codes, data codes, and characters on beverage containers.

The system included an AIIS-3400P 4-channel PoE, as well as an AIIS-3400U 4-channel USB compact vision system, both with Intel® 6th/7th generation Core i CPU; Inspector Express, a GUI machine vision application specifically designed for easy design and deployment of automated inspection on the factory floor; and QCAM series, 5.0MP industrial cameras with PoE and USB for simple installation and maintenance.

System Diagram



Why Advantech?

Advantech Inspector Express facilitates building and deploying machine vision applications without any programming skills. It supports a wide range of Advantech industrial PCs, smart cameras, and embedded systems, and can be deployed on different hardware platforms without modification.

The AIIS-3400P's series' support of PoE combines power and signal supply into a single cable, and GigE Vision compliance and the system's compact size further simplify installation and maintenance.

Advantech Empowers Smart Pharma Manufacturing Equipment and Machinery

Location: **China**

Background

The pharmaceutical industry increasingly relies on intelligent automation to meets safety requirements, improve product quality, and minimize human error and perturbations in the production process. Automatic process control and monitoring, enabled by internet connectivity, is therefore bringing Industry 4.0 to fruition within the pharma sector.

Chutian Technology Company is one of China's foremost pharma equipment developers. Based in Hunan Province, Chutian works closely with leading automation experts, including Advantech, in building advanced intelligent automation solutions that meet demand in vertical markets by delivering quality-assured products.

One example of this reciprocal partnership is Chutian's production of intelligent monitoring and control equipment used on pharma production lines. This equipment integrates Advantech's high performance industrial controllers and panel PCs for outstanding industrial craftsmanship.

System Requirements

The pharma inspection equipment requires the highest level of precision, accuracy, consistency, and stability. It cannot be affected by human emotions or fatigue due to extensive hours of operations. The system acquires images and implements data processing and image analyses. Higher computing ability allows for the system to process and analyze more images within a given period of time. To achieve precise, high quality inspection at rapid speed, performance computing power (including graphics processing power) is the most important requirement for industrial computers embedded in the system.

In addition to high speed and precision, Chutian emphasizes compact and simple mechanical designs so that their pharma inspection equipment can be easily installed or removed and avoid corners or edges that might incur hygienic issues. Automation components for pharma equipment must fulfill their form factor demands in addition to industrial requirements for reliability and durability.

Chutian prioritizes inspection equipment that acquires, integrates, and analyzes data, while also automatically comparing and checking up on historical data to identify problems in the production process. As such, computing capacity is critical to high quality data storage.

Project Implementation

TPC-5212W

Modular 21.5" Full HD with 6th Gen. Intel® Core™ i3-6100U Multi-Touch Panel Computer

ACP-4340

4U Rackmount Chassis for Full-size SHB/ SBC or ATX/MicroATX Motherboard with 4 Hot Swap Drive Trays

PCI-1761

8-ch Relay and 8-ch Isolated Digital Input PCI Card

PCI-1730U

32-ch Isolated Digital I/O Universal PCI Card

PCIE-1154

4-port PCI Express USB Vision Frame Grabber

PCIE-1674

4-Port PCI Express GigE Vision Frame Grabber

QCAM-UC0640-750CE

Camera, 640x480 0.3MP 1/4" Color 751fps USB

System Description

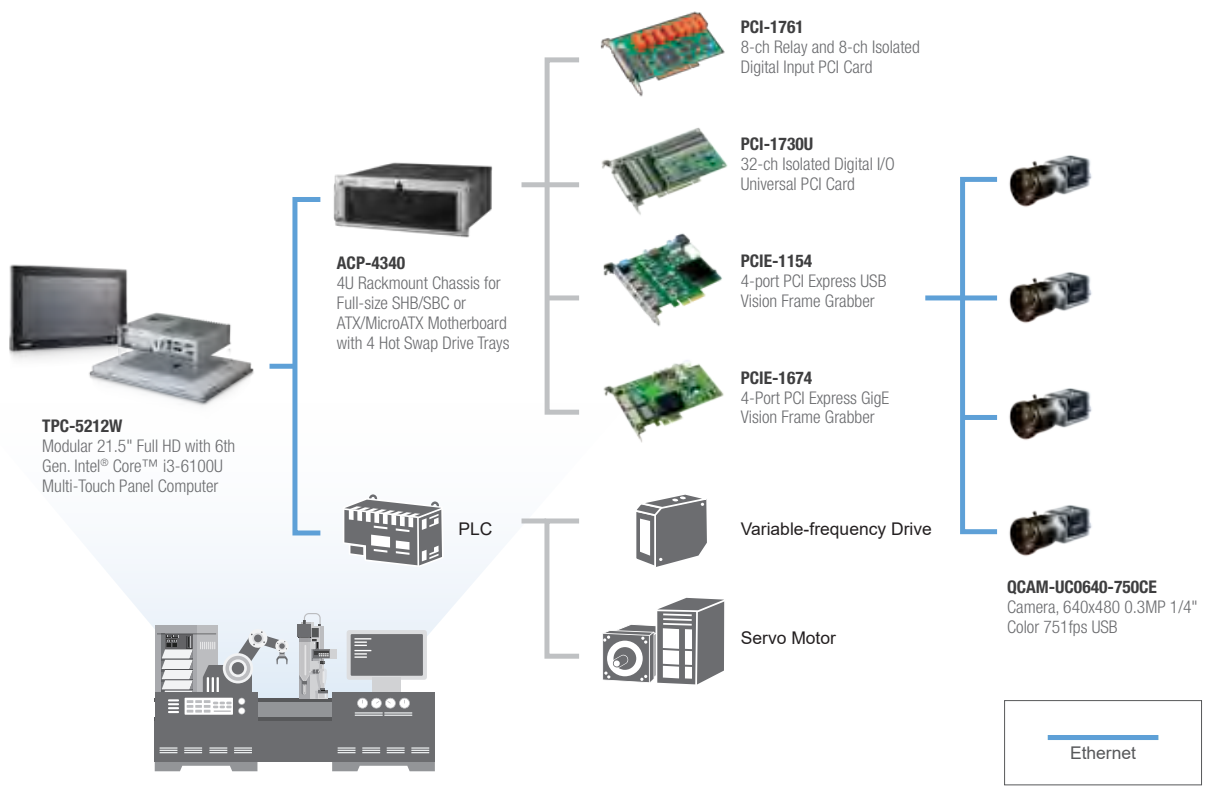
Chutian's intelligent inspection system for pharma production is based on the following client/server architecture: an Advantech Industrial Panel PC (TPC) serves as the server connecting to several Advantech industrial controllers (clients) at different workstations which are respectively in charge of detecting different types of flaws.

The industrial controller at each workstation connects to a PLC via a PCI-based interface to enable automatic motion controls. It connects to camera(s) via a USB card or PoE interface of the PCIe standard to acquire, process, and analyze images and upload the results to the TPC server for integrated analysis and storage.

The Advantech Industrial Panel PC not only visualizes and displays processed data, but also executes algorithms provided by the upper computer at the backend and delivers feedbacks to controllers and PLCs. In this way, the small form factor TPC plays a niche role in connecting and communicating with all parts of the system and in realizing motion and visual controls required in IIoT applications

As the PC controllers play a major role in processing and analyzing images acquired from the cameras, Advantech offers high performance industrial computers that can be embedded in the system with commensurate computing power to support the highest precision, quality, and speed requirements of Chutian's pharma inspection equipment. Advantech's solution is in keeping with Chutian's design philosophy of compactness and simplicity.

System Diagram



Why Advantech?

According to the head of Chutian's inspection department, the company chose Advantech because our products provide high speed and reliable performance that meets quality benchmarks, fulfills industrial requirements for anti-shock and vibrations capabilities, and offers a wide temperature range for operational reliability.

For the inspection system, Advantech provided high performance controllers for implementing data acquisition, graphic processing, and image analyses that ensured the highest levels of precision and speed. The controllers provided sufficient storage capacity for storing analyzed images in batch production over extensive hours.

Advantech's TPC series provides critical server functions with minimum footprints. With a complete array of products on the market, Advantech provides options of varied sizes, performance grades, and with flexible I/O expansion for our customers to select products that are best suited for their applications. We work to ensure Advantech technologies seamlessly fit into the systems of our customers with minimum adjustment.

AI Empowered Cookie Factory

Location: **Japan**

Background

Can artificial intelligence cook and prepare the food we eat every day?

One such factory that makes cookies uses it to ensure that each individual item is perfectly baked before packing and shipping so that customers receive a consistent high-quality product. Part of maintaining a perfect bake means keeping a constant temperature in the ovens 24/7, especially when it comes to batch baking different types of cookies. Right now the factory uses visual inspection, whereby workers check the bake levels and adjust oven temperatures based on their skill and experience. Staff experience is not always 100% consistent though and each person has their own subjective judgement. On the contrary, AI behaves in a non-emotional way and each robot inspects each cookie objectively and controls the oven temperatures automatically. The ever increasing scale of production means the factory can no longer rely on human intelligence to keep up with consumer demand. But with AI, production is optimized and new product types can be developed based on market research from customers.

System Requirements

To build an AI-driven quality control system for the production line, AI models needed to be prepared prior to deployment. An AI model training server was setup to capture video and collect image datasets from the production lines. Meanwhile, AI models were generated based on carefully designed neural networks and AI training servers leveraged GPU and CPU processing power to manage all the edge AI systems. These AI models were deployed to inference systems via model management software on the training server and on-site training was necessary to improve accuracy on the actual production line.

The AI inference systems on the production line needed to be fanless designs to resist flour and dust damage from the environment. A small form factor was another feature needed to integrate the new edge AI system with existing legacy equipment. AI deployment was critical since the cookie product lines were expected to run at full speed and could not be delayed during inspection. The edge AI system required multiple I/O interfaces to grab video/images from cameras and transmit metadata to central management.

Project Implementation

MIC-720AI

AI Inference System based on NVIDIA® Jetson™ Tegra X2 256 CUDA Cores

HPC-7000

Server Tower Chassis for EATX/ ATX/MicroATX Motherboard

ASMB-815I

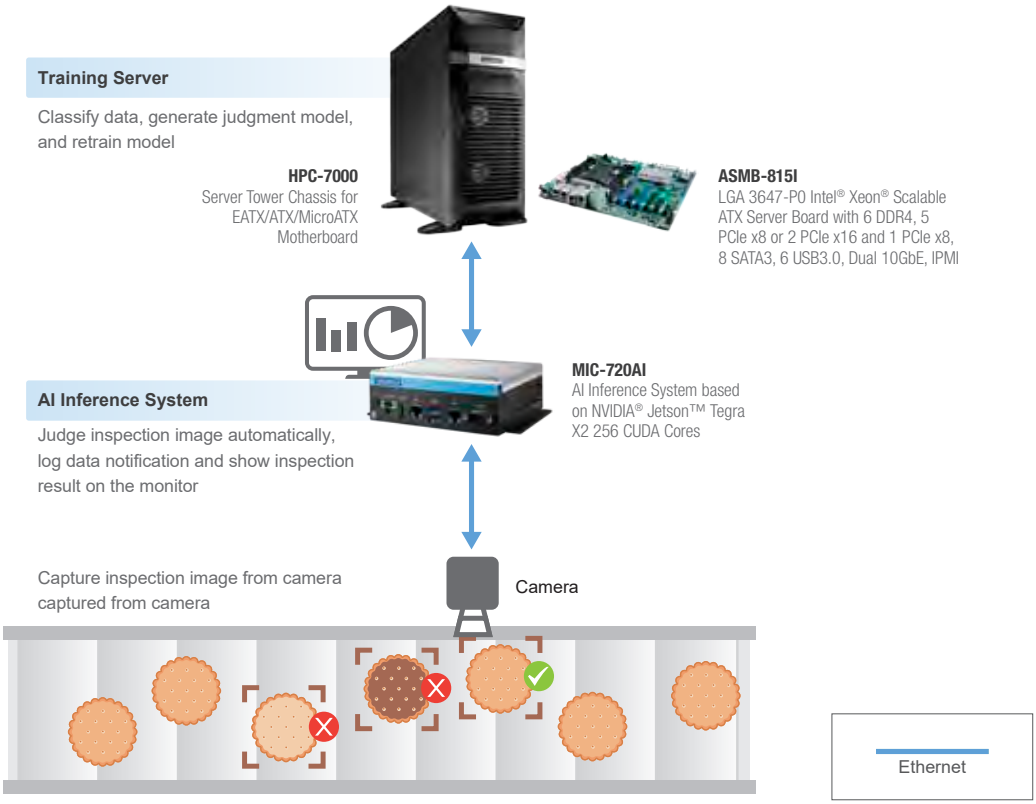
LGA 3647-P0 Intel® Xeon® Scalable ATX Server Board with 6 DDR4, 5 PCIe x8 or 2 PCIe x16 and 1 PCIe x8, 8 SATA3, 6 USB3.0, Dual 10GbE, IPMI

System Description

To collect such a large dataset and train various AI models, the factory integrated Advantech's HPC-7000 server with ASMB-815I server board and installed an RTX graphic card to make a powerful training server. The server has the capability to collect data from edge systems, perform image pre-processing before dataset labelling, and generate AI models for the production line. Once new data arrives, the process can quickly re-train models to increase accuracy.

To maintain baking consistency, Advantech's MIC-720AI AI Inference System was embedded with a variety of AI models that performed real-time inspection that ensured all cookies were perfectly baked. This edge AI system was also capable of capturing video/image data from area-wide cameras and automatically inspecting bake quality and sorting it into OK and NG categories. NG category cookies were flagged and show up on the display monitor for the attention of inspectors. Oven temperatures are adjusted as necessary. NG product images and log data were also recorded and sent to the management system for assessment. The factory now enjoys much better efficiency and more consistent high-quality cookie production thanks to their state of the art edge AI system.

System Diagram



Why Advantech?

To meet a wide variety of edge AI computing requirements in different environments, Advantech provides an AI end-to-end solution and offers a full range of edge servers and AI inference systems, which go together to perform AI inference solutions. Traditional industries typically reach a tipping point before they make the leap into AI. Advantech's product offering leverages powerful AI computing to support customer's business objectives. This AI solution for the cookie factory is a smart example of helping food manufacturers take that AI leap.

Yogurt Container Maker Uses Visual Inspection System to Increase Quality Control

Location: **Australia**

Background

An Australian dairy company has been producing the purest high quality set yogurt in traditional pots for over 60 years. In keeping with their spirit of innovation and commitment to quality, the yogurt manufacturer requires quality at every step of the process, which includes the special containers used to package their main product—yogurt.

While container production may seem trivial in the larger production picture, health and quality control results are dependent on the direct control of each step of the process. For the yogurt manufacturer, delivering the perfect container is not a trivial thing. A single imperfection can create sealing or hygiene issues that are incompatible with their impeccable standards for food production.

System Requirements

The yogurt manufacturer's approach to safeguarding quality standards involved the collaboration with a system integrator (SI) to augment the quality control process for their containers. As market innovators, the yogurt manufacturer understood their quality requirements started with production and continued all the way through to labeling and packing.

Quality starts with details and only correctly placed labels would pass quality controls and prevent a container from being removed from the final production line. On larger containers, handles are incorporated requiring specific orientation and placement for effective use, which was another crucial detail within the manufacturing process.

Project Implementation

AIIS-3400

Compact vision system

MIC-7700

Intel® 6th/7th Generation Core i desktop compact fanless system

PCIE-1674

Frame grabber card

FPM-7211W

Industrial monitor with PCT touch

QUARTZ

0.3-20.0 Mega Pixel PoE industrial cameras

System Description

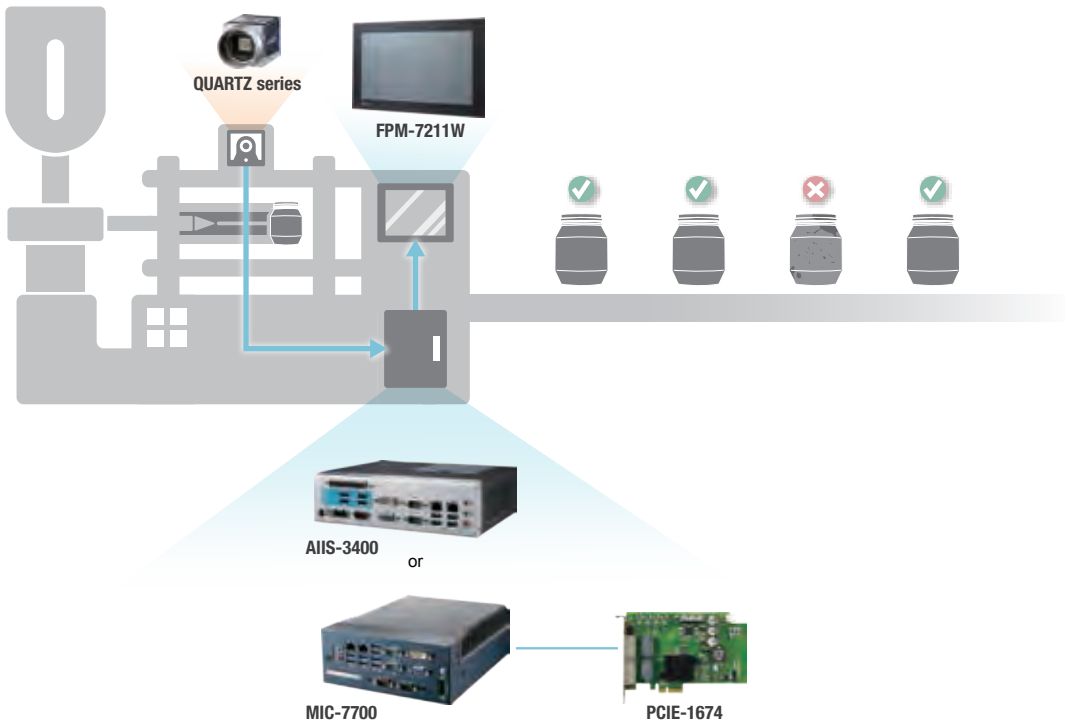
Stringent specifications meant delivering quality within the bounds of tight tolerances and that meant providing accurate production line inspections at all stages. The SI developed a visual inspection system on fundamentally sound principles, which meant a good container should easily go through the production line without any disruption.

Advantech QUARTZ cameras were installed to provide persistent inspection and real-time feedback on the quality of each batch. Achieving this task required the SI to locate and develop multiple positions within the plastic molding and assembly line for the inspection cameras.

Control cabinets provided operators with access to a user interface for system configuration and programming. This entailed determining the right location within the production line for the optimal positioning of the cabinets and their front facing viewing screens.

Cable routing needed to be discrete and out of sight throughout the entire system, which was facilitated by the use of bespoke networking devices. In addition, a future-proof design was needed to ensure flexible utility, minimal downtime and improved production output.

System Diagram



Why Advantech?

By implementing an automatic inspection system to inspect each container, the whole manufacturing process was streamlined.

The detection of defects was not the only outcome of the system. The inspection system also brought about the means to identify equipment issues. These could be tracked directly to the source and quickly resolved to prevent trickle-down problems. A secondary benefit came from the accumulation of data. The Advantech solution provided timed stamped images of defects for further analysis and refinement.

The inspection system allowed remote access, so they were able to monitor the system in real-time and perform inspection adjustments. In conjunction, manufacturing operators were able to alter production schedules based on surveillance results.

The Advantech vision inspection solution formed an integral part of the client's ability to consistently deliver high quality yogurt products to market while minimizing total cost without compromising on quality.

Screw Inspection Solution

Location: **Taiwan**

Background

Developments and upgrades in electronics industries have coincided with an increase in the usage of electronic screws, which has led to greater demand for high-quality screws.

Due to electronic screws requiring comprehensive quality control checks for appearance, size, and quality, it is a time-consuming task and one that can cause fatigue to the human eye when performed manually—especially given their vast number and small size—resulting in low efficiency and human error. Replacing this task with an optical inspection solution is thus becoming a necessity.

System Requirements

The customer required screw inspection equipment that could acquire images and data to analyze whether the screws were being fabricated according to specification, all of which had to be performed in real time. The analysis results were then to be used to determine whether the screws had any defects. Defective screws were then to be routed to a screening device for removal, and the production timing and number of defects were to be recorded.

Project Implementation

MIC-7700 / MIC-75M13

Intel® 6th / 7th Generation Core i Desktop Compact Fanless System / 4-slot Expansion i-Module with 1 PCIe x16, 3 PCI

PCI-1274

Basic 4-Axis Motion Control Card with Multi-Latch/Comparative Trigger Function

PCI-1730

32-ch Isolated Digital I/O Universal PCI Card

PCIE-1674E

4-Port PCI Express GigE Vision Frame Grabber

QCAM-GC1300

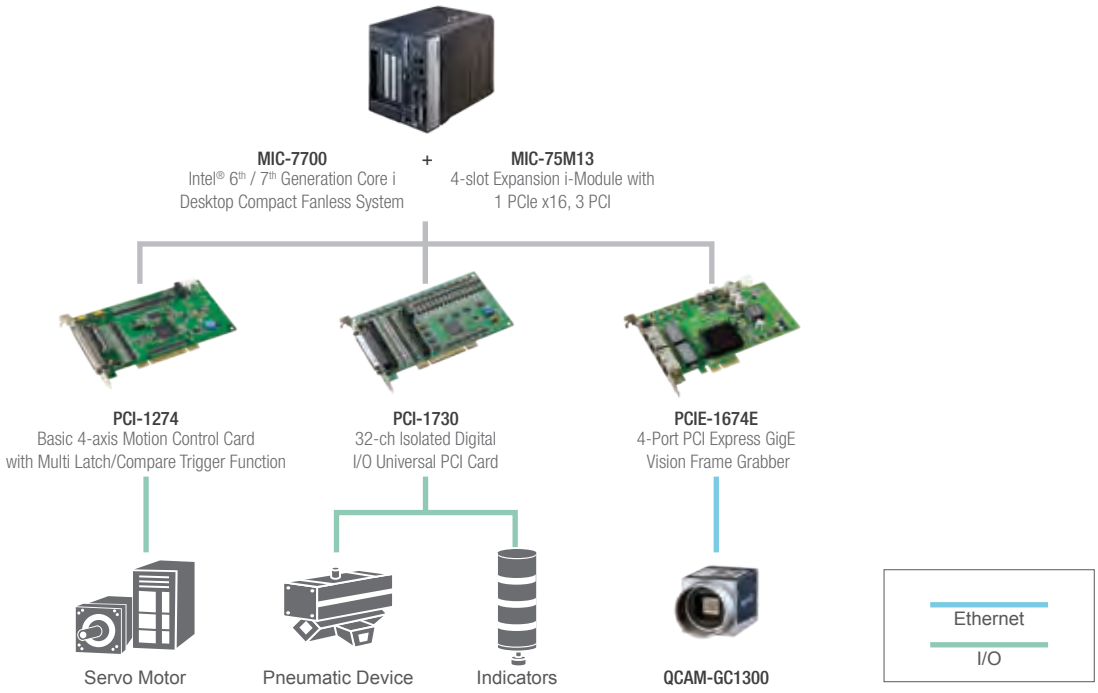
0.3~15-MP PoE Industrial Camera

System Description

The screw inspection platform was based on the modular IPC MIC-7700 with a MIC-75M13 4-slot expansion i-Module, the system was able to manage multi-tasking between precise motor control and high-accuracy visual inspections. Installed in the system was a PCI-1274 4-axis DCP-based motor control card for connecting to servo motors.

With support for Advantech's Common Motion API, this enabled the customer to utilize comparative trigger functions to efficiently plan for motor control. PCIE-1674E + QCAM GC1300 POE cards were also utilized to power the CCD cameras and retrieve image data. The PCI-1730 32-ch digital I/O card was also employed to connect the system to pneumatic devices and acquire signal data.

System Diagram



Why Advantech?

The PCI-1274's comparative trigger function cut costs for the customer by allowing them to shorten their program development time.

In addition to the benefit of adopting a total solution, this saved system integration time and accelerated the customer's development speed.

With our team of application engineers providing technological support, we were thus able to satisfy this customer's CCD needs.

Advantech Solution for Aerospace Electronics Testing Systems

Location: **Taiwan**

Background

At the initial stage of airplane development, the various controls are first simulated using an aerospace electronics testing system. First confirming the switch logic and functions ensures that the system's control surfaces can be safely replicated in an actual flight cabin. This approach ensures that the controls will function as intended and is thus critical to flight safety.

Aeronautic electronics testing platforms feature a variety of control devices, dashboards, and signal displays, and are laid out identically to those found in actual aircraft, even with simulated flight instructions. These systems are then employed in professional flight simulation platforms, which are critical to pilot training because they provide a safe environment for becoming familiar with the controls without any human risk. Moreover, the cost of simulations is markedly lower than the cost of purchasing and flying an actual plane.

System Requirements

Cockpit controls are complex and intricate, with numerous digital and analog switches. The customer needed a system that was both reliable and flexible in order to handle varying requirements and the testing of multifunctional signals.

To ensure high stability, it was essential to have an industrial-grade PC with digital I/O, A/D conversion, and A/D signal data acquisition capabilities. Furthermore it had to be able to output analog and digital signals to control the automated knobs and digital switches.

Project Implementation

ACP-4340

4U Intelligent Rackmount Chassis with 4 Hot-Swap Drive Trays

PCE-5129/ PCE-5B12

PICMG 1.3 CPU card supporting 6th / 7th Generation Intel® Core™ i Processor/ 12-Slot BP for 14-Slot Chassis

PCI-1747U

250 kS/s, 16-bit, 64-ch Analog Input Universal PCI Card

PCI-1724U

14-bit, 32-ch Isolated Analog Output Universal PCI Card

PCI-1753

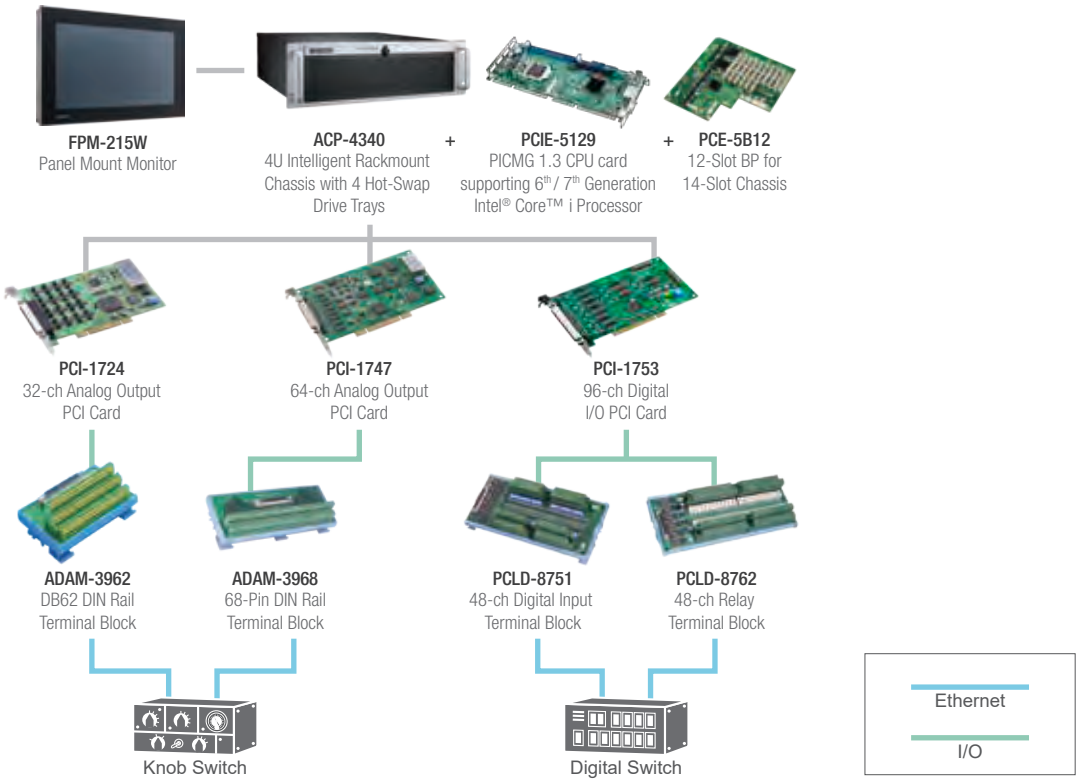
96-ch Digital I/O PCI Card

System Description

The system comprised an ACP-4340 rackmount chassis, PCE-5129 Intel® Core™ processor-based platform, PCE-5B12 12-slot backplane, and FPM-7212W 21" monitor. It was fitted with a Core-i7 CPU to ensure high-performance multi-task processing between controlling the A/D switches and acquiring signal data. Adopting the PCE-5B12 ensured that the system could support a range of specifications, with PCI, PCIe, and PCI-X slots to satisfy the customer's various control cards, digital I/O modules, A/D converters, and data acquisition cards.

With Advantech's DAQNAVI SDK, the PCI-1747 64-ch analog input card, PCI -1724 32-ch analog output card, and PCI-1753 96-ch digital I/O card provided a powerfully rich interface to simulate the control surface, with the ISD-3221 utilized for the cockpit display.

System Diagram



Why Advantech?

Aerospace applications have continued to expand with developments in basic electronics technology, particularly with aerospace systems being such a key component in aircraft development and pilot training. Modern aviation applications have thus emerged from the integration of advanced aerospace systems and onboard electronic equipment.

To satisfy this customer's multipurpose signal testing requirements, Advantech's stable and efficient platform as well as the flexible expansion options of the motherboard complemented the various card requirements, such as the need for multi-channel digital I/O, A/D conversion, and data acquisition cards. By utilizing Advantech's DAQNAVI software SDK, the customer is now able to rapidly develop aeronautics testing platforms to verify the dashboard logic control and functionality.

In addition, at the initial stage of dashboard development, the customer will not need to invest large sums of capital to obtain US/EU high-end measurement equipment signals. With the high price–performance ratio of Advantech's industrial calculator, the customer can attain reliable measurement control data at minimal cost.

Accurate Predictive Maintenance System for World Leading Screw and Nut Manufacturer

Background

This global leader in screw manufacturing partnered with Advantech to create a predictive maintenance system for screw forming machines. With a production capacity of 6.6 billion nuts per year, the company depends highly on automated manufacturing equipment. As such, the risk of considerable losses in the event of equipment failure is high. Previously, experienced technicians had to literally listen to the equipment and identify the source of a problem when a machine would make unusual noises.

However, this subjective troubleshooting method is relatively limited, particularly given the noise levels of factories, difficulty in transferring experience other workers, and the unique sounds that different machines make. To rectify this problem, the company invested in predictive maintenance. Initially, they considered purchasing a solution from a major overseas automation vendor. However, because of the high cost, the company sought a local system integrator.

System Requirements

Finding a local manufacturer suitable for this task proved difficult, primarily because working with screw forming machines requires considerable specialized knowledge. Most equipment suppliers and system integrators lack relevant experience and would likely need to invest time and effort into research and development. Even after system implementation, calibration would require substantial effort, and system performance would unlikely be sufficient. Eventually, a professional system integrator was contracted to implement the system with Advantech's products. Leveraging Advantech's extensive experience in this field, the screw manufacturer successfully completed its predictive maintenance system.

To create an optimal system, sufficient technical expertise in screw forming is imperative. In the process, metal wires are cut and then passed through a cold forging press three times before the screws are formed. Subsequently, the rough cut must go through several operations, including turning, thread rolling, heat treatment, and electroplating before they are completed. The most important step in this procedure is cold forging. Because this process requires up to dozens of tons of pressure to impact the screw die, the die's lifespan is difficult to estimate. Replacing it too early would be too costly, while delaying its replacement might damage the machine and delay production. Thus, accurately estimating the die's useful life is critical.

Project Implementation

IPC-7130

Desktop/Wallmount Chassis for ATX/MicroATX Motherboard with Dual Hot-Swap 3.5" Drive Bays

AIMB-786

LGA1151 8th/9th Gen. Intel® Core™ i7/i5/i3/Pentium®/Celeron® ATX with Triple Display, DDR4, USB 3.1, SATA 3.0

PCIE-1810

500 KS/s, 12-bit, 16-ch PCI Express Multifunction Card

PCLD-8712

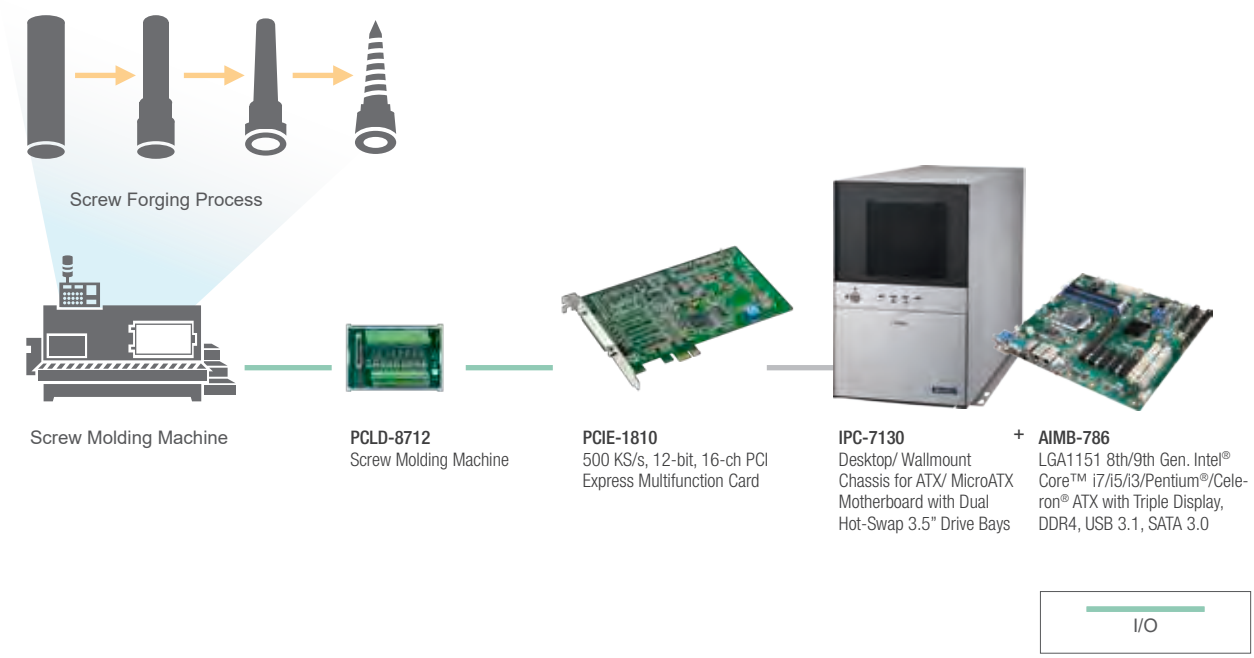
Signal Conditioning Terminal Block

System Description

Advantech proposed using an IPC-7130 chassis with an AIMB-786 motherboard (featuring a Core i7 CPU), a PCIE-1810 analog multifunction card (500-KS/s, 12-bit, 16-channel), and a customized PCLD-8712SSO signal-conditioning terminal block. The operation of the overall system is as follows: a piezoelectric sensor is installed in the forming machine to monitor the stamping waveform to determine the degree of deterioration of the die in order to ensure timely replacement.

The key performance indicator that the company sought to improve by implementing the predictive maintenance system was the availability rate. Following installation of the system, the screw forming machines used by the company can now accurately detect the status of each die, and the likelihood of equipment failure has been significantly reduced.

System Diagram



Why Advantech?

The screw forming machine is a typical example of an industrial IoT (IIoT) application, which must be constructed on the basis of specialized knowledge about vertical markets. For screw forming machines, because the stamping pressure exerted on the die is extremely high and because screws are produced in large volumes at very high speeds, accurately detecting the die status is inherently difficult, which is why adequate industry experience is essential in deriving the optimal implementation method. Advantech equipped the forging mold with sensors; by continuously analyzing the vibration waveforms to determine the mold's condition, the entire system was completed in less than 6 months, including design, testing, implementation, and calibration.

For smart factories of the future, IIoT will be the principal framework for manufacturing systems. However, there are many types of manufacturing, each involving a different set of products and vastly different automation equipment. Thus, the development of IIoT systems relies on the expertise of system integrators and equipment suppliers for systems to be built in a reasonable timeframe.

Realizing Human–Robot Control and MES Management with Advantech's Total Industrial HMI Solution

Background

Industry 4.0 is changing the way manufacturing industry operates. Increasingly more manufacturers are leveraging advanced technologies such as robotics and automation systems to improve productivity and efficiency. As a result, human–machine interfaces (HMIs) are becoming more important in their role in the digital connectedness of humans and machines. However, using the wrong HMI can lengthen development times and increase implementation costs.

Taking RISC-based HMIs as an example, their simplified instruction architecture makes it difficult to design a versatile system for robotics, and future system expansion tends to be limited. Once such an HMI has been adopted, additional hardware may need to be purchased in order to complete the system. This not only complicates the system configuration but also requires additional effort and time to be spent on program design and system maintenance.

System Requirements

As a specialist in the field of robotics and automation technology, KUKA Robotics is a leading manufacturer in industrial robots. The company boasts a comprehensive portfolio of products and solutions ranging from individual robots and robotic cells for automated production steps all the way to large-scale customized systems.

Recently, KUKA Robotics was custom-developing an automated production management system for automotive transmission factory in Shanghai, China. The company previously used a RISC-based computer as the HMI. Since the functionality of this computer is too simple and because the system is difficult to customize, KUKA required an x86-based industrial panel PC to provide richer features for factory users. To facilitate maintenance and management, the new computer was to be utilized in the production lines to control the low-level robots as well as the upper-level MES; it also had to be suitable for monitoring assembly line operations and for managing product reworks.

Therefore, the new x86-based panel PC had to meet the following requirements:

- All-in-one panel PC with a compact size for easy deployment in any workspace
- Support for the Profinet communication protocol to connect various PLCs for control of robots
- Easy-to-use software for HMI GUI customization
- Compatibility with IE browser for system access and data visualization
- Power-failure protection mechanism to ensure the reliability and stability of the system.

Project Implementation

PPC-3120S

12.1" fanless panel PC with Intel® Celeron® N2930 processor

PPC-IPS-AE

12~30 V_{DC} input, 24 V_{DC} output UPS module

WebAccess/HMI

HMI software

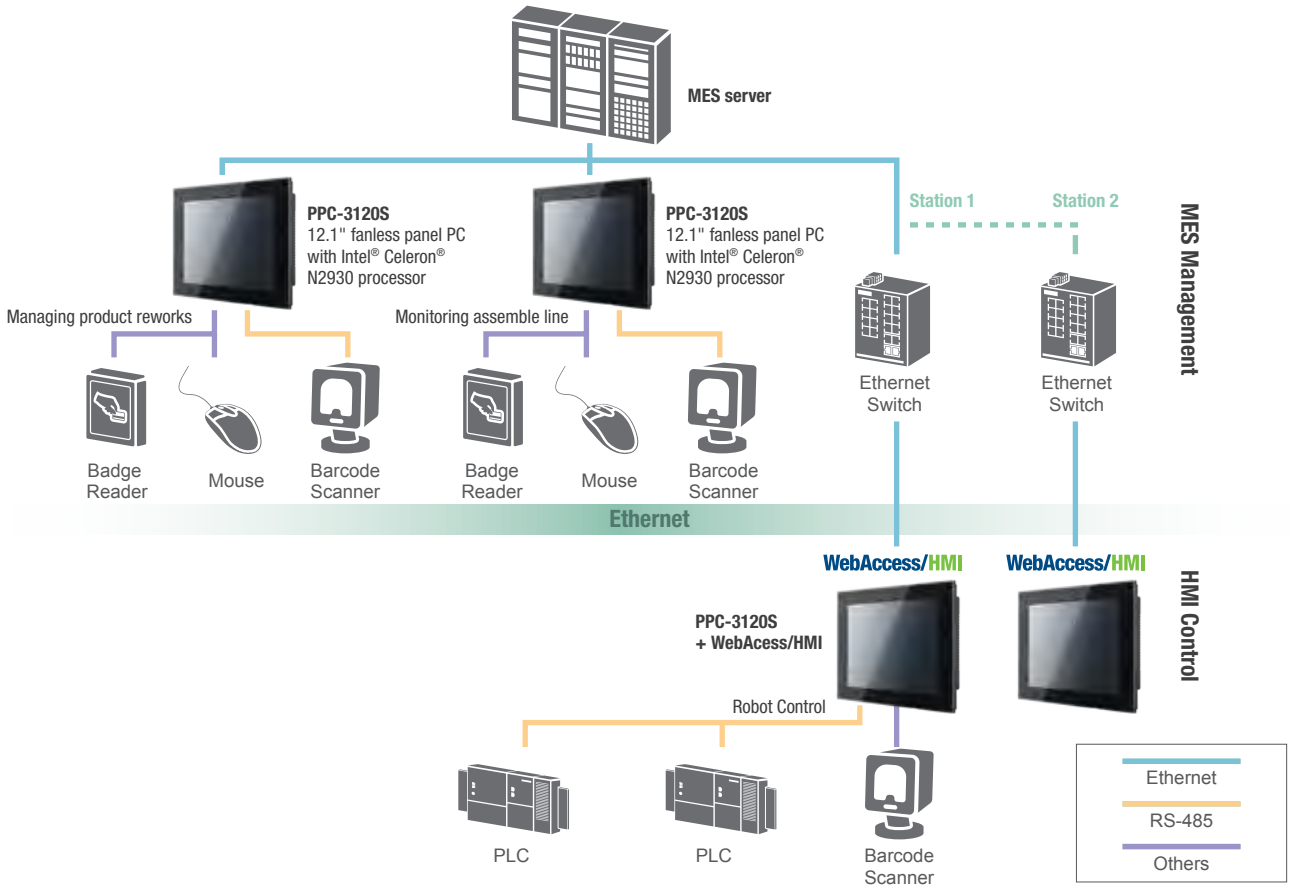
System Description

Advantech provides a total solution that met KUKA Robotics' needs. The solution included the PPC-3120S ultra slim panel PC, WebAccess/HMI software, and the PPC-IPS-AE uninterruptible power supply (UPS) module.

The project contains two parts: human robot control and MES management. For the human–robot control, the PPC-3120S was installed to provide an HMI for each work station. This unit was responsible for receiving work orders from the MES via the network while also being connected to PLCs via Profinet in order to control the robotics. It also displayed the SOP to help ensure that staff perform their job properly. For MES management, the PPC-3120S can act as a general computer for assembly line operation monitoring and rework management.

With a compact form factor and fanless design, the 12.1" PPC-3120S is an ultra-slim industrial-grade panel PC that users can freely install at their own convenience. The Intel® Celeron® N2930 processor ensures that the PPC-3120S delivers high-performance computing in an x86 development environment, providing flexibility for system developers in designing a multifunctional system. Equipped with a die-cast aluminum alloy enclosure and a touch screen with an IP65 rating for the front panel, the PPC-3120S also offers anti-shock and anti-vibration that make it solid and highly durable. For software, WebAccess/HMI provides a convenient graphical programming environment for system developers to intuitively create HMI screens, thus reducing programming time. With its browser-based interface, users can remotely engineer, monitor, and control the system via any standard browser such as IE. Supporting hundreds of industrial communication protocols, the PPC-3120S can be connected to a range of devices such as PLCs.

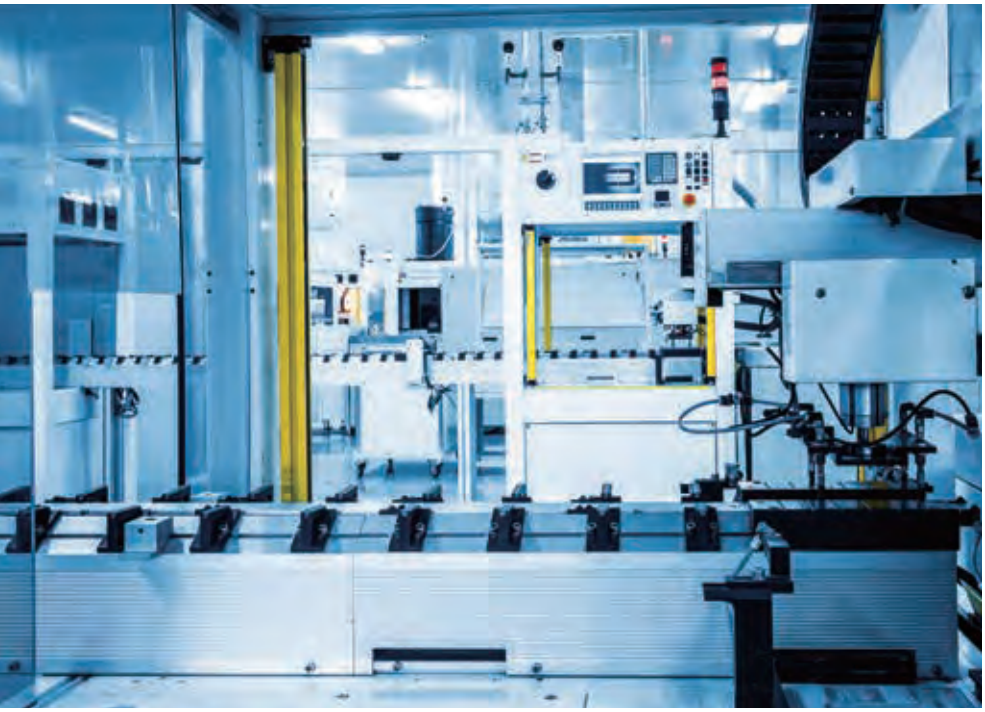
System Diagram



Why Advantech?

Industrial panel PCs are becoming essential tools for factory robotics and automation. Choosing the wrong product can lead to many problems, including lengthy implementation times and increased setup costs, but the right choice can ensure smooth operations. Advantech's PPC-3120S is an aesthetic, durable, and feature-rich ultra-slim panel PC that can be intuitively operated using WebAccess/HMI software. Furthermore, the PPC-IPS UPS module adds more value by ensuring system stability. This total solution has helped the KUKA's developers to easily complete system development, thus meeting their client's requirements. KUKA Robotics has gained satisfactory results, prompting the company to continue using the PPC-3120S in other projects.

Passive Component Inspecting Machine Solution



Location: **Taiwan**

Background

In the current market environment, passive components — inductors, capacitors, resistors, RFIDs — are being produced at high speeds with diversified modularization. However, quality testing remains an important issue to be addressed by respective manufacturers. To find an appropriate balance between throughput, quality, and diversification, a trustworthy and high-performance passive component inspecting machine is critical. To address this challenge, Advantech offers a total solution covering IPC, I/O cards, network communication cards, cameras, and motion control.

In this particular case, the customer required a technical solution combining IPC, a visual solution, I/O, POE, and an inspection speed of 2 m/s or less.

System Requirements

Micro-object inspection requires multi-module integration with the computer, PLC, pneumatic equipment, graphics processing, I/O, and network communication control.

Industrial computers are used to integrate three major components — the motor drive, pneumatic nozzle, and high-speed camera — and categorize items to be inspected in different classes. Once the item specifications are set, inspection and categorization can then be completed at high speeds. Doing so achieves greater efficiency with less manpower.

Effective system operation relies heavily on the stability of system integration. With inspection speeds of less than 10 m/s, there are several crucial elements for maintaining the equipment level: real-time interfacing of multi-camera transmission, the precision level of pneumatic control, and control over classification disk associativity.

For automation suppliers, stability in controlling respective modules, logistic support, and, in particular, integration between the computing platform and the PLC/pneumatic system are major priorities.

Project Implementation

IPC-7130

Desktop/Wallmount Chassis for ATX/MicroATX Motherboard with Dual Hot-Swap 3.5" Drive Bays

PCIE-1756

64-ch Isolated Digital I/O PCI Express Card

PCL-10250

SCSI-100 to 2*SCSI-50 Shielded Cable

ADAM-3951

50-pin DIN-rail Wiring Board w/ LED Indicators

PCIE-1674

4-Port PCI Express GigE Vision Frame Grabber

QCAM-GM0640-300CE

PoE Industrial Camera

System Description

In this case, the automation supplier chose the Advantech IPC-7130 industrial computer with ASMB-823 dual-CPU as the core of system. Through the composing procedure, the servo-control of the camera, pneumatic components, and rotating disk control were integrated to carry out three major tasks: splitting, multi-facet optical inspection, and pneumatic splitting.

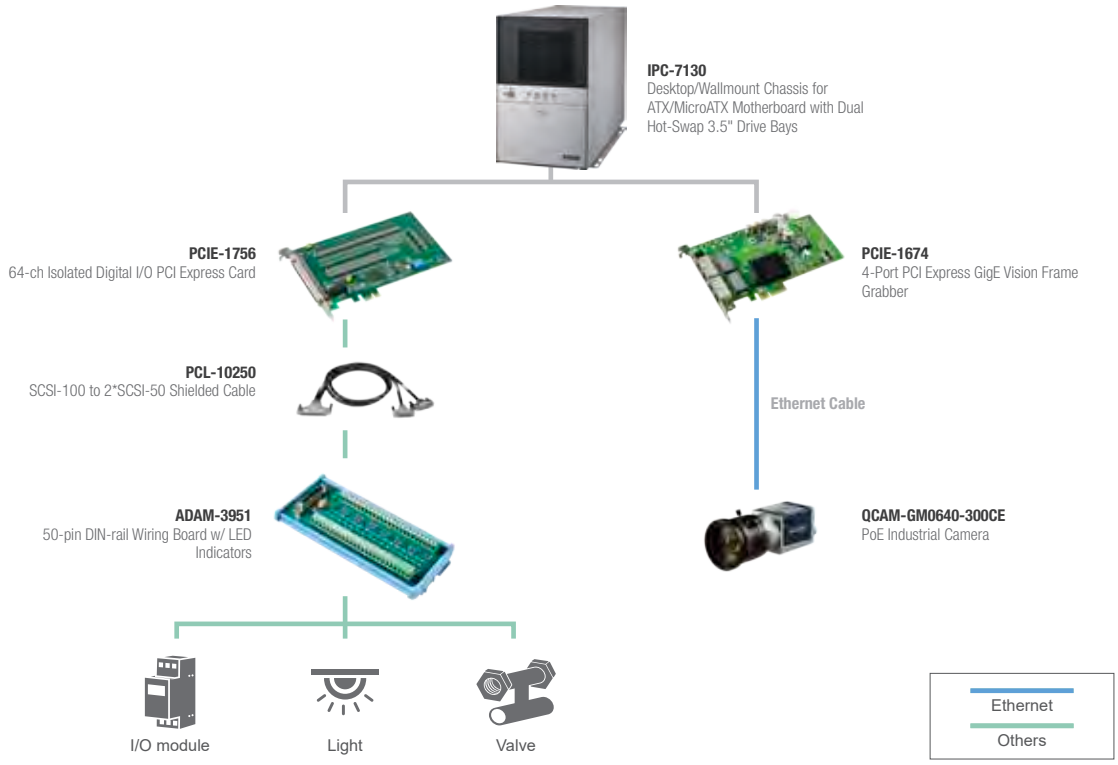
Integration of the three major control systems — ensuring IPC, AOI, and IO had the ability to perform high-speed processing, analysis, and control — was critical. Even when detecting micro-objects invisible to the human eye (0.6 x 0.3 x 0.2mm), the processing speed remained fast: less than 2 m/s per picture. As a whole, the competitive advantage of three-module integration that is similar to general automation lies in the stability of the pr high speed among different components in a multi-module combination.

Charge-coupled devices (CCD) with Advantech cameras (QCAM system) inspected surfaces of passive components at 120 FPS. A total of six cameras were set up for the inspection and took real-time photos, performed tests, and determined the product class.

For pneumatic components, the PCI-1756 high-speed I/O card simultaneously controlled more than ten nozzles in a multi-tasking manner and classified them at a rapid speed.

In terms of information integration, the industrial computer, together with the multi-channel I/O card and the multi-channel high-speed network card (PCIE-1674), integrated data from six cameras. The system performed graphical analysis, classification, and storage.

System Diagram



Why Advantech?

Due to its low speed and poor detection rates, traditional flow line inspection is often unable to fulfill production traceability requirements, and, as a result, increasingly being replaced with automatic visual inspection to fill the enormous demand for consumer electronics. Advantech's automated integration solution delivers one-stop service that integrates industrial computing, I/O data collection control, and AOI visual features. A specialized sales service focusing on integration can better address the issues arising on multiple modules quickly and effectively. Advantech provides comprehensive base-level integration experiences and upper equipment signal flow control that best meets the needs for production traceability and linkage required in the IoT era.

Advantech Defect Inspection Solution for Passive Component Testing Machines

Location: **Suzhou**

Background

Demand for consumer electronics products that are light, thin, short, and small has been increasing rapidly over the past few years. As a result, there is an insufficient supply of passive components on the global market — resulting in a constant increase in prices. Manufacturers of passive components need to improve both their throughput and quality in order to keep up. In this environment, high-precision and high-performance appearance testing equipment for passive components has been primarily monopolized by Japanese corporations. Chinese domestic equipment suppliers still lag behind their Japanese competitors.

The throughput of testing equipment for passive components from international leaders can reach 12000 pieces per minute. Domestic equipment, on the other hand, generally renders a throughput below 3000. How can Chinese domestics break the monopoly? Brand new solutions from Advantech and partners are here to help!

System Requirements

Products that may be machine tested primarily include patch resistance, capacitance, inductance, and certain ICs and LEDs. Machines are mainly used for component appearance testing. The test consists of one to six aspects with primary emphasis placed on the inspection of damage, scratches, unfilled corners, pits, bulges, and burr. Products are divided into categories: “good”, “defective,” “self-defined,” and “redo” based on the test results.

Depending on testing demands, 1 to 12 industrial cameras may be set up. Each camera works at a sampling rate of 50-200 frames and a maximum precision of up to 3 um. The camera captures images by taking photos at a flying speed. A GigE Vision camera is primarily utilized (sometimes it will be a USB Vision camera). The cameras are located at angles above and beneath the DD motor-controlled optic glass rotary disc respectively in order to detect defects at different levels and of different types.

At present, most of the domestic component testing equipment is controlled by the PLC, with a minimal throughput below 500 pieces per minute. Some equipment is controlled by the motion control card + IO, with a throughput of around 2000 pieces per minute. In this case, the customer required the new unit to reach 10000 pieces per minute. The throughput was close to that of international leading equipment — 12000 pieces per minute. Approximate performance measures, more flexible localized service, and better prices help secure a larger market share.

Project Implementation

ACP-4000

Quiet 4U Rackmount Chassis with Visual & Audible Alarm Notification

AIMB-786

LGA1151 8th/9th Gen. Intel® Core™ i7/i5/i3/Pentium®/Celeron® ATX with Triple Display, DDR4, USB 3.1, SATA 3.0

PCIE-1674

4-Port PCI Express GigE Vision Frame Grabber

PCI-1274

Basic 4-axis Motion Control Card with Multi Latch/Compare Trigger Function

PCI-1756

64-ch Isolated Digital I/O PCI Card

QCAM-GM0640-300CE

0.3-15 Mega Pixel PoE Industrial Camera

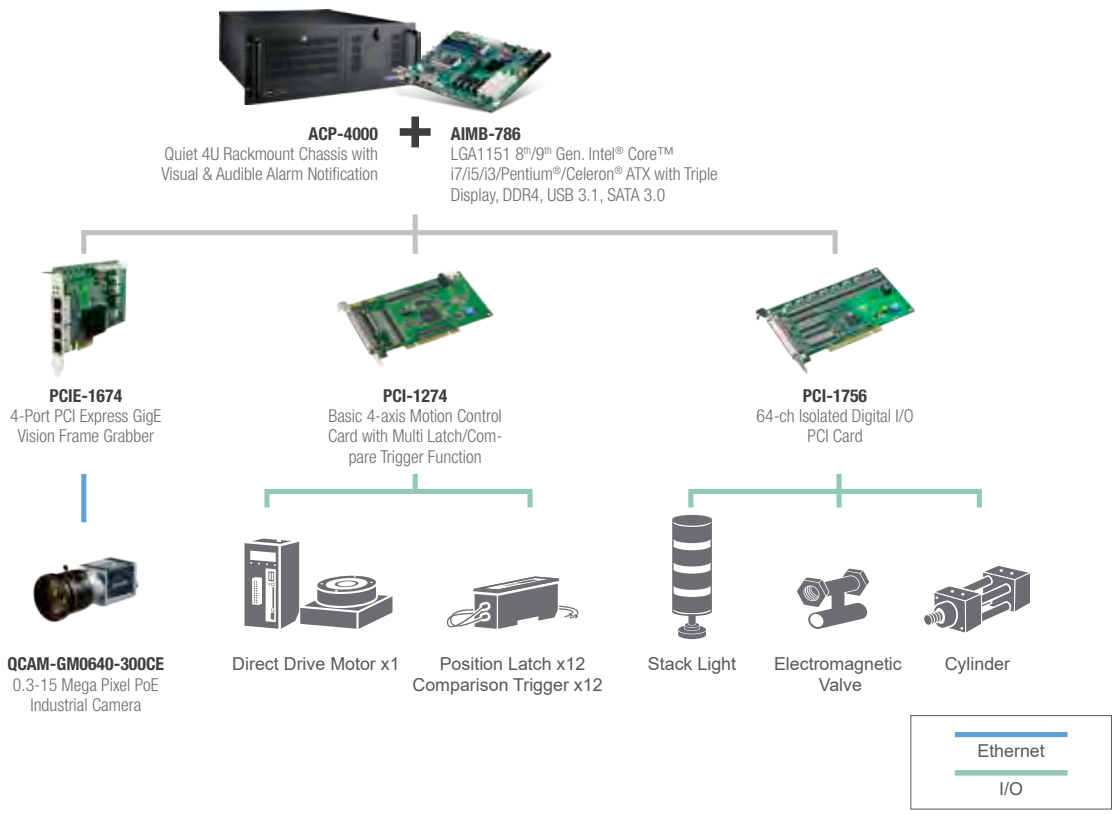
System Description

Advantech PCI-1274-12AE 4-axis motion control card is known for its precise acceleration/deceleration rate and softmotion computing core that precisely controls the position of the DD motor. Moreover,it has a 12CH position latch that can document precise position information provided by the encoder in real time when materials pass through the sensor to offer precise coordinates for reference in subsequent camera photo-taking and material classification. Plus, 12 channels for comparative positions and comparison triggering that can be customized according to the actual demands of each customer in order to satisfy demand for flying capture of up to 12 cameras with high-speed comparison control at four splitting positions.

On the other hand, PCIE-1674E involves one to four pieces and is meant to expand the GigE Vision camera (for some models USB Vision cameras are utilized). While PCI-1756 has a 32-channel DI and a 32-channel DO for controlling the three-color indicator, the emergency stop button, the solenoid valve, the cylinder, and other sensors of the unit.

As for system, ACP-4000 chassis with AIMB-786 main board has 2 PCI, 4 PCIE*4, 1 PCIE*16, and I7-8700 CPU with an internal memory of 16 G, 128G SSD+1T hard drive. Offering expandability, high performance, and reliable quality, it serves as the visual processing and motion control logic computing control platform for the customer's overall system.

System Diagram



Why Advantech?

In this case, precise acceleration and deceleration, in combination with softmotion computing, made precision position control possible. Along with the DSP and FPGA designs, customization of specific features was now made easy. The new unit had more cameras and the splitting positions could be controlled. Customized features satisfied a range of customer demands: with the PCI-1274 motion control card at its core, Advantech met the customer's specific requirements for the passive component testing equipment.

The PCIE-1674E, 4-port GigE Vision PoE interface card features with INTEL I350 server grade performance, allowed the multi-channel GigE Vision camera to perform high-speed image acquisition with dedicated 1.0 Gbps/port while the direct power supply through Ethernet reduces wiring for the customer. The IPC-610 has the largest sales of any IPC in the world based on its reputation for steady, safe, and reliable operation. In terms of the motion control algorithm and application experience, powerful R&D and professional technical support teams are available to help the customer with preliminary functional assessment, sample research and development, user-end field debugging, and to provide professional technical support.

Advantech Machine Vision Inspection Solution for Flywheel Manufacturing

Location: **Taiwan**

Background

A Taiwanese factory serves as the ODM for a U.S. fitness cycle manufacturer by using its specialized metal processing service to manufacture flywheels. Even though the factory has a dedicated measurement laboratory to inspect the quality of flywheels, it takes over three minutes to complete each inspection. To avoid negatively affecting production speed and ensure timely deliveries, the production line controls product quality through random inspections along with manual inspections.

Unfortunately, the factory received a complaint when it delivered its most recent batch of flywheels to the U.S. fitness cycle company—who claimed that the quality was poor. This forced production to be suspended and the U.S. company sought compensation for the defects.

To avoid future fines due to poor quality control, the factory decided to implement a machine vision system that inspected all products without affecting production speed.

System Requirements

Although the factory needed to quickly win back the trust of its customer, the implementation of a new system generally required a six-month development period (preliminary project planning, hardware selection, hardware compatibility testing, programming, defect definition and testing, system launch and testing) and couldn't be resolved in a timely manner.

This prompted the factory to purchase a total solution that could be completed within a short amount of time (less than three months), was able to execute multiple inspection tasks at once, could add or modify inspection items and products being inspected, was easy to use and maintain, and integrated both hardware and software.

Project Implementation

AIIS-3410P

Compact Vision System, Supports Intel® 6th generation Core i CPU, 4-CH Camera Interface for GigE PoE

QCAM-GM2440-035CE

PoE industrial camera with a resolution of 0.3-15 megapixels

VisionNavi

Flowchart-based Machine Vision Software

System Description

The system's operating process was as follows: When a workpiece entered the inspection range, AIIS-3410P sent a trigger signal to the QCAM series GigE industrial camera after it received a digital signal from the infrared sensor. A camera took a picture of the workpiece for inspection. The photographed image was then sent to AIIS-3410P via the Internet and compared and analyzed by VisionNavi to verify that it met all workplace quality requirements.

All software and hardware used in the ESRP-VAI-A3410 solution were top notch products. The high performance hardware platform was able to process large amounts of graphics data, allowing it to keep up with the industrial camera that took 20 high-resolution photos every second. This ensured the quality of every workpiece was inspected while maintaining high speed production. The VisionNavi software was flowchart-based and featured a friendly user interface for effortlessly developing multiple image comparison functions. It simplified complex machine vision applications to shorten the development process and did not require any coding skills.

For this project, the factory did not have any programmers but it was able to begin using VisionNavi after a few days of training. Compared with typical optical inspection systems that require long development periods, VisionNavi only requires a few minutes to click, drag, copy, paste, and input settings—which are common computer operations—in order to define defects or conforming products and begin inspection of the appearance and size of all flywheels going through the production line. VisionNavi offered a variety of machine vision applications—such as gauge, positioning, guidance, and identification—and was used by the factory for multiple purposes.

System Diagram

Why Advantech?

Machine vision inspection is a powerful tool for product quality control in the manufacturing industry. The ability to inspect all products effectively lowers the risk of being fined by customers; making it the best solution for increasing productivity and product quality.

Advantech's intelligent inspection system eliminates the stereotype that optical inspection systems require a long development period and are hard to maintain. A simple, flowchart-based user interface and practical functionality accelerate the speed of system implementation while providing stability and high performance hardware components for multi-task full inspection applications. In this case, by replacing the factory's manual inspection and sampling inspections, quality control issues were resolved. The system offered flexibility for expanding the number of inspection items so that administrators can continue delivering on product quality in the future.

Advantech's 3C Inspection Solution Integrates Motion Control, Machine Vision, and MES

Location: **China**

Background

With the rapid development of 3C technology, smartphones are now ubiquitous. One key component in smartphone cameras is the filter. Filters block invisible light that interferes with the camera and introduces inaccurate colors. Filter manufacturers need to fully automate the inspection process to ensure control quality.

Currently, manufacturers in this market face a range of problems. Since multiple key processes such as motion control, visual inspection, and databases are involved, the realization of a filter inspection and control system requires industrial control computers and multiple PLCs. Programmers knowledgeable in two different programming languages are also necessary. Projects face delays due to due to time spent on integrating multiple systems. When there's a significant amount of communication between the controllers, it is necessary to sacrifice a portion of the equipment processing efficiency. At the same time, multiple controllers and large data transmission volumes also present hidden dangers that may reduce system stability and inspection accuracy.

System Requirements

The customer is a domestic company that specializes in AOI filter inspection algorithms, who, with the increase in market automation and intelligentization, needs a comprehensive AOI solution that includes materials storage, collection, inspection, sorting, and information which must be uploaded to a database and integrated with an MES.

Since the visual processing requirements are high, a CPU with powerful data processing capabilities is required for the control system. To improve inspection efficiency, it's necessary to accurately turn on the camera and perform line scan processing during motion, so a high-speed position comparison trigger is required to trigger the camera to take photos.

The entire set of testing equipment involves 39 axes (9 servo motors and 30 electric cylinders), which are placed at three stations. There must be a connection between the stations. Centralized control cannot be used, and high immediacy performance is also required. A decentralized I/O is also required. Due to the need to move and inspect products, communication and interconnection with three robot arm controllers is necessary.

Project Implementation

AMAX-5580 with CODESYS

Intel® Core™ i7/i5/Celeron® control IPC with EtherCAT Slice I/O expansion and IEC-61131-3 control software

ICAM-7000

PoE industrial camera with 0.3-15 megapixel resolution

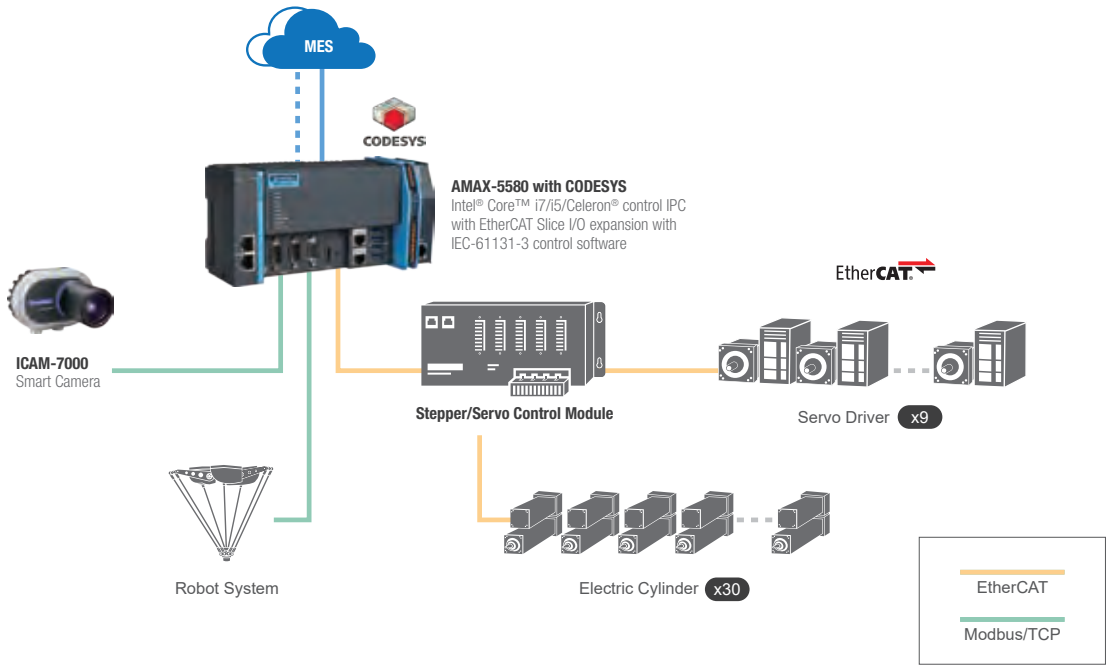
System Description

Advantech has provided customers with a Soft Motion solution that uses a high-performance Intel Core I7 processor and a split-core structure. This solution integrates the powerful Windows 7 environment and the CODESYS real-time stable kernel. Each system has its own CPU that does not interfere with the other.

The customer of this project runs machine vision, a C# host interface, and the database in Windows 7. At the same time, the customer runs multi-axis motion control and robot communication in CODESYS. The shared memory communication mode lets CODESYS interact with Windows in a timely manner.

Hardware: As the main control system, AMAX-5580 controls the 39 servos and electric cylinders through ETHERCAT, and the field sensor signals are accessed through distributed I/O. Software: CODESYS realizes motion control and seamlessly connects with the C# program developed by the customer through shared memory, both of which run on the AMAX-5580.

System Diagram



Why Advantech?

The solution's AMAX-5580 control system integrates the original industrial computer and PLC architecture. The number of motion control axes can reach up to 128 which reduces costs and improves stability. With the split-core and sub-system features, AMAX-5580 is a controller with both the Windows operating system and the CODESYS SoftPLC real-time kernel. Embedded with an Intel i7 processor, which can handle multi-axis motion control in the CODESYS PLC core and tens of thousands of I/O control points, the solution connects the control systems of third-party robots while handling MES machine vision and the database in Windows.

Advantech's well-integrated Soft Motion solution realizes motion control, machine vision, decentralized I/O, and MES, enabling the automated movement, inspection, storage, and informatized management of mobile phone filters. This solution cuts development time in half and optimizes system execution time from 2ms to 0.5ms, improving inspection efficiency and accuracy while realizing informatized management.

Deploying AI Inspection for Heat Sink Factory

Location: **Taiwan**

Background

In the past, most factory components were visually inspected by employees. Although prior education training was provided for inspectors, inspection based on individual perception made it difficult to integrate inspection standards. Moreover, visual fatigue, weariness and staff turnover result in high missed inspection rates for production lines. After the defective products are released into the market, the complaint rate has skyrocketed.

In addition, if factories lack staff with programming abilities, their understanding of machine vision inspection will be very limited. Thus, even if a factory wishes to implement technological products to lower the missed inspection rate and increase inspection efficiency, it lacks the ability to do so.

The cooperative program between Advantech and Smasoft aims to help the manufacturing industry shift from human visual inspection to AI inspection. A solution which combines rule-based machine vision and AI visual identification is not only the perfect answer to a factory's problems but also contributes to the introduction of automatic inspection systems.

System Requirements

The heat sink factory originally had three major inspection stations, in which multiple inspectors conducted size, thickness and appearance inspections. Smasoft's current automatic software development platform (SmaSEQ) integrates modularized visual inspection, motion control, I/O control, AI defect inspection tools (SmaAI), AI training and other functions, creating a heat sink inspection machine that can conduct three types of inspections while continuously training AI deep learning models to further lower the missed inspection rate and enhance inspection quality.

SmaSEQ has user-friendly interactive interface and is easy to learn. After taking the software training courses, client operators are able to operate SmaSEQ with ease, despite not having an engineering background or proper understanding of AI deep learning. SmaSEQ is simple, straight-forward and does not require complex program settings, allowing system integrators and end users to train machines by themselves.

Both Smasoft's software and Advantech hardware play an intricate role in optimizing the AI system of the heat sink inspection machine. Smasoft adopts the Advantech i-Modules Expansion Slot Compact Fanless System MIC-770 and features a built-in NVIDIA Jetson® Xavier MIC-730AI AI Inference System.

In the past, Smasoft adopted IPC from other companies, some of which clients requested replacements due to IPC sizes being too large; others met client requirements in terms of size but often crashed. Advantech's MIC series remain stable even after long time burn-in process. If additional I/O is required, MIC series can be expanded at any given time. This saves the need of re-evaluating hardware for every project.

Project Implementation

MIC-730AI

AI Inference System based on NVIDIA Jetson® Xavier

MIC-770+MIC-75G20

Compact Fanless System with 8th Gen Intel® Core™ i CPU Socket (LGA 1151)+ GPU i-Module, 1 PCIe x16 + 1 PCIe x4, dual front accessible storage bay

AINavi

AINavi is deep-learning-based image analysis software that includes AI defect inspection tools and independent AI training software.

System Description

The two Advantech hardware products embedded in the system's AI inspection machine each conduct different tasks respectively. The MIC-770 installed with SmaSEQ controls the inspection station process and conducts rule-based vision inspection to determine whether the size and thickness of the heat sinks meet the specifications.

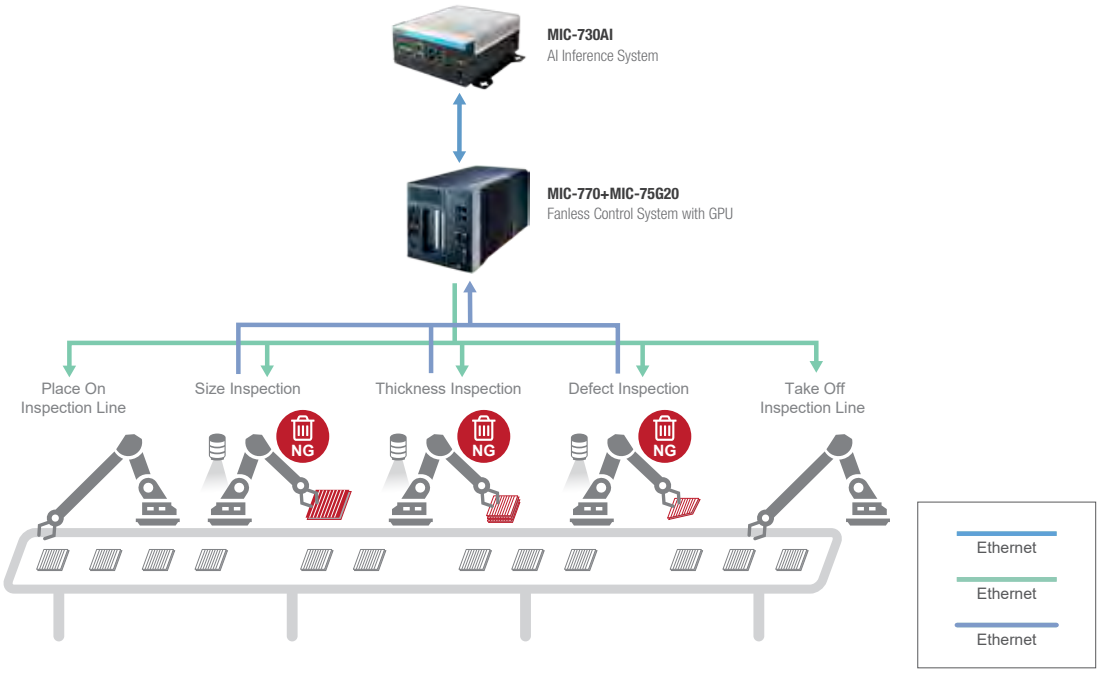
Moreover, MIC-730AI installed with SmaAI conducts AI image analysis to compare and identify heat sinks with appearance defects. This is made possible by feeding SmaAI with images of defective products that Smasoft collects from clients, prior to the import of software and hardware. After SmaAI completes relevant training, the trained models are placed into the MIC-730AI. AI visual inspection can then be conducted to evaluate the flatness and identify crushes, stains, scratches and other defects that are difficult to categorize through general physical rules.

Smasoft's automatic AI software coupled with Advantech's hardware, allows the heat sink factory to complete assembly and testing of the AI inspection machine within three months.

Smasoft stated that, "Initially, the client factory expected the new system to have 90% accuracy rate, but the Smasoft and Advantech's solution achieved an accuracy rate of up to 97%, far exceeding the client's requirements." In the past, there were ten inspectors to a production line. It took 30 seconds to conduct three types of inspections on each heat sink. Today, only one inspector is required to conduct final re-inspection and it only takes 4 seconds to complete the task. Therefore, the introduction of the solution not only reduces labor costs but also improves inspection efficiency.

Additionally, this AI inspection solution adopts distributed architecture configuration, allowing one MIC-770 to cooperate with multiple MIC-730AI in conducting AI inference. Therefore, when the factory wants to implement additional AI inspections or enhance inspection speed, it can simply install additional MIC-730AI through a network cable, making future factory expansions convenient for our clients.

System Diagram



Why Advantech?

1. Cost-efficient solution and flexible structures allow combination of rule-base machine vision method and AI method at the same time.
2. Flexible and distributed architecture configuration, making future factory expansions convenient.
3. Simple, straight-forward and does not require complex program settings, this AI inspection solution allows system integrators and end users to train machines by themselves.

Highly Integrated IPC Solution Selected as Universal Platform by Worldwide Manufacturers

Location: **Asia**

Background

A global manufacturer in Asia that produces a wide range of high quality fastening products and merchandise, wanted to upgrade their systems for better production efficiency and to do this they needed a high-end IPC solution which could be widely deployed on their production lines across all their manufacturing sites worldwide. The solution needed to feature high computing power and legacy compatibility, but needed to be a modularized design so they could change/upgrade add-on cards (motion, frame grabber, GPU etc.) and add new functions as production needs required.

System Requirements

The manufacturer wanted an innovative platform that could fit their existing and future needs. The specification included processing requirements that must go beyond what regular industrial PCs (IPC) can deliver. This invariably meant it would need to use a server-grade system to meet their specifications. But buying a server solution was too expensive for what they wanted, plus they would only utilize part of its capacity, which was an unnecessary waste.

To mitigate the cost of purchasing expensive servers, they decided to combine a CPU + GPU solution that would meet their needs. The GPU would be used not only for graphics, it could also be utilized to provide an additional source of powerful processing. The standard way to integrate a GPU card is to insert it into a slot on the motherboard and that usually means a 4U chassis. But the customer only wanted a 2U size chassis and a 2U chassis cannot accommodate full-sized GPU cards — so what to do?

Project Implementation

ACP-2020G

2U Rackmount Chassis for ATX and uATX Motherboard.

AIMB-787

Industrial ATX Motherboard with Intel® 10th generation Core™ i9/i7/i5/i3/Pentium®/ Celeron® processor and Q470E chipset.

GPU Card

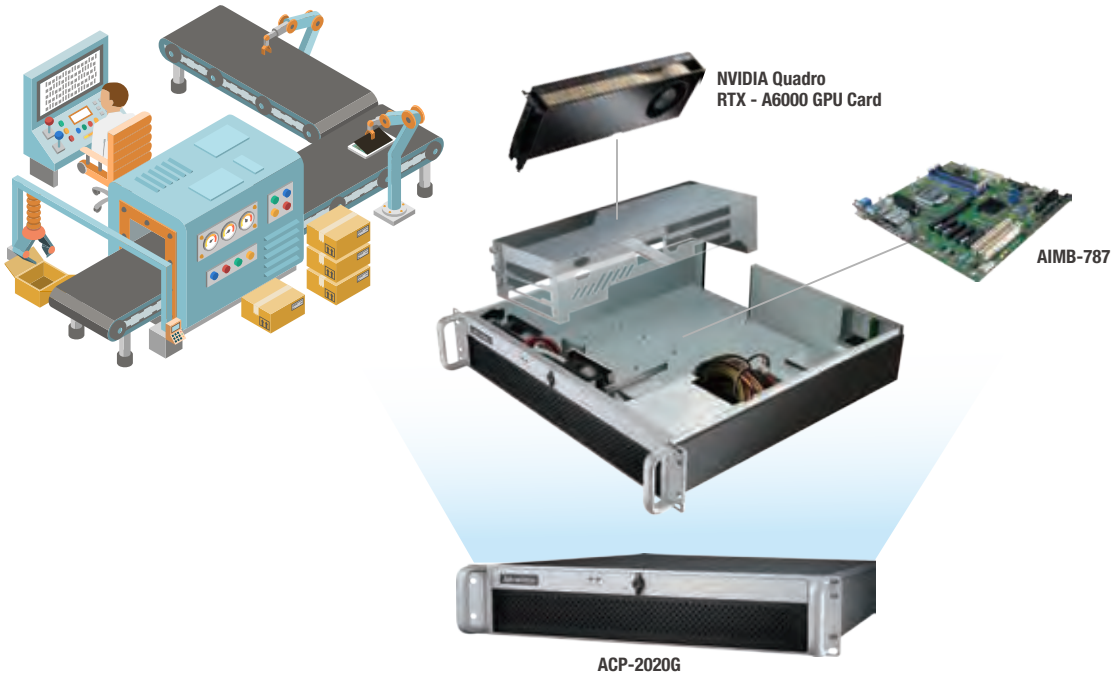
NVIDIA® Quadro RTX™ A6000

System Description

Full-sized or double decker graphics cards are taller than a standard 2U chassis, so the card needed to be installed vertically via a rear adapter connected to the motherboard, which holds the card horizontal. Also a full size RTX GPU card with thermal heat sink can weigh a lot and installation may damage the connector or cause unstable signal transmission. So Advantech offered the ACP-2020G 2U rackmount chassis for ATX and uATX motherboards, which is a premier IPC solution that uses the Intel Gen 10 processor and chassis with a special bracket design which can hold full sized / double decker GPU cards and effectively disperse heat via dual 100 CFM fans.

Advantech's ACP2020G chassis with NVIDIA® Quadro RTX™ A6000GPU card and AIMB-787 motherboard was selected to be deployed in all their manufacturing sites because it was the most cost-effective solution that met their expectations in the most efficient way. Advantech specially designed their innovative card holder bracket in ACP-2020G to support heavy GPU cards, so that the whole system can run at peak performance. Of course a GPU card running at full capacity generates heat so there are 2 x 100 CFM fans installed that make good use of the built-in 850W 80 plus platinum grade power supply.

System Diagram



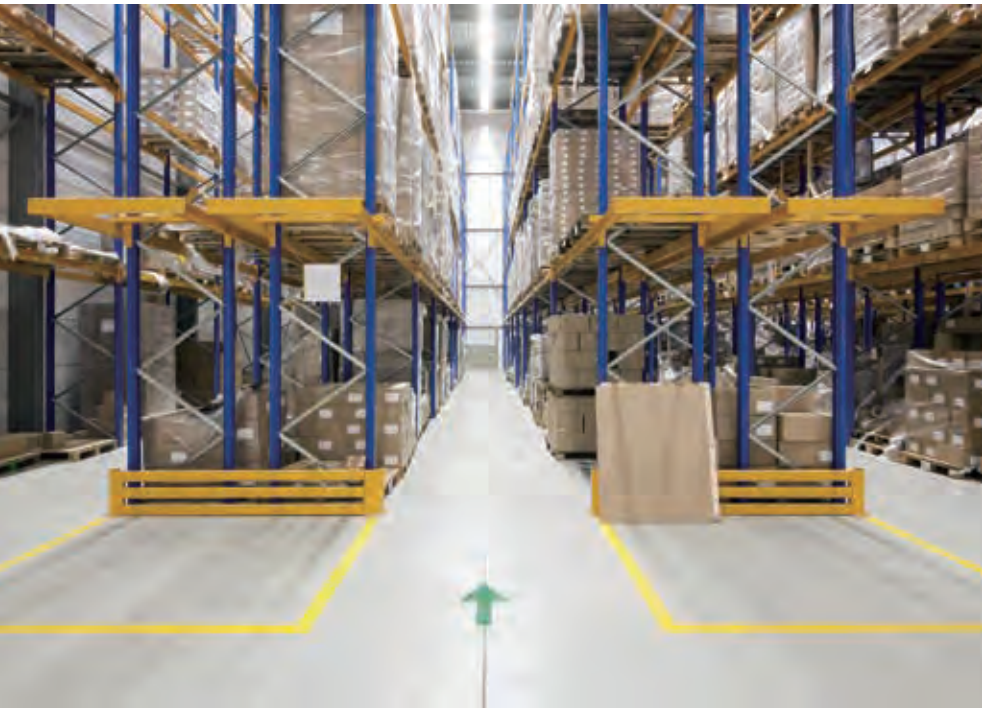
Why Advantech?

The whole solution delivers on high performance computing, legacy compatibility, and most importantly, cost efficiency.

ACP-2020G's 2U footprint saves space and its card holder bracket is designed for full-sized GPUs with heat sinks. And not only GPU cards, it can also accommodate motion cards, frame grabber cards, as well as single, double, and even triple decker GPUs as well.

ACP-2020G benefits customers who want to upgrade their system to server level but don't need full server performance. It greatly optimizes production efficiency whilst minimizing capital investment.

"Shop Till You Drop" With Advantech's e-Commerce Warehouse Logistics Solution



Location: **China**

Background

This company is the largest e-commerce platform in the United States and is committed to continuous innovation with a customer-centric focus. To shorten shipment times and improve the customer experience, the company is currently seeking to update their warehouse logistics system in China.

Accordingly, numerous automated guided vehicles (AGVs) will be introduced into the new warehouse logistics system and, together with sorting personnel, will be able to conduct fast, efficient cargo sorting to reduce the time between product sorting and shipping.

System Requirements

The computers used by the customer in each sorting station were conventional wall-mount computers. The system upgrade and increase in cargo handling meant that personnel would require a system with multi-screen support; thus, the original computer configuration was no longer suitable. In addition, as is common with warehouse environments, the presence of dust is a known problem for computers because it invariably results in fan malfunctions, thus affecting heat management. Given the volume of orders received by this company, any workflow errors or interruptions due to equipment failure would be unacceptable.

Another key consideration was the massive data transmission requirements for processing the enormous amount of cargo.

Construction of a network environment that improved on the reliability and stability of the company's system was a critical issue. A key point of the new system was to ensure that each sorting station could be linked together while providing continuous data transmission in order to construct the most reliable transmission backbone network to meet the needs of modern warehouse logistics.

The two major system requirements were thus 1) high-performance, fanless, small-sized desktop industrial computers and 2) a stable and reliable wired/wireless network.

Project Implementation

MIC-7700

Intel® 6th/7th Generation Core i Desktop Compact Fanless System

EKI-7710

8FE+2G Combo Managed Ethernet Switch

EKI-6332

IEEE 802.11b/g/n Wi-Fi Access Point/Client

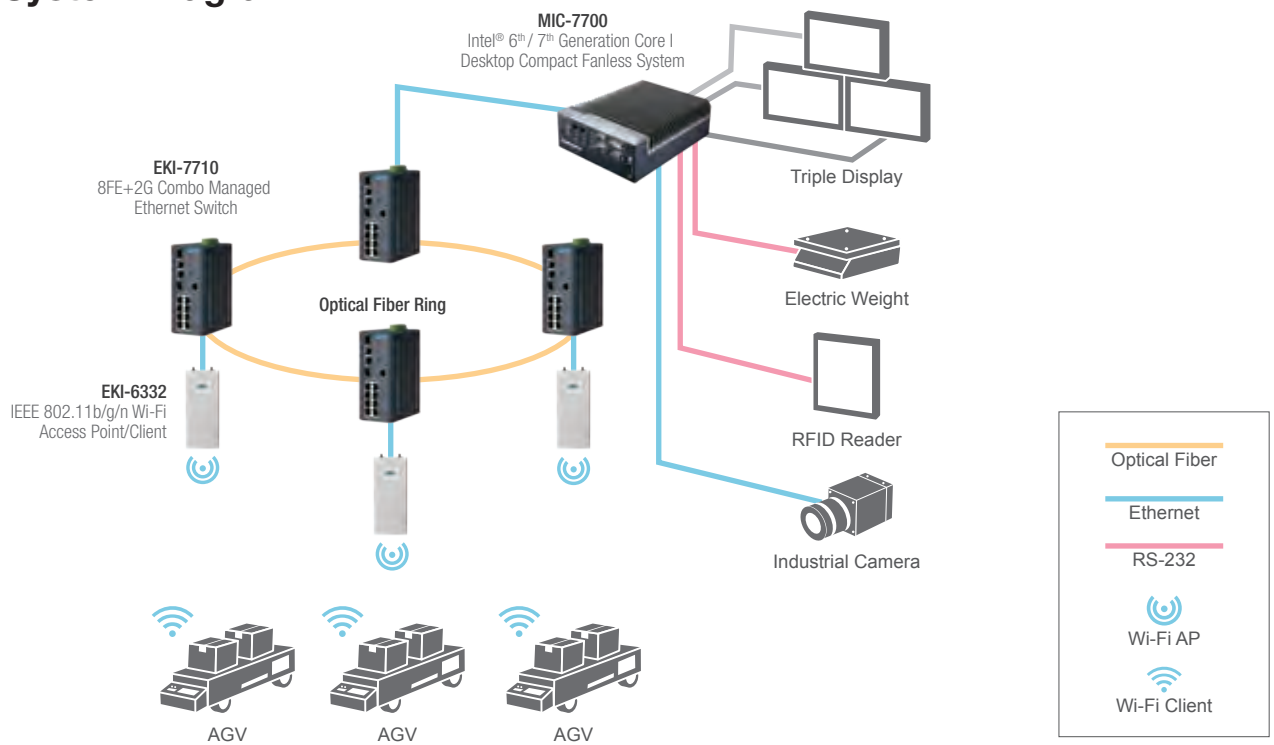
System Description

Advantech recommended the MIC-7700 as the core for the overall warehouse logistics system. This fanless system was to be used at each sorting station, providing a high-performance CPU that would more than satisfy the company's computing requirement while eliminating problems caused by dust. The MIC-7700 is a low-cost option that supports desktop processors while ensuring high performance. Its compact structure and single-side I/O design facilitates quick installation and subsequent maintenance. Advantech's own MIC-Door iDoor design reserves I/O space with a scalable i-Module design for at least 20 PCIe buses (1~4 slots), 9~36 V power voltage, and functions environments where temperatures are in the range of -10~50°C.

For the network architecture, we recommended utilizing the EKI-7710 industrial-grade managed Ethernet switch as the overall backbone network. Given the sheer amount of equipment in the whole warehouse (e.g., metal cargo shelves, logistic transport belts, and automated cranes), standard business switches—although low-cost—would be unable provide a reliable and stable network environment. Furthermore, with the large volumes of data requiring upload, any interruptions could potentially result in major problems for the entire sorting process. As an effective countermeasure, a fiber optic loop network with the EKI-7710 was adopted to eliminate this possibility.

Because the warehouse logistics system utilized many AGVs that are controlled wirelessly, establishing reliable wireless environment coverage was critical in order facilitate their operation. For this, the EKI-6332 industrial-grade 2.4G wireless access point was adopted for wireless coverage of the whole site. This unit provides a high level of interference resistance and, through its connection with the EKI-7710, extended the entire network environment from a wired configuration to a wireless one. With this system, all AGV control orders are given from each MIC-7700, passed through the EKI-7710, and then wirelessly transmitted to the AGV via the EKI-6332. The AGV accordingly moves the cargo shelves to the target sorting station as instructed. Hence, the implementation of Advantech's solution provided a complete, stable, and reliable network architecture.

System Diagram



Why Advantech?

Advantech's comprehensive solution was a successful upgrade for the customer's warehouse logistics system, effectively improving the efficiency of cargo sorting, shortening the time from product collection to sorting and then shipment, and minimizing shipment errors, thus ensuring improved customer satisfaction.

Intelligent Parking System Powered by PC-Based AGV Parking Robot

Location: **China**

Background

Automated guided vehicle (AGVs) are most often used in industrial applications to transport materials around a manufacturing facility or warehouse. In today's era of the industrial Internet of Things, factories are not only undergoing a fourth industrial revolution, but AGVs are also shifting from automation toward intelligentization, with applications expanding from the factory to the parking lot. Using a Wi-Fi module, laser navigation, and comb-exchange technology, an AGV manufacturer has created an intelligent parking robot that can lift and park a car in just 120 seconds.

To ensure the parking robot can accurately receive tasks from the centralized dispatch system and execute commands without collision or accident, a palm-sized, fanless, in-vehicle x86 industrial communication gateways was incorporated.In the past, AGVs were typically controlled and operated using a programmable logic controller (PLC). However, parking AGVs must perform multiple arithmetic operations to ensure comprehensive monitoring, for which PLCs offer inadequate speed and function.

System Requirements

The client has developed parking, logistics, and e-commerce AGVs for various application fields by leveraging the experience of their parent company in developing and manufacturing 3D garage parking systems. Recently, the company revised its parking AGVs by replacing the original controller with a more cost-effective gateway in order to harness key technology and increase market penetration.

Featuring two guidance modes (laser and magnetic tack), the client's new comb-type intelligent parking AGV can automatically move forward/backwards, turn left/right/around, spin, and perform plane translation and differential drive. However, because of the AGV body's limited dimensions, minimal space is available for essential hardware devices. Therefore, the AGV control gateway must be capable of performing complex movement calculations and sufficiently compact to be embedded into long plate vehicles while also featuring vibration, shock, and collision protection.

Additionally, the intelligent AGV parking system must be capable of managing over one hundred vehicles simultaneously. Thus, remote device monitoring software is required to ensure that the central control room remains aware of the real-time vehicle status. Furthermore, early warning capabilities that allow managers to arrange vehicle maintenance in advance are essential to ensure the continued dispatch of intelligent parking AGVs in the parking lot.

Project Implementation

UNO-2272G

Intel® Atom™ J1900 Processor, up to 2.41 GHz, with 2 GB of DDR3L Memory

PCM-24S2WF

iDOOR Module: Wi-Fi 802.11a/b/g/n 2T2R w/ Bluetooth 4.0, Half-Size mPCIe, Antennas

PCM-26D2CA

iDOOR module: 2-Port Isolated CANbus mPCIe, CANopen, DB9

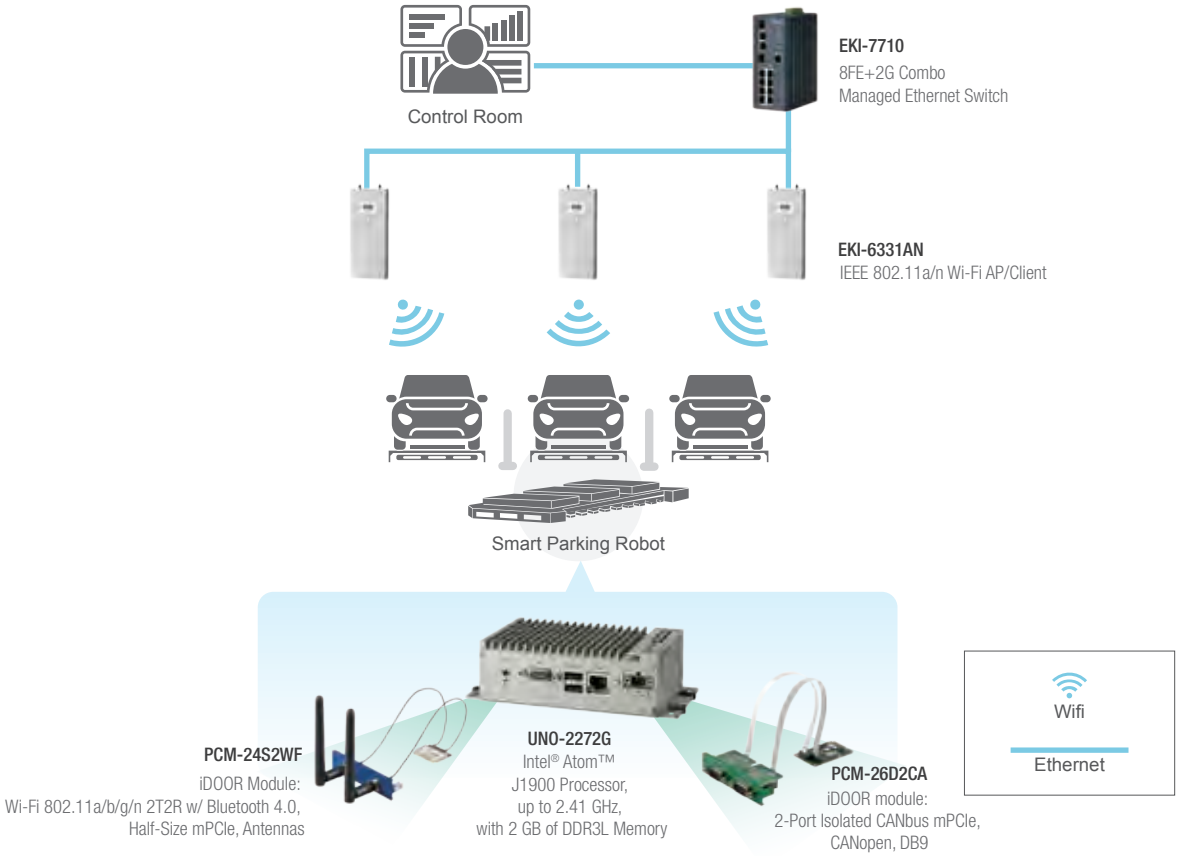
System Description

Featuring an Intel® Atom™ J1900 processor, wireless communication module (PCM-24S2WF), and CANbus module (PCM-26D2CA), Advantech's palm-sized communication gateway, UNO-2272G, is capable of not only receiving commands from the central dispatch system, but also processing data collected from the anti-collision sensor, 360-degree laser transmitter, and magnetic nail scanner to calculate the parking location and travel path, and then instructing parking AGVs to autonomously transport vehicles to specific parking spaces.

Regarding ruggedness and reliability, the system's lightweight aluminum enclosure enhances heat dissipation and protects the components and modules from damage due to water or dust ingress. The durable built-in mSATA solid-state hard drive offers increased read/write speeds. Furthermore, UNO-2272G has been certified according to IEC standards for shock and vibration tolerance to ensure continued and reliable operation in extreme environments.

Although the primary objective of this project was to supply hardware for an intelligent AGV parking system, Advantech also offered added value with its software, which included custom drivers for Wi-Fi and CANbus modules and remote device monitoring software.

System Diagram



Why Advantech?

Advantech's PC-based embedded automation computer UNO-2272G equipped with two iDOOR modules (Wi-Fi communication and CANopen fieldbus protocol) not only fulfills the performance requirements of parking AGVs, but also supports componentized real-time operating systems (Windows Embedded Compact 7), customized drivers, and remote management and monitoring software (WISE-PaaS/RMM). These features provide AGV robots with additional capabilities, such as instruction issuing, travel track and position monitoring, system health diagnosis, and automatic scheduling.

The client's intelligent AGV parking robot featuring Advantech's UNO-2272G communication gateway can generate a massive 40% more parking spaces in congested areas due to its accuracy and help drivers to find a space and slots in just 120 seconds!

Currently undergoing testing, the client's new system is set for deployment at its Nanjing parking lot in 2017. Meanwhile, the company will continue to adopt Advantech products and develop AGVs for other application fields.

Advantech's High-Performance Embedded Computers Deployed in Substation Inspection Robots

Location: **China**

Background

Electrical substations are crucial for transmitting electric power between the generating station and consumers. Therefore, inspections must be conducted periodically in order to identify potential safety hazards and prevent power failures. In the past, these inspections were mainly conducted by inspection officers. However, the likelihood of errors and negligence was high due to the heavy inspection workload in large-scale substations, as well as the potentially harsh and challenging working conditions in remote substations. Thus, full-time inspection robots have become an increasing trend in recent years.

The general operations are as follows: First, inspection instructions are transmitted wirelessly from the control center to the robot, which then carries out the instructions following a designated route. Along the route, the robot captures high-resolution images, measures temperature using an infrared thermometer, and then transmits the data back to the control center. If an abnormality is detected, the inspection robot notifies relevant personnel by emitting an alert signal.

System Requirements

The client for this project was a high-tech company located in China and dedicated to the provision of software/hardware development and system integration services to the electric power industry. The company is constantly applying new IT technology to smart grid, power distribution and control, power distribution and transmission, substation management, and other related applications. Based on its pioneering research and successful field solutions, the company has gained quite a positive reputation and substantial consumer recognition. In recent years, the company has begun developing substation inspection robots for remote monitoring applications in an effort to support/eliminate the need for inspection personnel.

Because multiple hardware devices are required for inspection robots to perform inspection tasks, the company requires highly functional and durable embedded computers for controlling the inspection robots.

To satisfy the various requirements in different areas of a substation, the client company has developed a standard and a simplified model of its inspection robots; and the two models differ in appearance, size, and functionality.

Project Implementation

UNO-2484G

Intel® Core™ i7/i5/i3 Processor with 8GB DDR4 built-in Memory,4 x GbE, 4 x USB 3.0, 1 x HDMI, 1 x DP (4K)

UNO-2272G Optional

Intel® Atom™ Processor, Palm-Size, w/1 x GbE, 2 x mPCIe, VGA/HDMI

EKI-6332GN

IEEE 802.11 b/g/n Wi-Fi AP/Client

System Description

Advantech's UNO-2484G and UNO-2272G fanless embedded industrial computers serve as competent robot controllers. These systems can be easily connected to wireless access points, GPS modules, CCD cameras, infrared thermometers, digital signal processors, etc. via multiple I/O interfaces. When installed in a robot, Advantech's UNO computers are capable of processing images, videos, e-maps, and GPS positioning data at high speeds. These capabilities enable substation inspection robots to complete various tasks, such as receiving instructions, conducting inspections, capturing images and data, uploading images, emitting alert notifications, and automatically returning to the start point after a task is complete.

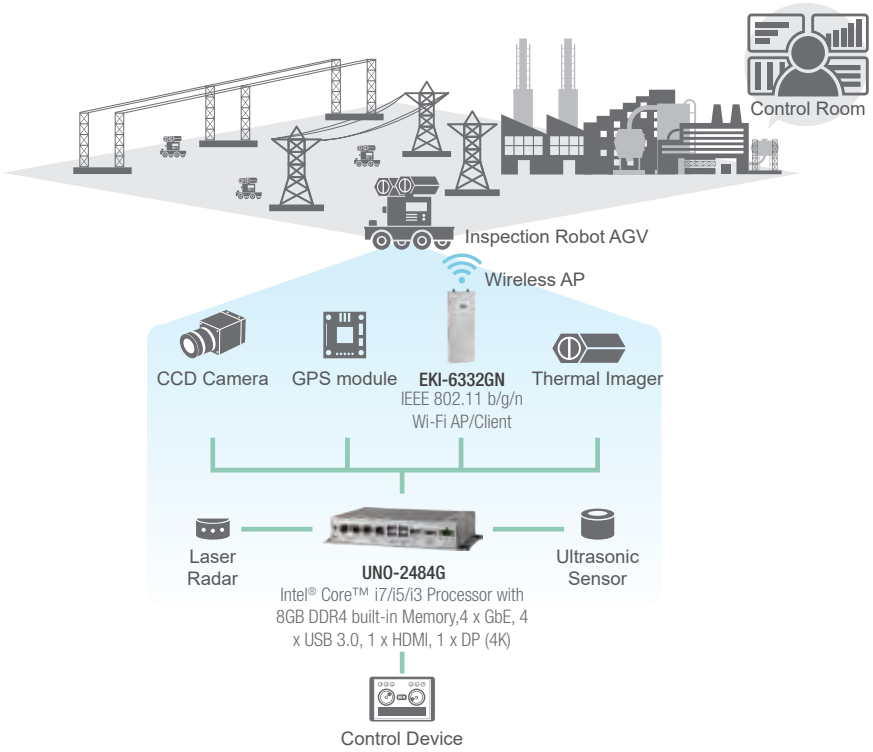
For this project, the standard substation inspection robot was equipped with UNO-2484G. Because the system is compact (252 x 149 x 62 mm) and lightweight (1.6 kg), UNO-2484G can easily fit into the robot's limited internal space. The comparatively lower weight also reduces wear on the robot wheels. Moreover, UNO-2483G features an Intel® Core™ i7 processor capable of high-volume, high-speed data processing. Thus, complex computing tasks involving images and videos can be easily completed.

Meanwhile, the simplified substation inspection robot was equipped with a palm-sized UNO-2272G computer. This small (157 x 88 x 50 mm) and lightweight (0.8 kg) system features an Intel® Celeron® J1900 quad-core processor to enable high-performance computing for complex tasks.

Both UNO computers are fanless, equipped with a solid-state drive, support a wide operating temperature range (-20 ~ 60 °C), and have passed IEC anti-vibration and anti-shock tests to ensure reliable operation. Additionally, both computers provide a variety of I/O interfaces, including serial ports, Ethernet ports, USB, DisplayPort, audio input/output ports, for a wide range of industrial applications.

Furthermore, Advantech's iDoor technology offers system integrators flexible expansion that overcomes the fixed specifications of embedded computers. This enables users to integrate diverse modules in order to add additional functions according to their application requirements.

System Diagram



Why Advantech?

In today's society, which is heavily reliant on electric power, maintaining a stable power supply is vital because it has a substantial role in everyday life and economic development. Accordingly, because they enable real-time reports, advance alerts, reduced maintenance, and enhanced efficiency, demand for substation inspection robots has increased significantly. However, whether a substation inspection robot can accurately follow instructions and complete inspection tasks depends solely on the performance of its embedded computer.

Advantech's UNO-2000 series of embedded computers offer cost-effective solutions for control applications. They satisfy the size, performance, durability, stability, and expansion flexibility criteria required for installation in substation inspection robots. More importantly, Advantech can leverage its years of development experience and domain expertise to assist system integrators with developing new products for automated substation inspection applications.

Advantech's Modular Box PC Enables Four-Way Shuttle Robots

Location: **China**

Background

Traditionally, the logistics industry is heavily reliant on human resources. However, with the advancement of technology, logistics robots are being increasingly deployed for superior accuracy and efficiency. Automation robots are also utilized as human resource replacements especially in highly compact 3D storage systems and hazardous working environments such as cold temperature warehouses.

Embedded computers play a significant role in ensuring the accurate and stable functioning of logistic robots, especially in massive storage spaces or cold warehouses. For example, the four-way shuttle robot is capable of fulfilling tasks by moving along longitudinal or transverse rails. Because its capability is reliant on complex direction programming, computer stability is crucial to ensure smooth functioning of shuttle robots. Use of an inferior computer may result in system failure, which could lead to additional repair costs and potentially negatively impact the company's reputation.

System Requirements

The client for this project was a high-tech company that provides fully automatic intelligent storage solutions. The company has independently developed four-way shuttle robots, freezer storage robots, stacking robots, transitional mode robots, heavy storage robots, and many other rail guided vehicles (RGVs). However, because the company previously used assembled computers, the robots did not deliver the expected performance due to occasional lag, which could only be fixed by restarting the computer. In order to effectively improve performance and resolve computer lag, the company began searching for a new embedded computer for their third-generation shuttle robots.

The company's third-generation shuttle robot is designed for low-temperature logistics systems. The shuttle robot is flat like a pallet with very limited internal space for the required hardware, which includes a computer, battery, microcontroller, and wireless client. Accordingly, the company's requirements for the embedded computer were as follows:

- Intel® Atom™ quad-core processor to ensure sufficient computing capacity
- Small unit that can fit into limited spaces
- Wide operating temperature range to ensure stable functioning of the shuttle robot in cold storage warehouses
- Advanced hardware design with anti-vibration and anti-shock features for enhanced stability and safety
- Multiple I/O interfaces for integrating various hardware devices, including a touchscreen, microcontroller, mouse, keyboard, barcode sensor, and wireless client

Project Implementation

UNO-2372G

Intel Atom/Celeron, Modular Box PC, w/2 GbE,4 USB, 4 COM, 2 x mPCIe

EKI-6332GN

IEEE 802.11 b/g/n Wi-Fi AP/ Client

FPM-7061T

6.5" VGA Industrial Monitor with Resistive Touchscreen, Direct-VGA/DP and Wide Operating Temperature Range

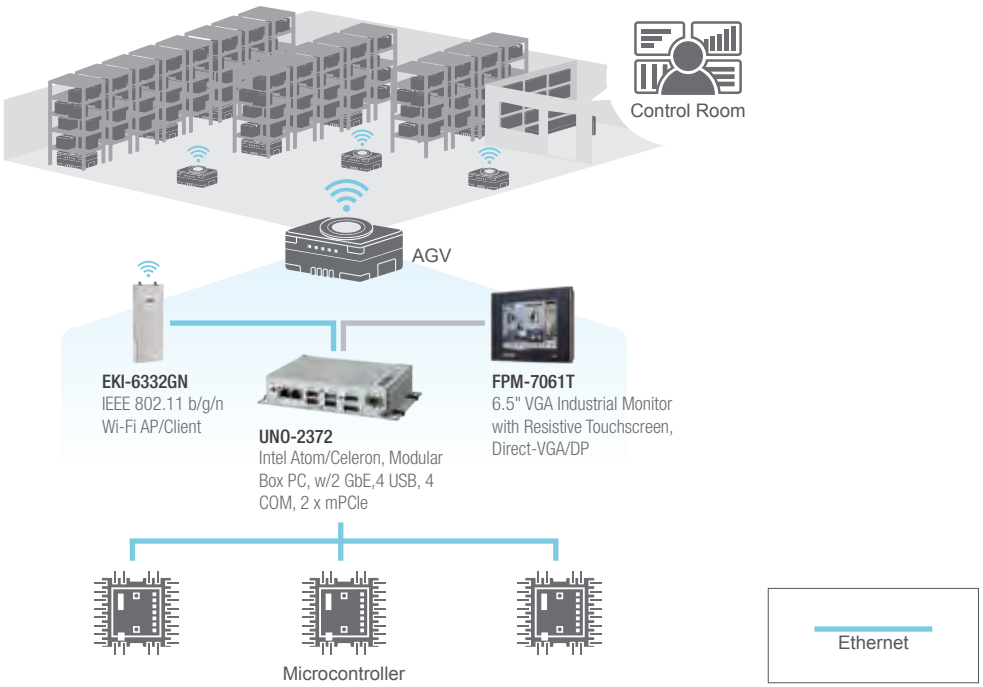
System Description

Advantech's UNO-2372G high-performance embedded computer meets the company's usage requirements. When installed in four-way shuttle robots designed for cold storage warehouses, UNO-2372G receives commands and instructs the microcontroller and other hardware devices inside the robot to conduct logistics tasks. Meanwhile, for real-time monitoring, UNO-2372G transmits the location and other robot data to backend management during operations.

Equipped with an Intel® Atom™ E3845 processor, UNO-2372G provides high-performance computing with low energy consumption. The compact design (150 x 105 x 35 mm) ensures that the system fits perfectly into the company's pallet-shaped shuttle robots. Moreover, UNO-2372G supports a wide operating temperature range (-20 ~ 60 °C) that ensures reliable function in freezers with a temperature of -20 °C. Regarding stability, UNO-2372G is made from durable aluminum alloy and features a fanless, wireless, anti-vibration, and anti-shock design.

Additionally, UNO-2372G supports multiple I/O interfaces, including RS232/422/485, USB, RJ45, and HDMI, enabling flexible allocation and system integration. For this project, the robot's microcontroller was connected via a serial port, the wireless client via an internet port, the small touchscreen via an HDMI port, and the storage barcode scanner via a USB port. Engineers can also connect a mouse and keyboard to the robots to conduct tests.

System Diagram



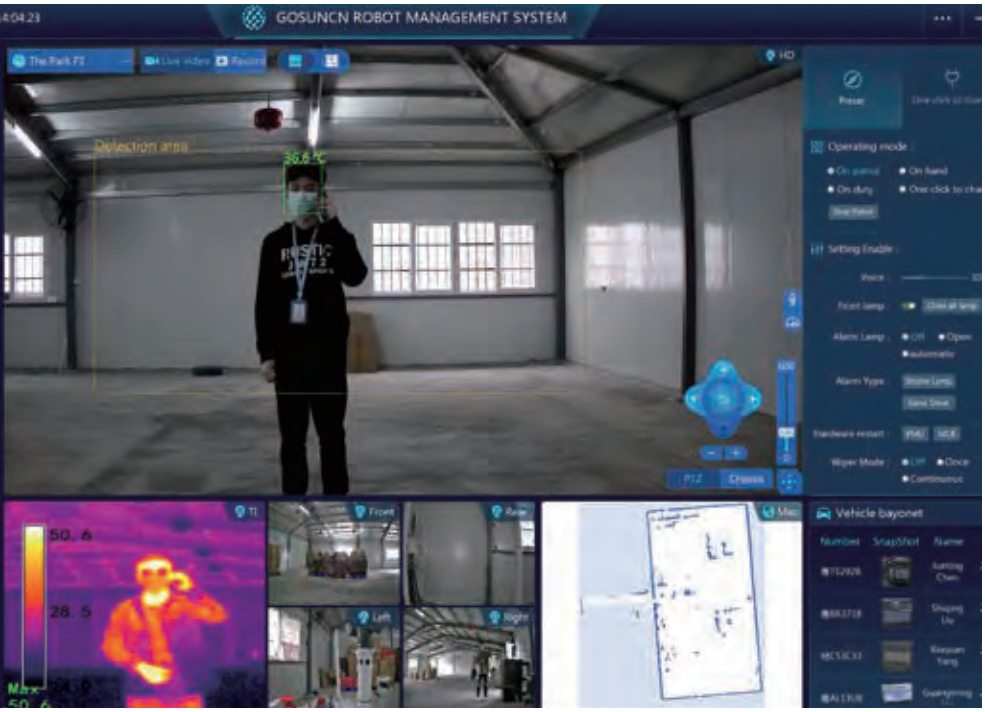
Why Advantech?

In the field of logistics, mistakes and errors can occur easily because of the detailed and monotonous nature of most tasks. However, human resources are being increasingly replaced with robots, especially for operations in unpleasant or hazardous working environments. To ensure the robots complete tasks accurately, embedded computers are crucial.

Advantech's UNO series offers a range of fanless embedded computers suitable for robots aimed at highly compact 3D storage systems and cold storage warehouses. For this project, Advantech's UNO-2372G system was installed in the company's four-way shuttle robots, enabling them to reliably complete logistics tasks in cold storage warehouses. Advantech's technology team also supported the customization of system compatibility.

Since the introduction of Advantech's UNO-2372G embedded computers, the company's robots have functioned exceptionally well. The company no longer encounters system lags and the inconvenience of restarting the computer. Moreover, the number of maintenance incidents has greatly declined as well. More importantly, the clear increasing in product stability and market competitiveness has prompted the company to implement Advantech's UNO series devices in their other robot development projects.

Advantech Edge Solutions: Empowering 5G Patrol Robots



Location: **China**

Background

Robots are increasingly common in our daily lives. They are versatile, smart tools that help complete basic, repetitive, and dangerous tasks, promote security service upgrading, and reduce expenses. A leading brand of smart patrol robots, with over 20 years of experience in public safety, working together with Advantech, created a specialized robot for various application scenarios.

System Requirements

Advantech recently helped develop a patrol robot capable of measuring temperature. It required five high-resolution cameras to enable panoramic surveillance, needed to support remote visualization commands, and had to be able to assist front-line e police officers in completing disease inspection and undertaking preventive measures. It needed to conduct swift temperature checks within 5m of infrared light, measuring the temperature of 10 individuals all at once with a possible error rate within ±0.5˚. It also needed to support 5G and be capable of transmitting temperature measurement data to the control room in real time.

The robot had to identify whether surrounding people were wearing face masks by inspection, activating an alarm system if necessary. To make robots capable of carrying out patrols regardless of time, weather, or terrain, while enabling panoramic surveillance, required a sustainable edge computer. Consideration also had to be given regarding the actual operating environment, as systems were challenged by different temperatures across regions. The robot required restricted cooling performance and needed to respond quickly in low temperatures.

Project Implementation

MIC-770+MIC-75G20

Desktop Compact System with GPU iModule

PCIE-1680

2-Port CAN-Bus PCIE Card with Isolation Protection

QUARTZ

0.3-15.0 Mega Pixel PoE Industrial Camera

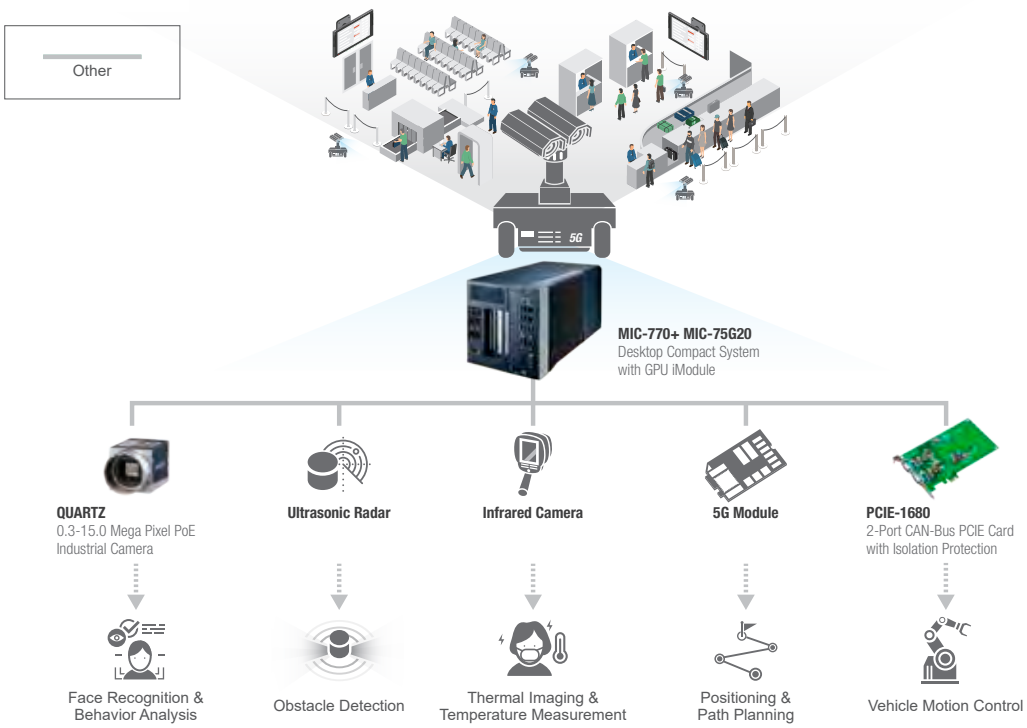
System Description

The 5G patrol robots integrate IoT, AI, cloud computing, and big data technologies to conduct environmental sensing, dynamic decision-making, autonomous motion control, as well as behavioral sensing and interaction. To enable such advanced computing, 5G patrol robots are powered by a high-performance industrial edge computer (MIC-770) equipped with an 8th gen Intel® Core™ i processor and GPU iModule (MIC-75G20) aimed at IoT applications.

Developed by Advantech, a leading provider of high-performance industrial computing solutions, the MIC-770 industrial-grade edge computer combined with MIC-75G20 GPU iModule provides a high performance system for AI training and inference. To withstand 24/7 operation under extreme conditions, the MIC-770's ruggedized chassis and cast aluminum heat sink protect against vibration and shock. The passive thermal solution ensures silent operation and all electronic components satisfy industrial standards for environmental protection, EMI/ESD tolerance, and high-voltage surge requirements (2KV). The MIC-75G20 GPU iModule supports PCIe/PCI I/F add-on cards, such as frame grabber, GPU, and motion control cards, in addition to mainstream GPU cards (with active cooling), and reserves an additional 12VDC of power from the onboard connector for cards that require additional power.

Aside from facial recognition, vehicle recognition, and toxic gas detection, with this edge solution robots can perform preliminary incident handling, sound alarms, and scare off intruders with noise. When patrolling, they can make computing -based judgments and analyze human behavior. They provide backstage notifications immediately after taking pictures, scanning, and analysis, and act in coordination with command centers for public security departments. Augmented reality (AR) visualization allows public security departments to step into the era of intelligence.

System Diagram



Why Advantech?

The high-performance computing power of Advantech's edge solution is compatible with a wide range of processors; allowing customers to flexibly configure custom solutions based on specific application requirements. The flexibility on slot, or I/O expansion, can be integrated for enhanced functionality. The modular design ensures the solution is widely applicable to urban security, smart equipment, autonomous vehicles, AI inference servers, high-end medical or security inspection equipment, and machine vision solutions to enable diverse industrial automation applications.

Empowering 3D Vision Guided Robots With Advantech's Ultra-Compact Edge

Location: **China**

Background

Electric vehicle (EV) development has received much attention in recent years. These innovative products are proving increasingly popular options for those seeking new cars. However, due to charging concerns, some people are still hesitant to try one. EV owners face challenges created by access to charging facilities—their car might run out of power on the road, there may not be enough time to charge cars at home, and charging stations are sometimes hard to find. Drivers without a garage or designated parking spaces cannot utilize personal charging kiosks. Conversely, long electric cables inside houses creates inherent safety risks. Advantech's partner, an innovator dedicated to robotic solutions, decided to adopt Advantech's edge industrial computer to address these challenges. This compact highly-stable high-performance computer was used to create a 3D vision guided robot to aid in charging.

System Requirements

This 3D vision guided robot system is a cost effective flexible solution. It turns "cars looking for kiosks" into "kiosks looking for cars". Using this system, ordinary parking spaces can be converted into a charging kiosks. Drivers don't need to exit their vehicle when entering these unmanned charging stations. Instead, the robot's "eyes" locate a charging port and guide the plug to the car quickly and automatically. This robot automatically closes the charging cover when finished. The whole process takes a few minutes, enabling a high turnover rate. The 3D vision guided robot comprises several machine vision systems — AGV systems, drive motors, batteries, IPCs, 3D positioning sensors (binocular cameras), laser radars, switches, 4G/5G network modules, and speakers. The robot primarily utilizes USB 3.0 to connect key cameras that manage guidance and capture images. Therefore, having a lockable, small form-factor, high-performance, and a highly-reliable edge solution is important.

Project Implementation

IPC-240

Compact Industrial Computer System with 6th/7th Gen Intel® Core™ i CPU Socket (LGA 1151)

PCIE-GIGE4

4 GbE Ports ethernet card

PCIE-1154

4-port PCI Express USB Vision Frame Grabber

QCAM-UM1440-220CE

Industrial camera with 1440x1080 resolution

PCI-1680U

2-port CAN-bus Universal PCI Card with Isolation Protection

BB-SL300 series

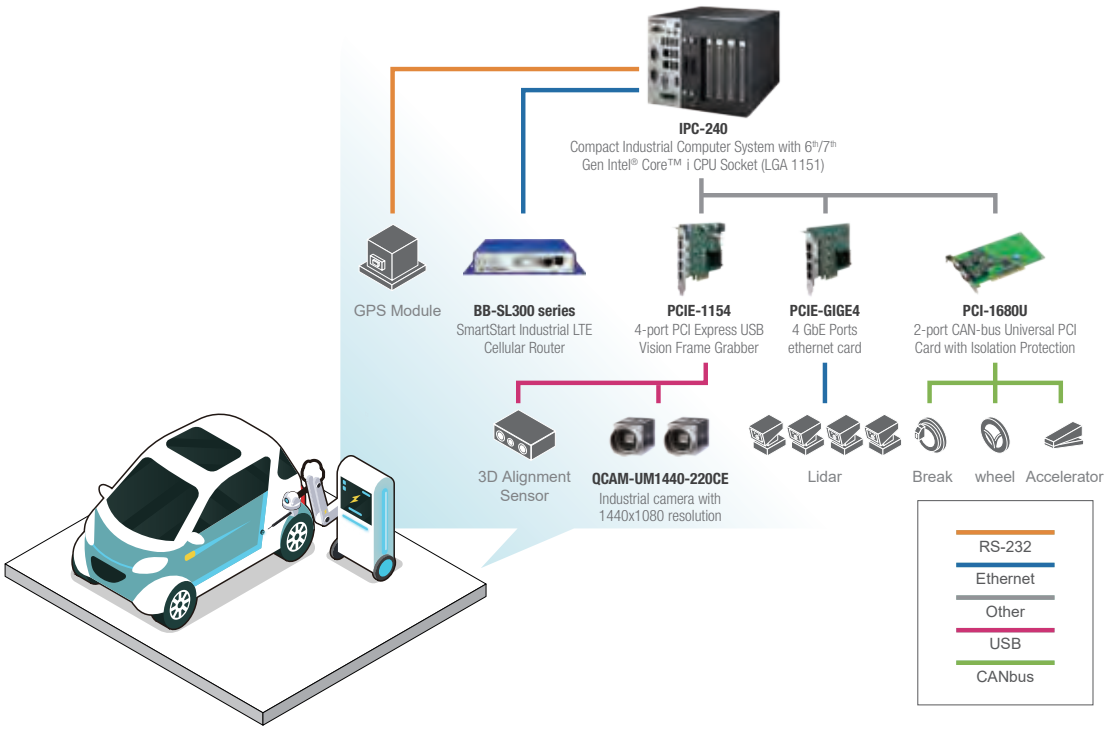
SmartStart Industrial LTE Cellular Router

System Description

This 3D vision robot performs varied tasks — including autonomous identification (face recognition, behavior analysis), network communication, and visual positioning during unmanned driving. The network module is used to obtain precise locations and access maps when driving. Similarly, industrial cameras are used to gather environmental data. Laser radars measure distances, detect obstacles, and find charging ports when the robot approaches an electric vehicle. It also uses binocular cameras to accurately locate and control individual robots.

Advantech's IPC-240 Compact Industrial Computer System features one panel with multiple I/O and PCIe/PCI card expansion slots. This computer integrates image acquisition (USB), communication (LAN), and fieldbus control into a single highly-adjustable solution. This industrial computer's compact size and stable industrial control design enables easy installation as a key controller on robots. PCIE-1154 features a 4-CH USB frame grabber card. It also utilizes an isolated USB 3.0 for independent bandwidth camera interfaces to ensure stable data transmission without dropping frames. PCIE-1154 has a lockable design to ensure reliable cable connections for robot vision applications. This system uses a PCE-GIGE4 expansion card with an Intel® Ethernet controller i210. This controller is connected to a laser radar which delivers fast data transmission. When combined with a PCI-1680U control card, it helps control the movement of the robot — by hitting brakes, changing directions, and accelerating. This system is connected to an external Advantech BB-SL300 series router that supports LTE full Netcom to deliver seamless industrial communication.

System Diagram



Why Advantech?

Advantech's complete product portfolio makes obtaining highly integrated solutions easy. The compact IPC-240 system with 7th Gen. Intel® Core™ i CPU provides the flexibility of multiple PCIe/PCI ports — delivering excellent performance in an ultra-compact package. The industrial input voltage design coupled with the Smart fan system ensures stable CPU operation in harsh environments. Advantech's global support stations provide repair and consulting services in a timely manner to increase solution stability. In sum, this solution's excellent capabilities won the trust of our customers.

Data Acquisition Solution with High Price-Performance Ratio for Distributed Temperature Sensor Systems

Location: **China**

Background

Rather than using temperature sensors to monitor temperature, distributed temperature sensor (DTS) monitoring systems use optical fibers as temperature sensing devices. With temperature sensing optical fiber cables installed in the monitored area and connected to a host computer, measurement software can be used to display real-time temperature changes. Benefiting from the advantages of optical fibers, which include being unaffected by electromagnetic interference, freely bendable, small and easy to install, and able to support detection in large areas without blind spots, DTS systems are especially suitable for high-risk, disaster-prevention applications, such as power cables, oil/gas pipelines and storage tanks, and highway/railway tunnels.

The quality of DTS systems is determined by the system's ability to quickly and accurately continuously monitor the temperature of all sites along the cable. For system integrators, the optimal data acquisition (DAQ) product must be selected during development to ensure that the system performance meets market requirements and exceeds that of their competitors.

System Requirements

The company's DTS system comprises a DTS host machine, temperature sensing optical fiber cables, measurement software, and related products. Spatial temperature distribution information is obtained using the Raman effect of light transmitted in optical fibers and an optical time domain reflectometer (OTDR). Because the company's original DTS host, a DAQ-equipped personal computer, lacked sufficient speed and resolution, the company wanted to replace this hardware with a high-performance computer and high-speed digitizer to improve data collection accuracy and system

However, the new hardware needed to offer a high performance. price-performance ratio. Specifically, the digitizer needed to support a sampling rate of no less than 100MSPS, 16-bit resolution, simultaneous analog sampling, data transfers through direct memory access (DMA) for faster processing, and large onboard memory to ensure efficiency.

Regarding the computer, the client required a system equipped with a high-performance processor, multiple PCIe slots, and a storage device with fast read/write speeds, as well as suitable protection to withstand industrial usage.

Project Implementation

PCIE-1840

16-Bit, 4-Ch, High-Speed (up to 125/80 MSPS) DSA Card

IPC-220

Compact Industrial Computer System with 6th/7th Gen Intel® Core™ i CPU Socket (LGA 1151)

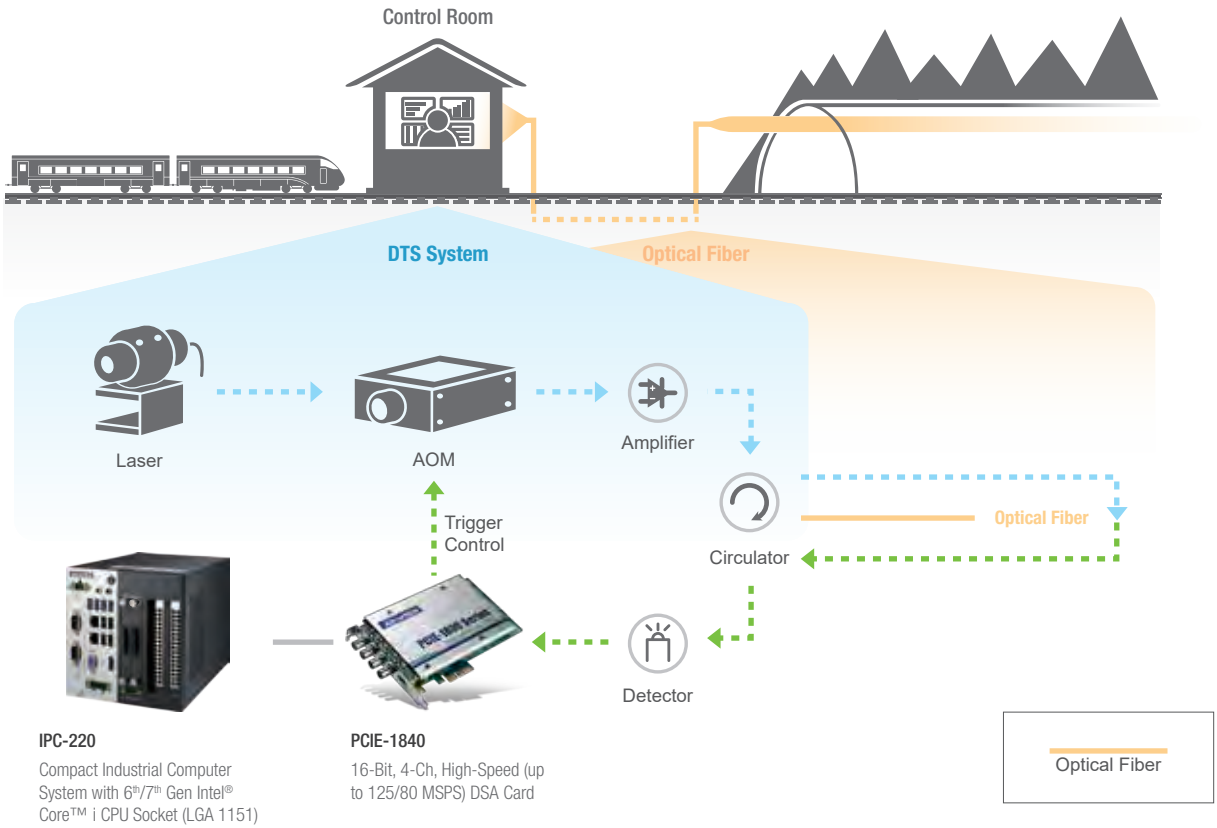
System Description

System Description

Advantech's DAQ solution includes an IPC-220 ultra compact IPC and a PCIE-1840 digitizer. Characterized by a wide dynamic range and high sampling rate, the system is extremely suitable for use as an optical fiber temperature sensor host that enables the DTS system to acquire high-frequency signals. By perfectly integrating the two products, the DAQ system is capable of triggering acousto-optic modulators (AOMs) that control lasers to send a laser pulse of set width to the propagator and then to the optical fiber cable, while also receiving the backscattered signal of the laser pulse source from the photo transducer. After processing on the host computer, the signal shows the temperature distribution for the entire temperature sensing cable. The PCIE-1840 digitizer is the most important component of the solution because it is this hardware that simultaneously triggers transmissions of the laser pulse while receiving the backscattered signal. This digitizer, with its sampling rate of up to 125 MSPS, 16-bit resolution, and four simultaneous analog input channels, enables precise and speedy data collection. Moreover, the inclusion of 2 GB of onboard memory satisfies the requirements for high-speed data transmissions. Data transmissions through CPU-independent DMA accelerate the overall transmission rate and reduce CPU load.

To further accelerate DMA data transmissions, Advantech adjusted the driver for this project by enhancing the transmission rate more than tenfold. In addition, because the strength of the laser beam is determined by the width of the laser pulse, Advantech customized the PCIE-1840 board with a field-programmable gate array (FPGA) to assist users with setting the pulse width.

System Diagram



Why Advantech?

The high sampling rate, resolution, number of channels, transmission speeds, and onboard memory of Advantech's high-speed digitizer PCIE-1840 exceeds that of conventional DAQ models and low-level digitizers.

The performance of the client's DTS system increased with the inclusion of the AiMC-3201 high-performance microcomputer.

Advantech also customized the PCIE-1840 board according to their specific needs to significantly improve the overall system efficiency.

Finally, because of the positive results of introducing Advantech's DAQ solution, the client company has decided to copy this solution with other systems.

Cost-Effective Audio Extraction Solution for Vehicle NVH Testing

Location: **China**

Background

Automobile manufacturers typically test all their vehicles for the following three performance indices: noise, vibration, and harshness. This is to ensure that the vehicles will pass the government's noise examination, while also increasing consumer purchase intentions and satisfaction.

For system integrators that provide noise, vibration, and harshness (NVH) testing systems to automobile manufacturers, data acquisition capabilities are as crucial as software programming and system integration capabilities. This is because precise collection of audio samples is essential for accurate signal reproduction and reliable software analysis. Another important consideration during system development is hardware costs. Excessive costs will reduce the company's overall profitability and affect the NVH testing system's market competitiveness.

System Requirements

An electronic technology company based in Shanghai, China, and specializing in the development of various sound, vibration, hydroacoustics, response, and temperature signal measurement and analysis software has produced various noise-testing-related systems for the automobile, space, energy, mechanics manufacturing, and consumer electronics industries over the years. Amid increasing demands for automobile testing in China due to the growth of the automotive industry, the company decided to update its automobile NVH testing system and high-cost hardware products with an audio extraction solution that offered a high price-performance ratio. Through this upgrade, the company hoped to gain substantial business opportunities by increasing the NVH testing system's market competitiveness.

The company's automobile NVH testing system is configured according to the client's measurement requirements. Numerous IEPE microphones are installed in an array and used to identify noise sources. Therefore, the audio extraction solution must include an industrial computer with an adequate number of slots for installing multiple PCI Express dynamic data acquisition cards. Moreover, the acquisition cards should support multi-channel synchronized sampling, 24-bit resolution, a sampling rate of no less than 100 kS/s, IEPE signal adjustment functions for microphone sensors, and a wide input voltage range in order to accommodate various sensors for different applications. Furthermore, the new solution must be capable of simultaneous sampling not just for all channels on a single card, but also simultaneous sampling between multiple cards to ensure precise measurement data.

Project Implementation

IPC-623

4U, 20 Slot Rackmount Chassis

PCE-5B19

19-Slot Backplane for 20-Slot Chassis

PCIE-1802

8-Channel, 24-Bit, 216 kS/s Dynamic Signal Acquisition PCI Express Card

PCL-10419

High-Speed Acquisition Card Sync Cable

PCL-108BNC

Mini SCSI to 8-BNC Cable

System Description

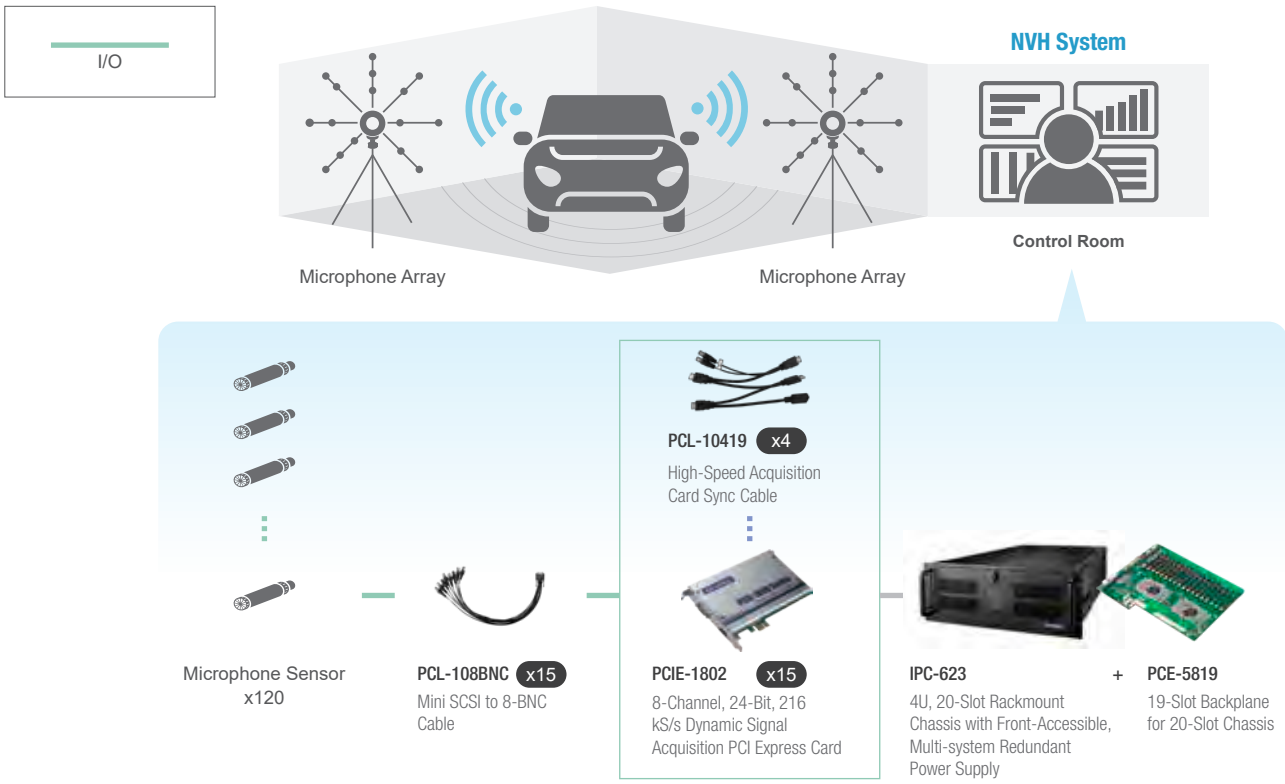
Advantech's audio extraction solution comprises Advantech's IPC-623 4U, 20-slot rackmount chassis, PCE-5B19 19-slot backplane, PCIE-1802 multi-channel high-resolution dynamic signal acquisition PCI Express cards, and a high-speed multi-card sync cable. The industrial computer is equipped with 15 dynamic signal acquisition cards that can support up to 120 IEPE microphones installed in the automotive noise testing laboratory. The sync cable is used to synchronize all PCIE-1802 cards. With this audio extraction solution, more than 100 audio channels can simultaneously sample noise signals and provide data to specifically developed software for NVH performance analysis.

In addition to an industrial computer with up to 19 slots that support microphone arrays, a key component of this solution is Advantech's PCIE-1802 dynamic signal acquisition cards. These cards feature eight 24-bit analog input channels and support synchronized sampling on all channels at a sampling rate of up to 216 kS/s. Thus, the cards satisfy the multi-channel, high-resolution, high sampling rate, and simultaneous sampling criteria required for microphone array applications.

PCIE-1802 also provides useful functions for different sensor specifications. One of these functions is IEPE signal adaption, which allows users to set the required firing current (0, 4, or 10 mA) using software. Another notable feature is the wide input range (±0.2~10V), which ensures the system does not lose resolution with sensor changes. These two features offer system designers increased configuration flexibility.

Furthermore, Advantech actually customized the high-speed multi-card sync cable especially for this project. This unique cable reduces the time lapse of each card to within nanoseconds, thus preventing errors and facilitating simultaneous sampling.

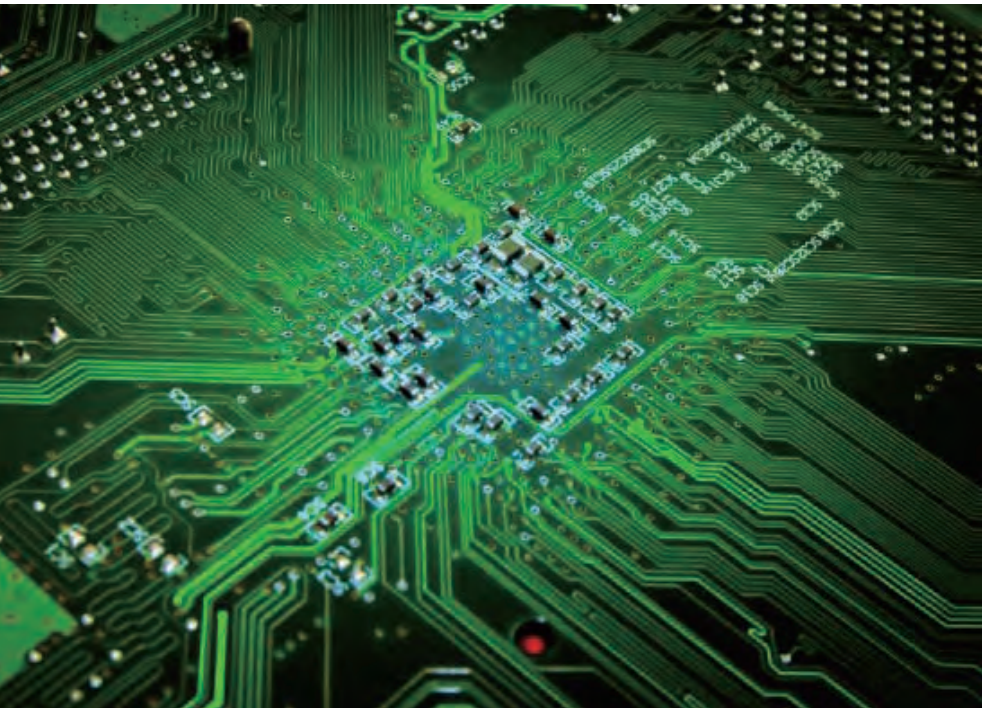
System Diagram



Why Advantech?

Advantech's multi-slot industrial computer, multi-channel high-resolution dynamic signal acquisition PCI Express card, and high-speed multi-card sync cable satisfy the system integrator's requirements regarding number of channels, resolution, sampling rate, synchronized sampling, IEPE function supply, input voltage range, and a high price-performance ratio. The company was able to assemble Advantech's hardware into a competitive platform capable of extracting audio signals precisely and accurately. Finally, Advantech's solution is cost-effective and suitable for other environmental noise testing applications in other industries.

High-Precision Stress Measurement Solution for Printed Circuit Boards



Location: **China**

Background

In response to increasing market demands for lighter and smaller products, printed circuit board (PCB) manufacturers are reducing the dimensions, thickness, and weight of their PCBs. However, this change has led to fractured tin solder joints becoming a common problem. Furthermore, during manufacturing, PCBs are subjected to various equipment and testing processes, which place the circuit boards under varying degrees of stress. The electronics industry has also begun to replace traditional tin/lead solder with lead-free soldering materials, which are relatively weaker. The result is that under the same levels of mechanical stress and tensile strength, solder joint failures have become a serious problem. Consequently, PCB manufacturers have begun to introduce various stress measurement solutions to avoid fractured tin solder joints and increase their overall yield.

System Requirements

In order to detect defects caused by stress at an early stage, PCB manufacturers are planning to introduce stress measurement systems into their production processes to verify whether the maximum mechanical stress is within a safe limit. The most common form of stress measurement involves using a data acquisition module to measure changes in the electrical resistance of strain gauges.

To measure strain during testing, the system must provide an excitation voltage to measure the resistance change in the stress gauge's electrical conductor. However, because the change in electrical resistance caused by external forces is extremely small, a Wheatstone bridge must be built into the circuit's high-precision data capture module to detect the resistance change of a stress gauge. A minimum resolution of 24 bits is required to measure such a small change. In addition, to further increase the accuracy of strain analysis results, synchronous sampling between each channel of the data capture module must be implemented to prevent deviation caused by sampling delays between various channels.

Project Implementation

MIC-7500

Compact, Fanless, 6th Generation Intel® Core™ i Processor

PCIE-1813

4-Channel, 26-Bit, 38.4 kS/s Bridge Input Card

PCLD-8813

Signal Conditioning Module

PCLD-8811

Low-Pass Active Filter Board

System Description

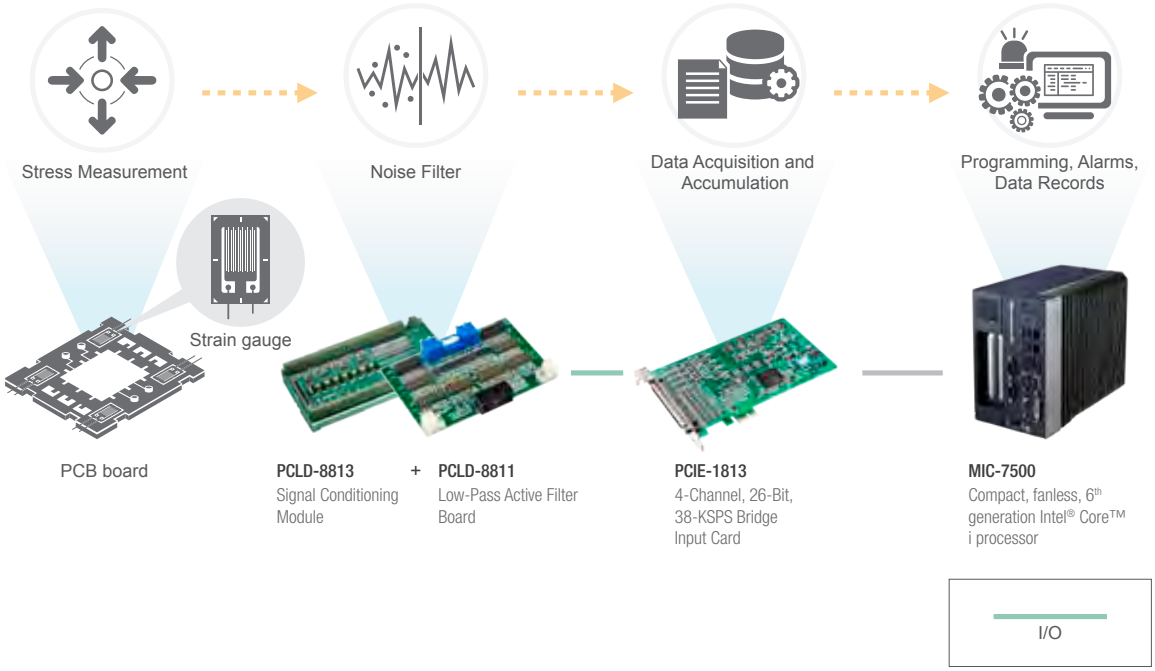
The stress measurement solution provided by Advantech comprised its MIC-7500 compact modular computer, PCIE-1813 4-channel, 26-bit simultaneous strain measurement card, and a signal processing card to provide isolated DI/O and signal filtering features.

Generally, 4 to 12 sets of strain gauges are used to measure strain on a circuit board. For this type of measurement system, strain gauges attached to the PCB are connected to the signal processing card, which filters out the noise. The PCIE-1813 strain measurement card's parameters are then configured according to the specifications of the strain gauges in order to collect signals sent by the strain gauges based on the specified sampling frequency, magnification rate, and excitation voltage.

The most important product in the solution is the PCIE-1813 card, which is capable of providing extremely high resolution measurements.

The card's 26-bit resolution provides the ability to detect and measure the slightest change in the strain gauge. The built-in supply of excitation voltage allows the card to be directly connected to the strain gauge. No additional modules are needed to provide the excitation voltage. The PCIE-1813 card also offers excellent magnification rates and the input range is able to reach ±31.25 mV/V. In addition to its four sets of analog-to-digital converters (ADC), which can be used to collect signals from four channels simultaneously, the PCIE-1813 card also provides a trigger function for implementing synchronized multi-channel data collection to meet the synchronized precision sampling requirements.

System Diagram



Why Advantech?

PCB stress measurement systems depend heavily on data collection products that are capable of providing high-precision stress measurements. Advantech's high-precision PCIE-1813 card offers several advantages, including high resolution, an outstanding price/performance ratio, as well as numerous signal processing features.

In addition to satisfying the measurement system requirements, this solution allows customers to select a modular industrial computer from Advantech's MIC-7500 series based on the number of card slots available as well as their strain test requirements and rapidly build various stress measurement systems.

Cost-Effective Vibration and Noise Testing Solution Enhances Quality Assurance Testing for Fan Maker

Location: **Taiwan**

Background

In product manufacturing, quality testing is crucial for ensuring that the final product received by customers meets the required standards. When building cooling fans for electronic products, after assembly, high-precision fans must be assessed not only for normal operation, but also to measure the vibration and noise caused by the bearing turning the fan blades in order to evaluate the overall product quality. Therefore, sensors, an accelerometer, and a microphone are necessary for collecting vibration and noise data to conduct fan quality testing.

Previously, quality testing of multiple production lines in fan production plants necessitated the installation of data acquisition cards into box PCs via PCIe bus. However, this solution is not only expensive, but also requires a comparatively larger computer, which overcrowds the already limited space of production lines. Additionally, the connection between the acquisition card and the port can be unstable, and interruptions in connection will impact data transmissions.

System Requirements

The customer for this project was a manufacturer located in Taiwan and specializing in the research, development, and production of precise motors, micro fans, and heat dissipation modules. In order to improve the breadth and depth of quality assurance, the fan manufacturer decided to increase the number of production line quality testing points to correlate with its recent production line expansion. The manufacturer planned to have full inspections conducted in the semi-finished zone in order to identify and reject defects in advance before subjecting products to spot inspections and quality rechecks in the finalized zone.

The company wanted to find a more cost-effective alternative with the following requirements:

- A compact hardware platform capable of supporting numerous production line test points
- IEPE signal conditioning and BNC adapters for the accelerometer and microphone
- Able to collect signals from multiple sensors through multichannel and high-resolution analog inputs
- USB ports for connecting to scanners
- Network ports for uploading test reports
- Support for open source programming languages to avoid total rewriting of system programs

Project Implementation

MIC-1816

16-Bit, 1 MS/s, 16-Channel DAQ Hardware Platform with Intel® Core™ i3/Celeron® Processor

ADAM-3017

Externally Powered IEPE Signal Conditioner

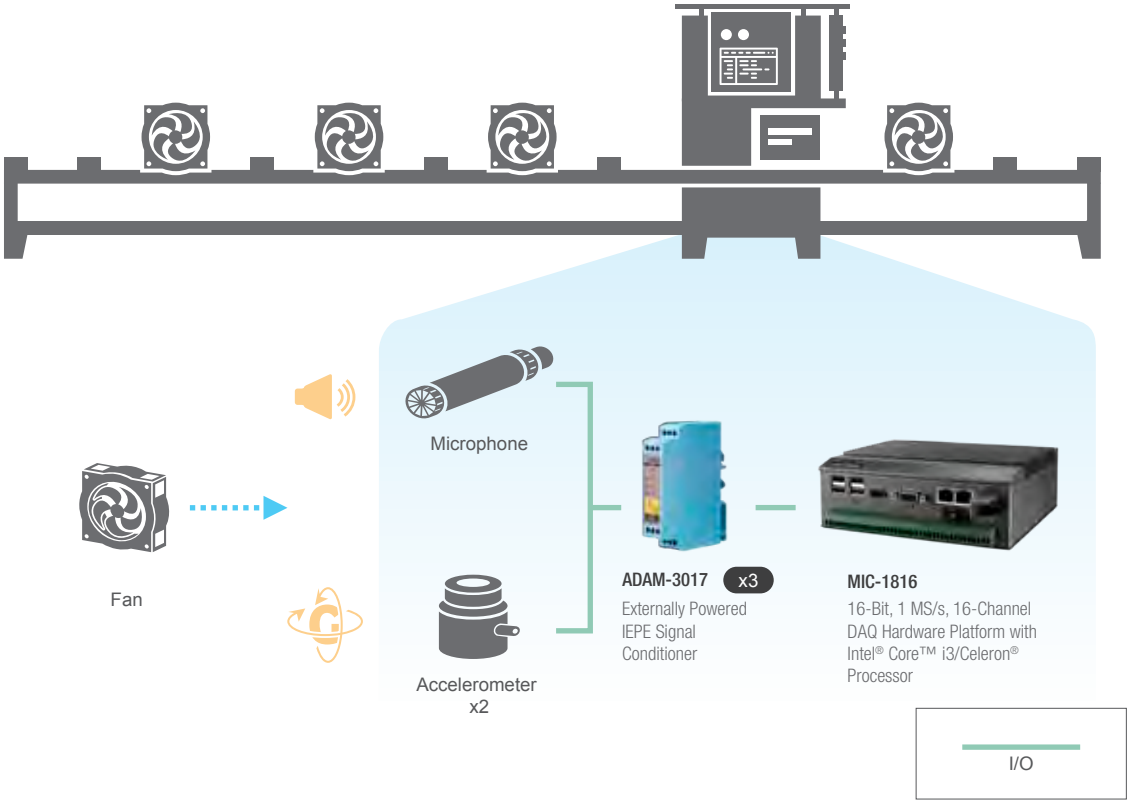
System Description

Advantech's fan vibration and noise testing solution comprises a MIC-1816 DAQ platform and ADAM-3017 IEPE signal conditioners. With three ADAM-3017 conditioners connected to two accelerometers and one microphone sensor, the MIC-1816's three differential channels can collect sensor signals to produce quality test reports on site. Meanwhile, the MIC-1816's USB port is connected to a scanner to enable rapid entry of product data, eliminating keyboard-based data input. The MIC-1816's network port is then used to transmit quality test reports to the backend management system for integrated management.

ADAM-3017 is an IEPE signal conditioner developed by Advantech in 2018. The accompanying BNC adapter meets the connection requirements for accelerometers and microphones that use BNC connectors. The IEPE signal conditioning function provides energizing currents and amplifies signals, allowing the DAQ platform to acquire not only basic analog signals, but also advanced physical signals such as vibration and noise.

The 16-bit resolution MIC-1816 is a DAQ platform that combines a data acquisition module with edge computing functions. Compared to pre-assembled card solutions, the MIC-1816 is compact (165 x 130 x 59 mm), making it ideal for limited-space installations that necessitate additional computers. Moreover, because no data acquisition card is required for data collection, the security and stability of the card connection are no longer a concern. Furthermore, the MIC-1816's fanless design prevents the accumulation of dust from affecting the device performance.

System Diagram



Why Advantech?

In order to improve the fan manufacturer's quality assurance, the production line must have enough test points to filter out low-quality products. Extensive installation of quality test points necessitates a solution with a high price-performance ratio to protect the company's profit margins. The advantages of Advantech's fan vibration and noise testing solution include its compact form factor for limited spaces, easy production line installation with built-in terminals, high-speed sampling without a data collection card, sufficient I/O channels for data acquisition and equipment signal control, and various interfaces for network and accessory integration. More importantly, this solution is economical. Advantech guarantees at least 10 years of serviceability with numerous service locations worldwide. The fan manufacturer's system requirements were fully satisfied. Thus, following the trial implementation on a single production line, the company decided to introduce the solution to their other production lines and overseas factories as well.

High-Integration DAQ Compact Computer for Industrial Measurement Systems

Location: **Taiwan**

Background

Volatile organic compounds (VOCs) comprise a broad range of carbon-based chemicals, some of which are dangerous to human health and the environment. As a result, the growing interest in indoor air quality in the workplace is stimulating the development of measuring instruments for detecting VOC emissions in enclosed atmospheres, such as laboratories, semiconductor cleanrooms, and production line environments.

In general, quality measuring instruments must be able to receive a variety of sensor signals, and may even feature advanced functions for controlling related devices. The collection of accurate data and successful execution of controls is largely dependent on the instrument hardware. Multi-brand hardware products increase the complexity of system integration by necessitating time-consuming compatibility testing, thereby delaying installation and implementation.

System Requirements

This client for this project was a Taiwanese supplier of measuring instruments and manufacturer of water quality monitoring equipment and VOC analyzers, whose products have been adopted by various industries, such as the public utilities, petrochemical, and semiconductor and electronics industries. The company's existing VOC analyzers use hardware of multiple brands to measure temperature and concentrations of atmospheric gas. This "patchwork-hardware" approach requires excessive cabinet space, hinders development and maintenance, and can be easily replicated by competitors. Therefore, the company wanted to upgrade the system with an all-in-one, industrial-grade solution.

The all-in-one solution needed to comprise an industrial box PC and DAQ module. Because the company's VOC analyzer is typically embedded in a cabinet computer with several other devices, the new hardware platform needed to be compact to fit limited spaces. Additionally, the solution required multiple I/O channels (both analog and digital) to accommodate numerous signal types. Finally, and most importantly, their system needed sufficient security to prevent the solution from being copied or imitated by competitors.

Project Implementation

MIC-1816

16-bit, 16-channel, 1 MS/s Data Acquisition Platform platform with Intel® Core™ i3/Celeron® processer

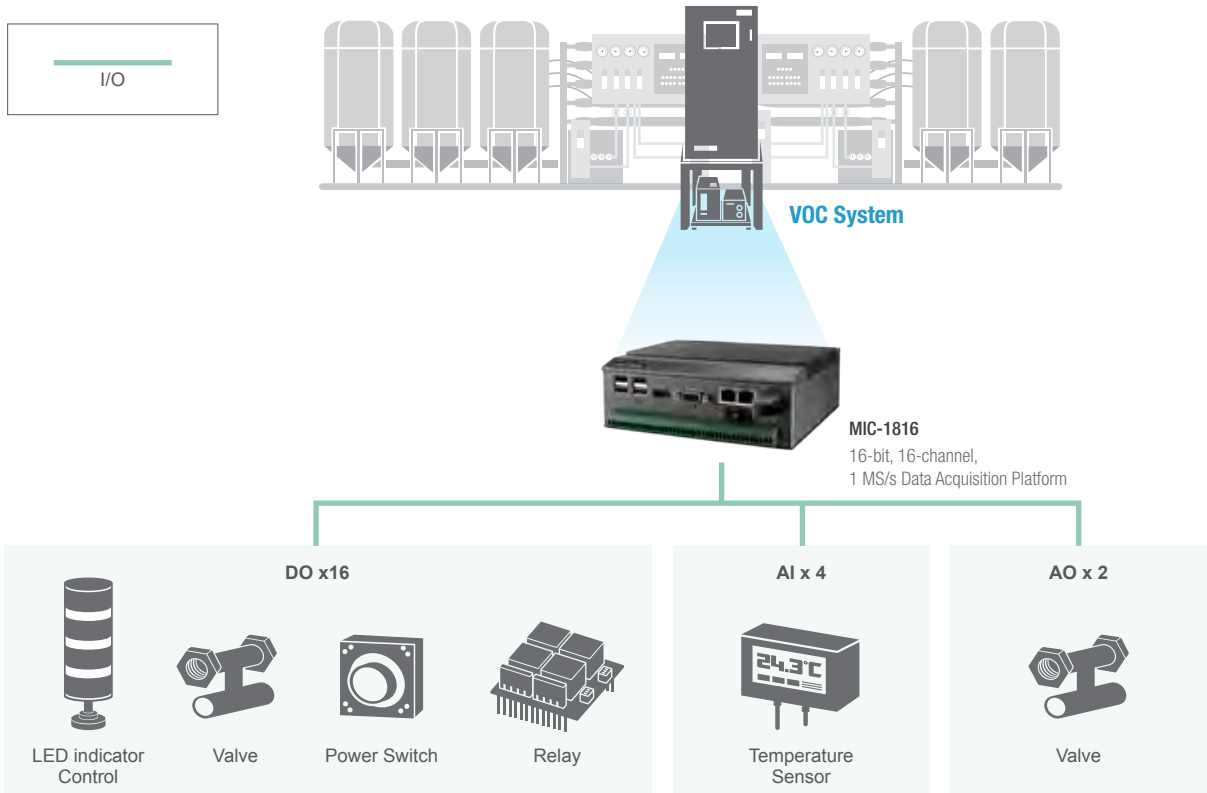
System Description

Advantech's MIC-1816 is an embedded computer equipped with DAQ module. The system's compact, fanless design makes it ideal for limited-space installations. For this project, MIC-1816 was installed in a cabinet in order to connect the thermocouple, intake valve, valve button, and relay with LED indicator. This allows the VOC measuring system to be used for collecting sensor signals and controlling related devices to thereby regulate temperature and VOC concentrations.

MIC-1816 is the industry's first embedded DAQ platform. Although the device is compact (165 x 130 x 59 mm) and palm sized, it delivers sufficient computing power to satisfy the requirements of this project. The system's high support for integration allows the company to replace the previous "patchwork" hardware with a single platform. Multifunction I/O (including analog inputs, analog outputs, digital inputs, and digital outputs) allows users to connect to multiple devices and manage various components. Moreover, the provision of 16-bit-resolution data acquisition increases the accuracy of measurements, and the detachable terminal block can be directly wired to sensors for easy installation and maintenance.

Finally, to prevent piracy and protect the customer's intellectual property, Advantech can embed MIC-1816 with a unique device ID that is stored in EEPROM. With this customization feature, available upon request, the MIC-1816 system will only function if the device ID matches that in the EEPROM. This is to prevent other manufacturers from copying the VOC measuring system's functionalities, even if they use the same hardware components.

System Diagram



Why Advantech?

System integrators or equipment manufacturers looking to develop an advanced solution for increasing business opportunities must select the appropriate hardware platform to successfully launch products while protecting their intellectual property assets. Compared with the company's previous VOC analyzer solution, which comprised multiple differently branded I/O modules, Advantech's MIC-1816 system is an all-in-one platform equipped with the required data acquisition and control functions. The platform supports integration, allowing system integrators and manufacturers to conveniently develop and maintain the system. Moreover, the provision of a unique device ID as an encryption mechanism prevents third parties from replicating the platform. Currently, the new VOC measuring system has entered the trial production phase. Thus far, the company is very satisfied with MIC-1816 and plans to continue developing the platform features and functions.

Automated Solution for 4K Video Output Inspection

Location: **Netherlands**

Background

This manufacturer of 4K set-top boxes with HDMI outputs previously employed traditional product inspection methods that relied on visual inspection and offered no means to improve the accuracy of inspection, the type of items that could be inspected, or the number of items that can be inspected. Hence, the client sought to implement automated inspection by utilizing image processing. The solution consisted of Advantech IPC and multi-channel 4K HDMI video capture cards, which allow a single system to capture and inspect video outputs from multiple set-top boxes. The system concurrently collects inspection data to ensure video output and improve product quality.

System Requirements

Before the system was implemented, it needs manual operations to inspect a number of set-top box output formats and relied on the naked eye to determine the accuracy of video output. This method is subjective and prone to errors. It is unable to verify many display modes. Furthermore, there is no detailed statistics to give manufacturers a good understanding of product quality or the verification results.

The client wished to utilize image detection in a single system to connect multiple set-top boxes so that the automated inspection can simultaneously verify 4K HDMI video outputs from multiple set-top boxes. Furthermore, manufacturers can preload testing patterns of video output modes to run additional quality verifications. All defects of the video output can be stored to reduce defect loss and improve yield.

Project Implementation

ACP-4010

Quiet 4U Rackmount Chassis for ATX/CEB/EEB Motherboard or Full-size SHB/SBC with Dual System Support

ASMB-815

LGA 3647-P0 Inte® Xeon® Scalable ATX Server Board with 6 DDR4, 5 PCIe x8 or 2 PCIe x16 and 1 PCIe x8, 8 SATA3, 6 USB3.0, Dual 10GbE, IPMINew

DVP-7011UHE

Capture Card: 1-ch H.264 4K HDMI 2.0 PCIe Video Capture Card with SDK

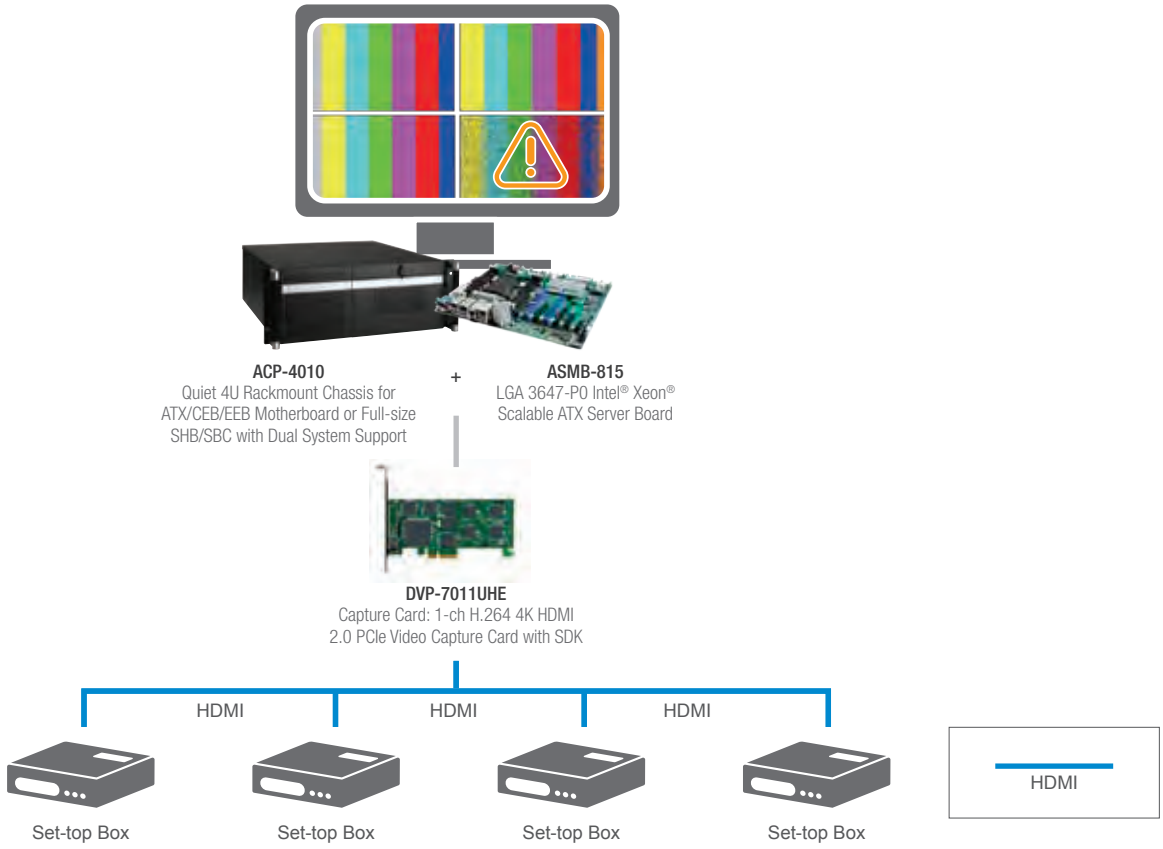
System Description

The DVP-7011UHE capture card was selected as the image capture device to be integrated into the system. DVP-7011UHE is capable to capture HDMI 2.0 video input and support 4K resolution (up to 4096x2160), which is on par with the video output formats of mainstream set-top boxes. Multiple DVP-7011UHE cards could be installed in a single system to capture video outputs from multiple set-top boxes and allow for large-scale automated inspection.

In addition, the client required an SDK so that they could quickly develop apps as needed. The SDK supports fundamental functions such as image capture and recording, and it has Intel and NVIDIA GPU hardware acceleration instruction sets that make automated inspection markedly more efficient. CPU resources can thus be managed more effectively to meet the quality assurance needs of set-top boxes in terms of image processing and display comparison.

The complete solution included ASMB-815 server boards and Xeon CPUs as well as up to five DVP-7011UHE image capture cards. The HDMI video input on the cards captures HDMI 2.0 signals from the set-top boxes, and then apps developed using the SDK inspect the video signal, effectively realizing a fully automated inspection process.

System Diagram



Why Advantech?

Many video output device manufacturers have attempted to implement automated inspection programs to replace manual visual inspection used in mass production. This is especially true when devices have different video output interfaces and require a specialized inspection procedure to inspect different video output formats. Devices such as laptops, Set-top boxes, video players, medical imaging equipment, and video converters can leverage automated image processing in video output inspection. As 4K video devices are becoming more ubiquitous, image capture cards play a key role in the approach to automation by capturing 4K images and comparing images in the inspection system. Image capture cards can boost production capacity and yield and reduce the risks involved in visual inspection.

Advantages

- The system can capture image outputs from up to five channels. This means that the system can inspect multiple devices without having to check each machine individually.
- Abundant SDK resources for development and hardware performance enhancement: All image processing procedures can be completed using the SDK, which provides GPU instruction sets to deliver high performance without affecting CPU performance.
- DVP card supports different video interfaces: In addition to 4K HDMI 2.0, products are available to enable image capture in interfaces such as HDMI, SDI, DVI, and composite.

Automotive Connector Testing Equipment

Location: **New Taipei City**

Background

As the trend toward intelligent automobiles and electric vehicles continues to grow, configuration and functionality are getting more complex and diversified than ever before. From traditional steering wheels, manual transmissions, and brake systems, to GPS, safety cameras, tire monitoring, car entertainment, and auto-pilot, there is now a large demand for automotive electronic parts. Automotive connectors, in particular, are being applied to all systems and made available in a variety of choices. There are three major categories: the FFC/FPC connectors, the Wire-to-Board connectors, and the Board-to-Board connectors. Equipment suppliers need highly compatible controller/testing systems that allow for flexible development in order to address the production needs of various types of connectors.

System Requirements

As more and more types of connectors become available, the existing production/testing equipment on the customer end can no longer satisfy all terminal needs. In light of different costs and frameworks, the actuators/motors of different brands (such as Panasonic/Oriental/Delta) are applied in the equipment. As customers are accustomed to using third-party authorized development toolkits, controllers need to support certain development settings.

Given these conditions, Advantech's controllers/testing products meet a critical customer requirement: various control cards/graphics cards may be added to industrial computers. The control system flexibly supports multi-axis (4-32 axes) control, can accommodate actuators/motors of various brands, and supports third-party development toolkits to allow for customized features in a familiar, programmable environment.

Project Implementation

IPC-510

Economical 4U Rackmount Chassis with Front USB and PS/2 Interfaces

PCIE-1674

4-Port PCI Express GigE Vision Frame Grabber

PCI-1203

2-port EtherCAT Universal PCI Master Card

AMAX-4856

32-ch Isolated Digital Input and 32-ch Isolated Digital Output EtherCAT Remote I/O Module

System Description

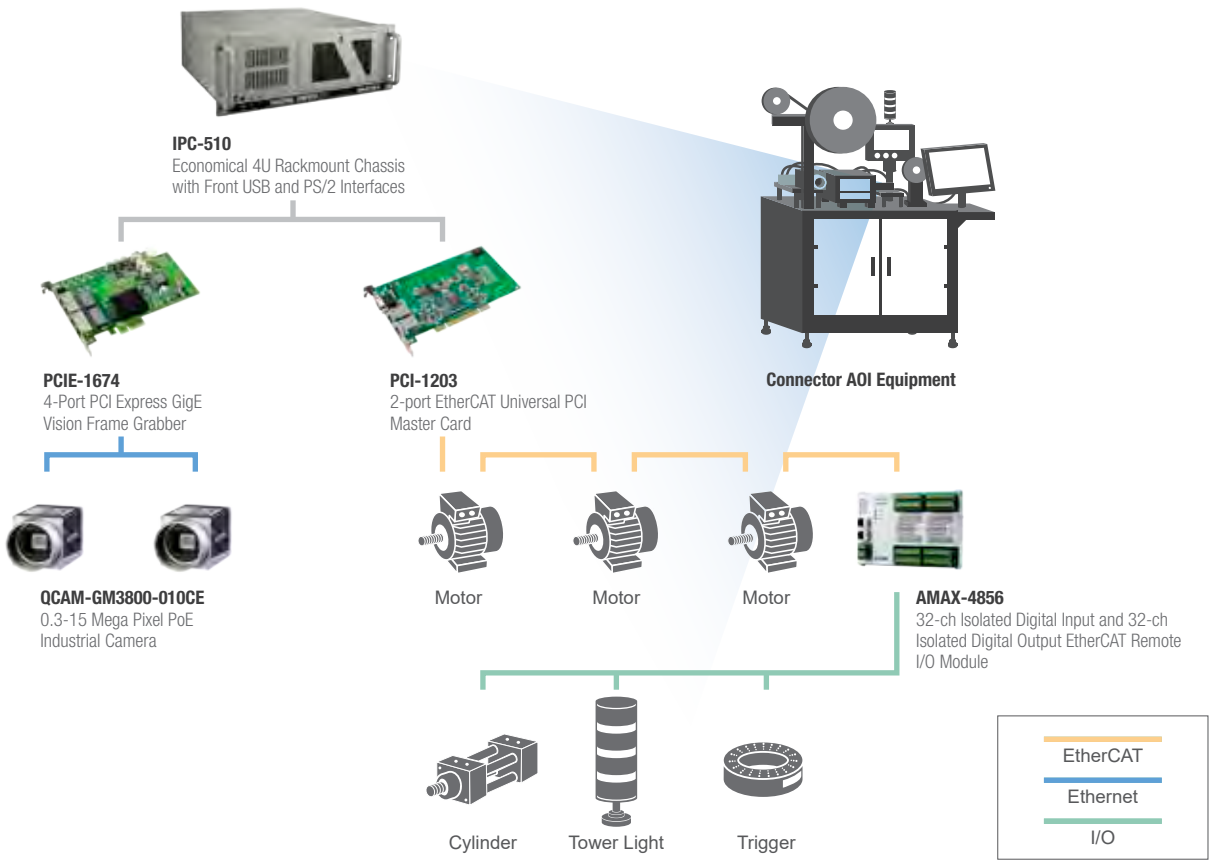
The equipment controller and testing solutions that Advantech provides are divided into three major segments: EtherCAT communication motion control, EtherCAT communication station I/O control, and industrial visual inspection of system components.

EtherCAT Communication Motion Control: With the PCI-1203 motion control card serving as the EtherCAT master main station control, EtherCAT actuators/motors of different brands are connected through the network. Two axes are used for the “pick & place” motion of the connector while the other two-to-eight axes are used to go with the motion of the testing system. The number of axes involved varies with the testing details required for different units and different connectors.

EtherCAT Communication Station I/O Control: With the PCI-1203 motion control card serving as the EtherCAT master main station control, all the I/O signals on the units are linked up by connecting the EtherCAT I/O AMAX-4856 modules and 32DI/32DO through the network.

Industrial Visual Inspection of System Components: The ten-million-pixel industrial camera QCAM-GM3800-010CE takes photos of tests performed on the connectors. It is connected to the PCIE-1674E video capture card PCIE-1674E through the network. Images enter the industrial computer and are analyzed through the visual software. Connector dimensions and connector defect determinations are recorded.

System Diagram



Why Advantech?

With this automotive connector testing equipment solution, Advantech played a crucial role by providing a core technology for equipment development. The industrial computer served as the main station of the controller. The motion control card realized the application of all automatic equipment functions. The industrial camera and video capture card built the testing system. It’s particularly worth mentioning the hardware and software integration capabilities of this Advantech solution: the software enabled the development of control and testing functions in third-party authorized development toolkit settings while the hardware could go with the actuators/motors of various big brands. In response to the customized testing needs of customers for different products, flexible development of units involving different numbers of axes, under the same product framework, was possible. Given Advantech’s strength in this field, our solutions can be successfully tailored to meet customers’ real-time demands and in changed in accordance with a quickly evolving market.

Advantech Notebook Industry Display Inspection Solution

Location: **Suzhou, Eastern China**

Background

With the continuous improvement of 4K technology, the earliest 4K TVs have now transitioned to notebooks. Since 2017, various major computer manufacturing brands have successfully launched 4K notebook products. A well-known PC manufacturer in Suzhou, China, also began investing in the development of 4K notebook products. The transition necessitated the upgrade and replacement of corresponding production equipment. This project was for 4K notebook screen inspection machines needed for product upgrades to the company's internal automation department.

System Requirements

The customer originally selected a different brand of IPC. After testing, the USB port was found unstable and often lost power. The original solution used one IPC, which included 4 single-channel image acquisition cards occupying 4 PCIE slots—thus demanding higher IPC performance. Even when paired with the visual configuration of I7CPU+8G RAM, the hardware failed to meet performance requirements. Another IPC for visual processing was needed, as well as motion control and I/O controlled by PLC. However, the 2 IPC + PLC architecture was extremely complex.

Project Implementation

IPC-631/AIMB-706

4U, 350mm short depth front I/O IPC featuring 9th Gen. 8-core Core i, compact size and easy cabling and maintenance.

PCI-1245L

4-axis Stepping and Servo Motor Control Universal PCI Card

PCI-1750

32-ch Isolated Digital I/O and 1-ch Counter PCI Card

PCIE-1174

4-port PCI Express Intelligent GigE Vision Frame Grabber

DVP-7031UHE

4-ch 4K H.264/MPEG4 PCIe Video Capture Card with SDK

ADAM-3952/ADAM-3937

DIN-rail Wiring Board

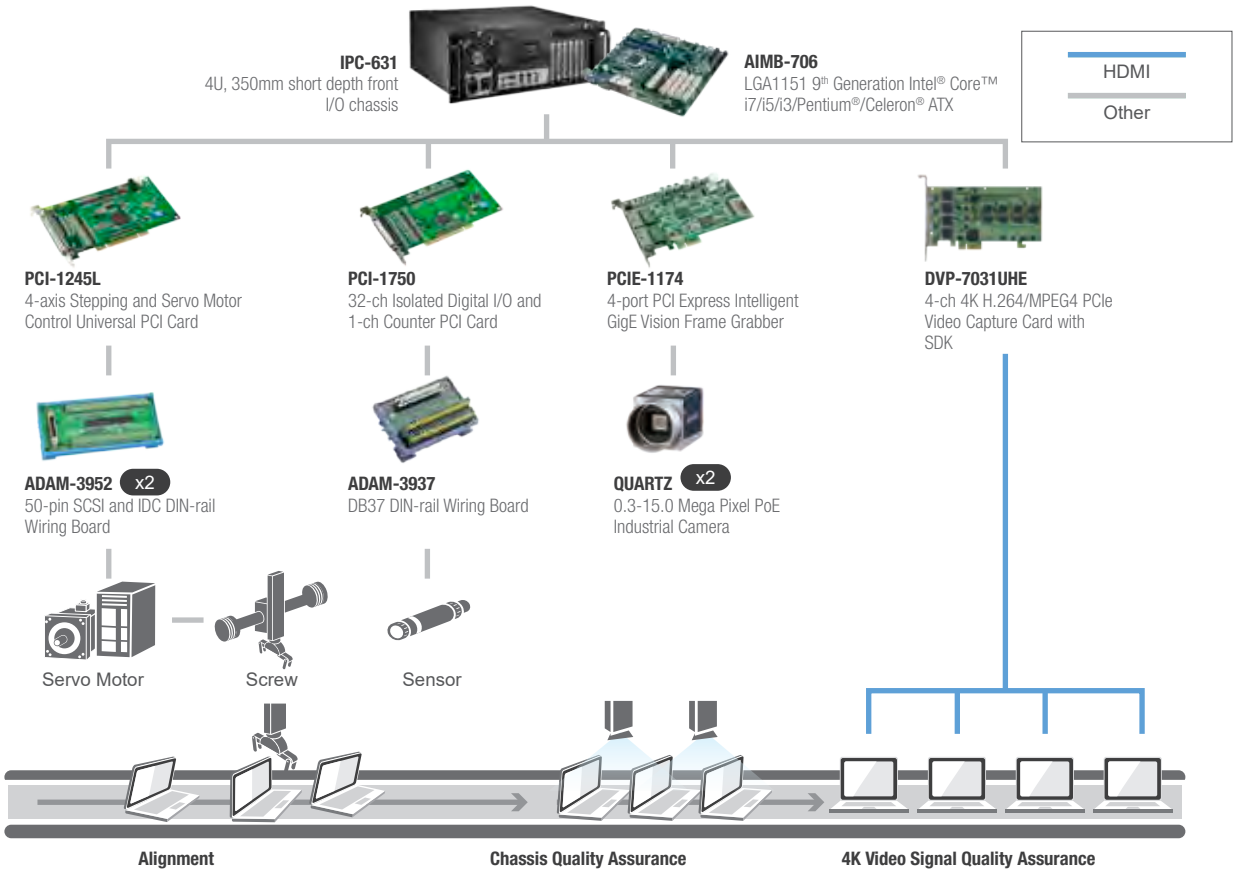
QUARTZ

0.3-15.0 Mega Pixel PoE Industrial Camera

System Description

Advantech's classic IPC-610L chassis with Intel Core i7 processor, 8G RAM, and AIMB-710VG motherboard, combined with Advantech's PCIE-1174E intelligent frame grabber, onboard FPGA chip, and high-level functionality, such as the built-in Trigger Over Ethernet (ToE) feature, effectively reduces the visual computing workload and performance of IPCs. The DVP-7031HE functioned as a 4K screen data acquisition card, which simultaneously sampled 4 sets of 4K signal data and only needed to occupy one PCIEX16 slot. Using PCI-1245L+PCI-1750 for axis control and I/O control eliminated the need for the original PLC configuration.

System Diagram



Why Advantech?

The PCIE-1174E intelligent frame grabber effectively reduced the load of the visual system on the CPU and saved CPU resources. The DVP-7031HE, which was used as a 4K screen data acquisition card, simultaneously collected 4 channels of 4K signals, and saved the number of PCIE slots. The PCI-1245L+PCI-1750, which provided axis control and I/O control for the machine, is Advantech's star product and proves extremely cost-effective. The IPC-631 + AIMB-706 IPC is designed for AOI application, features 9th Gen. 8-core Core i, compact size and easy cabling and maintenance. It uses Advantech's overall solution to streamline the client platform architecture without increasing customer costs. Advantech has a strong R&D team offering technical support to help fulfill customers' requirements for various special functions. This level of comprehensive support eliminates the need for customers to find suitable products one by one—thereby saving considerably on initial evaluation time for our customers. At the same time, Advantech's on-site technical support team has considerable experience in tuning machines to assist customers' on-site personnel and quickly identifying possible problems and abnormal conditions.

AI Defect Inspection for Textiles

Location: **Taiwan**

Background

Nowadays, the pace of industrial development is increasing and Taiwan's traditional textile industry wants to catch the global trend for fast fashion. The textile industry like textile manufacturers and fabric mills need to accelerate their upgrade roadmap to get to market faster. In traditional textile industries, design, selection, spinning, weaving, dyeing, and finishing, all consume a lot of resources and time. For example, it takes several days or weeks to manually identify the right types of fabrics and quality materials. However, if there are material defects, it can seriously stall the whole process from pre-production all the way to mass production phases and of course, delivery to the customer.

Thanks to artificial intelligence (AI), manual operations like textile or fabric pattern inspection can be performed by smart AI models. Robotic mechanical arms can perform many routine automated processes in textile manufacturing. When we combine robotic arms with AI capability, textile manufacturing processes can be significantly shortened from weeks to days to hours even. AI can really make a radical difference to the whole textile industry

System Requirements

An AI-guided robotic arm solution is powered by distributed computing, which has the scalability and flexibility needed to meet requirements at the edge. A centralized management system takes high speed raw images from all industrial cameras on the production line, and then delivers pre-processed images to edge AI systems for textile defect inspection. These industrial cameras run on the GenICam standard via high throughput gigE Power over Ethernet (PoE).

The management system needs high processing capabilities to performimage pre-processing in parallel, such as contrast adjustment, image calibration, and image segmentation. Then, pre-processed images will be sent to the edge AI system to perform AI inference and return metadata results back to the management system. Once defects are recognized, the management system will control the robotic arms to identify and rectify the defective materials. Since there are a multitude of textiles and materials and many different types of possible defects, corresponding AI models needed to be specified and deployed by the management system.

Project Implementation

MIC-730AI

AI Inference System based on NVIDIA Jetson® Xavier

MIC-770

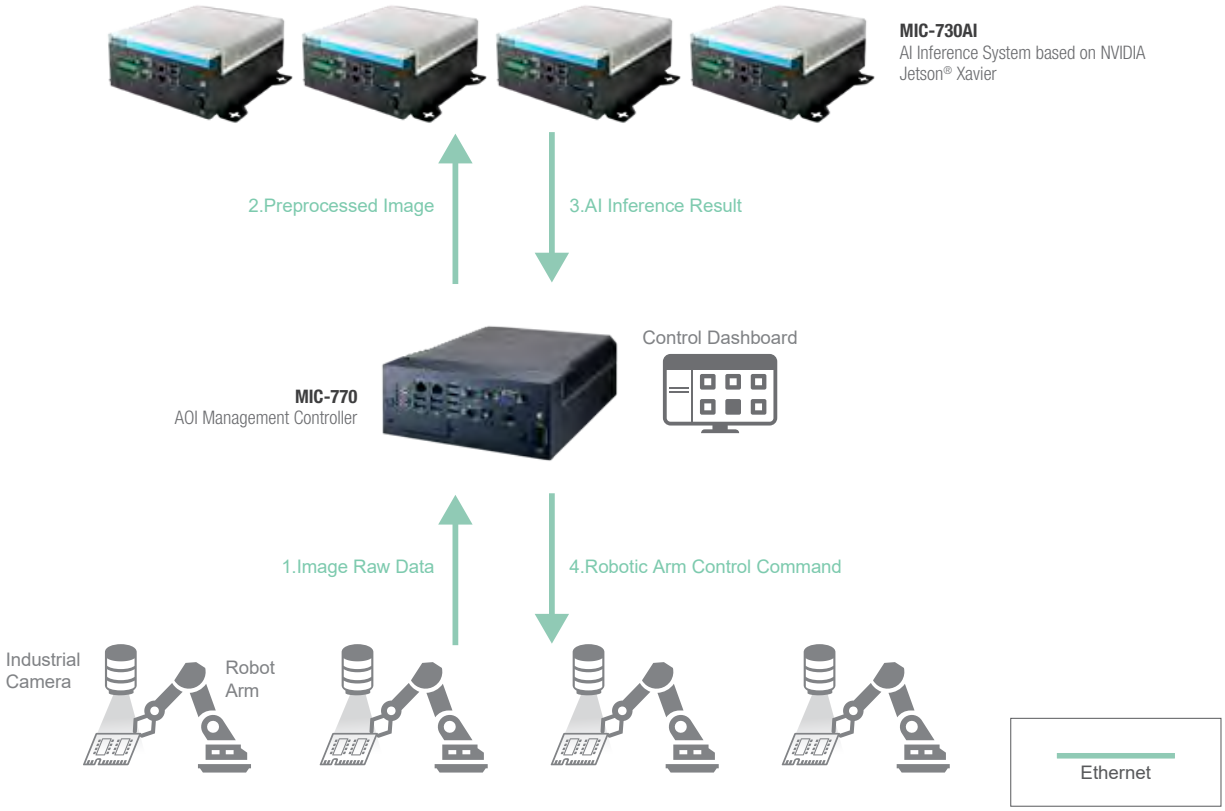
Compact Fanless System with 8th Gen Intel® Core™ i CPU Socket (LGA 1151)

System Description

The management system played an important role in the distributed computing system and needed powerful computing capability to deal with all the image pre-processing. Image pre-processing makes raw data more compatible for subsequent AI inference. Well-designed pre-processing can not only significantly reduce the edge AI workload but also raises the accuracy of AI inference. MIC-770 supports 8th gen Intel® Core™ i CPUs and has the flexibility to integrate a GigE PoE card via an expansion i-Module. MIC-770 meets all computing requirements as the management system can handle all connected edge AI systems.

AI inference requires high computation and needs a GPU-based solution to accelerate the computation. MIC-730AI is powered by an NVIDIA® Jetson AGX Xavier™ GPU and is employed as the edge AI system. Jetson Xavier's great processing power makes it possible to automatically inspect high-precision textile goods with better speed and accuracy. Textile defect inspections using AI inference technology can efficiently identify the most subtle defects and ensure high quality products. Now, robotic arms automatically controlled by the management system can pick and remove both good and defective products. Due to this distributed AI-guided robotic arm solution, textile manufacturers, and fabric mills can now monitor and control production yields in real time much better

System Diagram



Why Advantech?

To meet all edge AI computing in various environments, Advantech provides an AI end-to-end solution and offers a full range of edge computing and AI inference systems, which integrate to perform AI inference solutions. Advantech's product offering leverages AI computing to support customers. This AI-guided robotic arm for textile defect inspection solution is designed to help textile manufacturers and fabric mills get up to speed with the trends in AI. Advantech's MIC-770 and MIC-730AI are perfectly adapted to meet all AI computing requirements.

High-end AI Powered 3D Computed Tomography Equipment System

Location: **Israel**

Background

A medical center with advanced 3D computed tomography (CT) equipment was looking for a high-performance, medical imaging and storage solution that could be integrated with their CT equipment.

The customer needed to upgrade their old system for a high-performance industrial PC (IPC) that could process very high-resolution 3D images, display them, and store on large capacity memory drives. In addition, the whole process needed to be as fast as possible so super-fast data transmission links were essential.

In addition, an industrial grade IPC solution provided better longevity so the hospital would not need to replace systems every few years.

System Requirements

In the past, the customer used commercial hardware solutions, which took a lot of effort to develop and integrate. They also experienced component longevity problems related to commercial grade systems, which needed to be upgraded approximately every 2-3 years because component supplies were no longer available.
This meant older systems were made obsolete because they could not be upgraded when component parts became EOL. Furthermore, health and safety certifications presented other problems as medical equipment such as CT machines require stricter health and safety compliance.

The whole of IPC-7130 system is UL/CB 62368 certified, so finally they decided to replace their old legacy system with a new industrial grade system, which would mean less hassle, greater reliability, and prolonged longevity.

Project Implementation

IPC-7130

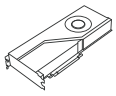
Desktop/Wallmount Chassis for ATX/MicroATX Motherboard with Dual Hot-Swap 3.5" Drive Bays

AIMB-787

LGA1200 10th Generation Intel® Core™ i9/i7/i5/i3/Pentium® /Celeron® ATX with DP/DVI/VGA, DDR4, USB 3.2, M.2, SATA 3.0

UNOP-1514C

4-port Fiber Optic LAN Card



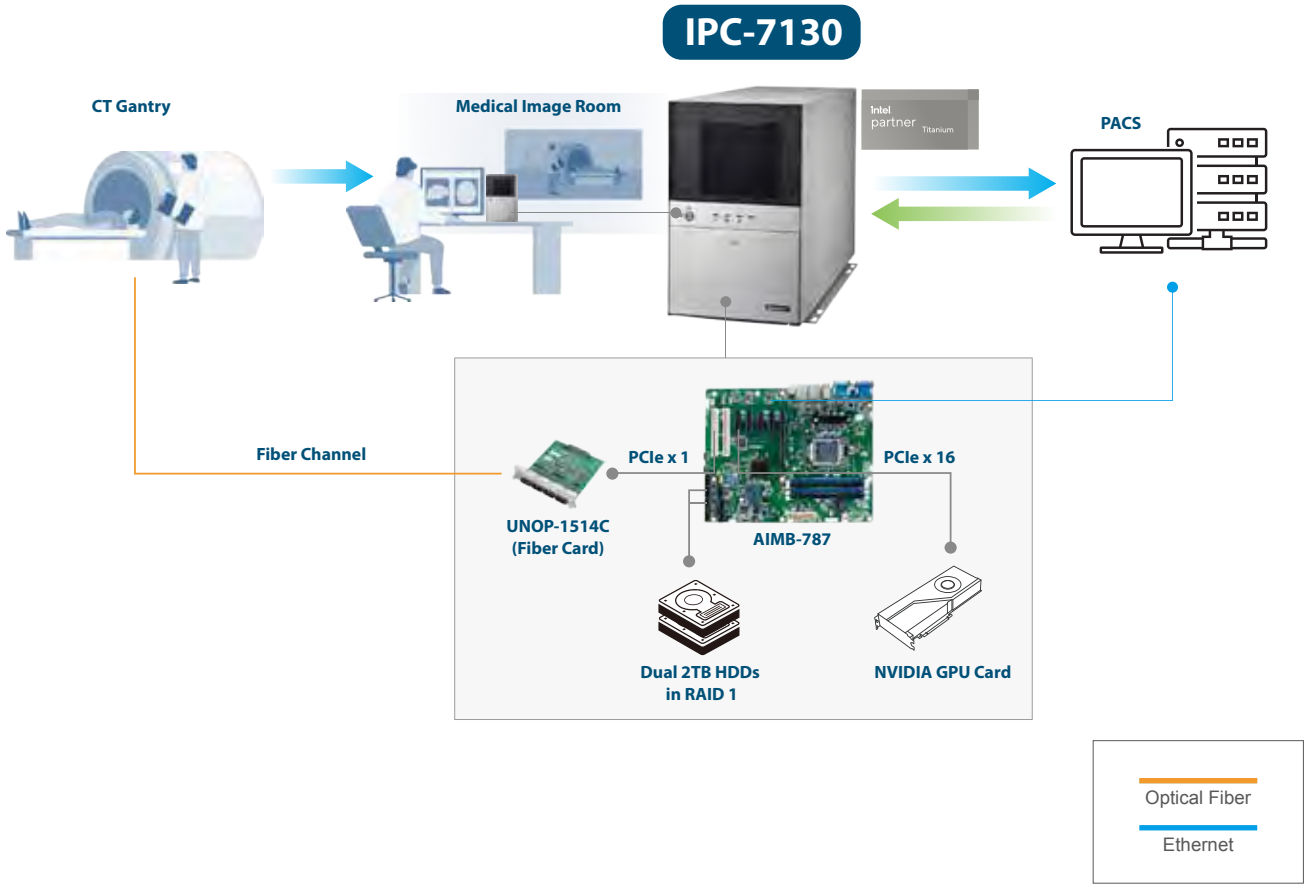
NVIDIA GPU Card

System Description

In their search for a high-performance IPC solution provider, because they were already connected with an Advantech Channel Partner, this opened the door for an Advantech-based solution. Advantech's IPC-7130 + AIMB-787 solution was identified as the best option to meet their medical imaging and storage requirements. End user requirements included a need for a high-performance processing system that was also able to accommodate one GPU card and one fiber optic network switch card.

IPC-7130 plus AIMB-787 with an Intel 10th Gen. CPU and NVIDIA's GPU card perfectly integrated with the CT equipment. The solution executes AI processes such as graphics optimization, graphic categorization at the edge, and then stores it all on the PACS server. IPC-7130 is very quiet with high endurance because of its smart fan. It supports dual 3.5" hot swap drives for storing large amounts of image data in a RAID 1 configuration. For this solution, a single fiber optic network switch card was connected with the CT gantry so large amounts of image data captured by the system could processed by the GPU card in real time. For storage they used dual 2TB 3.6" disk drives linked to a PACS medical grade sever in the hospital via a local network driven by the fiber optic network card.

System Diagram



Why Advantech?

Advantech's high-performing IPC-7130 + AIMB-787 IPC-based solution helped the customer process, display, and store large amounts of 3D images from their CT equipment. Because the solution was industrial-grade (AIMB-787 + IPC-7130 offers up to 9-year lifetime support for all key components.), the customer was able to improve their entire process because it was a super reliable system that lasted longer, offered flexible expansion, and provided a better TCO and ROI.

Industrial AI and Robotics Controller System in Waste Recycle Industry

Location: **USA**

Background

A recycling center customer was looking for a high-performance, industrial-grade Artificial Intelligence (AI) solution that could successfully function in harsh environments.
The customer needed an automated solution to help identify certain materials on the recycling line.

System Requirements

A recycling center end user needed an AI solution to help identify and filter the various materials on its recycling line such as glass, plastic, cans, etc. Recyclable materials are brought to the center, sorted by machines, poured into bins, and then moved to final destinations for processing. In its search for an AI solution, the end user was already connected with an Advantech Channel Partner, thereby opening the door for an Advantech solution.
The customer needed help creating a new solution to enhance recycling performance by accelerating object identification and classification capabilities. To do this, they needed an industrial AI solution to take the place of their previous, less-effective commercial hardware solution.

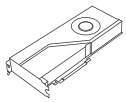
The new AI solution required high computing performance for processing on site. Advantech's MIC-770 + MIC-75G20 solutions were the best option to meet the customer's high-processing edge computing requirements.
The end user needed a high-performance processor system that was able to accommodate one GPU card, and two 4-port Power over Ethernet (PoE) cards to connect eight cameras. The hardware for the system also had to be able to successfully function in the industrial, harsh environments of a recycling plant.

Project Implementation

Robotic Arms Controller

MIC-770
Compact Fanless System with 8th Gen Intel®Core™ i CPU Socket

MIC-75G20
GPU i-Module, 1 PCIe x16 + 1 PCIe x4, dual front accessible storage bay



NVIDIA high performance GPU card

MIC 4-port PoE Advanced FIO

PCIE-1674 4-Port PoE card

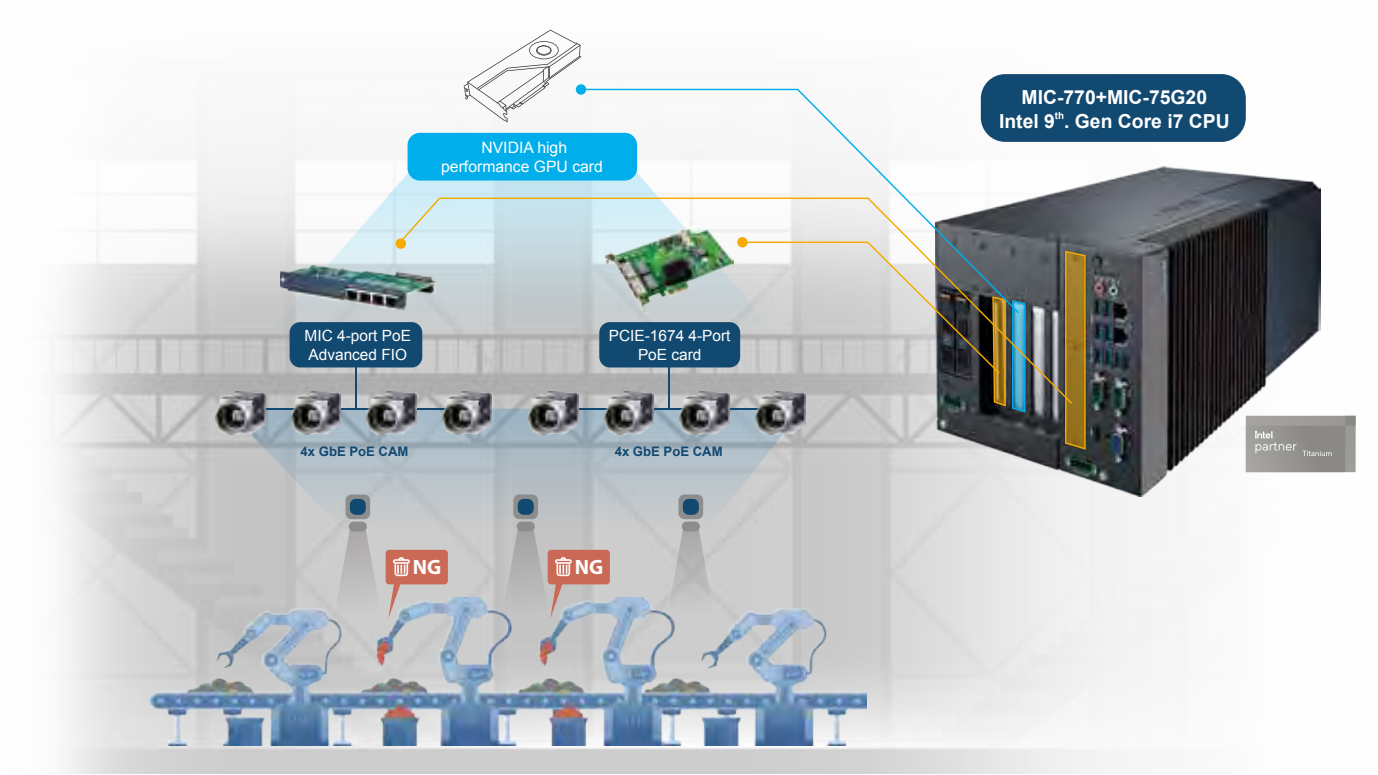
QUARTZ 0.3-15.0 Mega Pixel PoE Industrial Camera

System Description

Advantech's MIC-770 and MIC-75G20 incorporate Intel's 9th Gen. CPUs and NVIDIA's high performance GPU cards. Together they provide one of the most compact-sized IPCs on the market, and perfectly meet edge video AI requirements. MIC-75G20 is a GPU expansion module and accommodates one high-performance GPU card and one 4-port PoE frame grabber card, connected with four PoE cameras. By adding additional 4-port PoE FIO in MIC-770, the eight cameras were able to capture a lot video data.
Huge amounts of images are able to be captured and processed by the GPU card and analyzed by the user's AI model to identify and classify objects. Instructions are then delivered to the main controller via the MIC-770, which is a compact box computer that acts as an expansion slot module. Instructions precisely tell the robotic arms to pick-and-place specified items to a designated area. All actions can be done at eye-blinking speed, enabling the system to handle more than 80 items a minute.

The individual components used were MIC-7700Q + MIC-75G20 with NVIDIA GPU card + PCIe-1674 + 4-port PoE advance FIO. End user requirements included a high-performance processor system that was also able to accommodate one GPU card and eight ports for Power over Ethernet (PoE) cameras. Advantech's MIC-7xxxx series PCs met these requirements with high-performance processing, multiple I/O interfaces, and flexible expandability with the integration of i-Modules.

System Diagram



Why Advantech?

Advantech already had the needed hardware in its inventory and was able to work with our Channel Partner to prepare a complete solution bundle for the end user. Our inventory and Channel Partner bundle meant a quick turnaround time for the customer to get up and running. Advantech also prepared additional parts for the solution for faster repairs. By utilizing Advantech to create an automated AI solution to identify certain materials on the recycling line, the customer improved their entire process with more efficiency and accuracy. Additionally, with industrial-rated products, the end user did not need to worry about the solution functioning properly in harsh industrial environments.

Multi-Angle Vision Inspection and 6-Axis Smart Robotic Integrated Solution for Automotive Manufacturing

Location: **Europe**

Background

A traditional automobile manufacturer was aiming to expand their core business and investment in electric vehicle (EV) production. In automobile manufacturing industry, production lines are not duplicable. For either traditional (gasoline-powered) automobiles or new EVs, manufacturers need to establish a completely new production line for any new model. In other words, each single vehicle model has its own production line. Doing business in such a rapidly changing and competitive automobile market presents unique challenges. The entire automobile production plant needed to be re-configured while the EV designs were evolving and features for each new model were being specified.

System Requirements

Advantech received a request from a robotics system integrator (SI) who serves a global commercial automobile manufacturer which needed to expand their production lines for the new EV manufacturing. To make this happen, new robots needed be commissioned. Robots are key pieces of equipment that turn a standard factory into an advanced manufacturing center as they can be dynamically configured and upgraded to fulfill dedicated EV manufacturing processes.

Production line shut downs are never an option, so the new line had to be equipped with an advanced robotic platform that was capable of handling high-speed vision processing, data transmission, and multiple channels of digital I/O for data collection. The IPC solution to support the manufacturing needed to enable a 6-axis robot to achieve multi-angle automated visual inspection (AOI) at each point in the manufacturing cell where the four 6-axis robots were installed. Because Advantech has a solid reputation and in-depth experience in this kind of industrial application, the SI asked for Advantech's help.

The robots were tasked with performing AOI functions so each robot carried 3 cameras to enable multiple angle vision capture. An IPC solution was required to process and analyze data from the frames collected from the 12 x PoE cameras installed on the 4 robots in each manufacturing cell. Usually, an IPC computer is installed inside a cabinet aside from the robot but connected to it. But because so many cables were connected to the IPC, a front panel I/O design was required for easy management and maintenance.

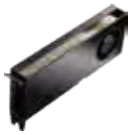
Project Implementation

AIMB-787

10th gen. Intel CPU motherboard

IPC-631

Front I/O 4U rackmount chassis



GPU Card

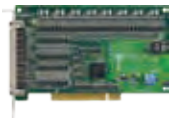
NVIDIA Quadro RTX A6000

QCAM-GM2500-014DE

PoE camera

PCIE-1674

Frame grabber cards



PCIE-1756

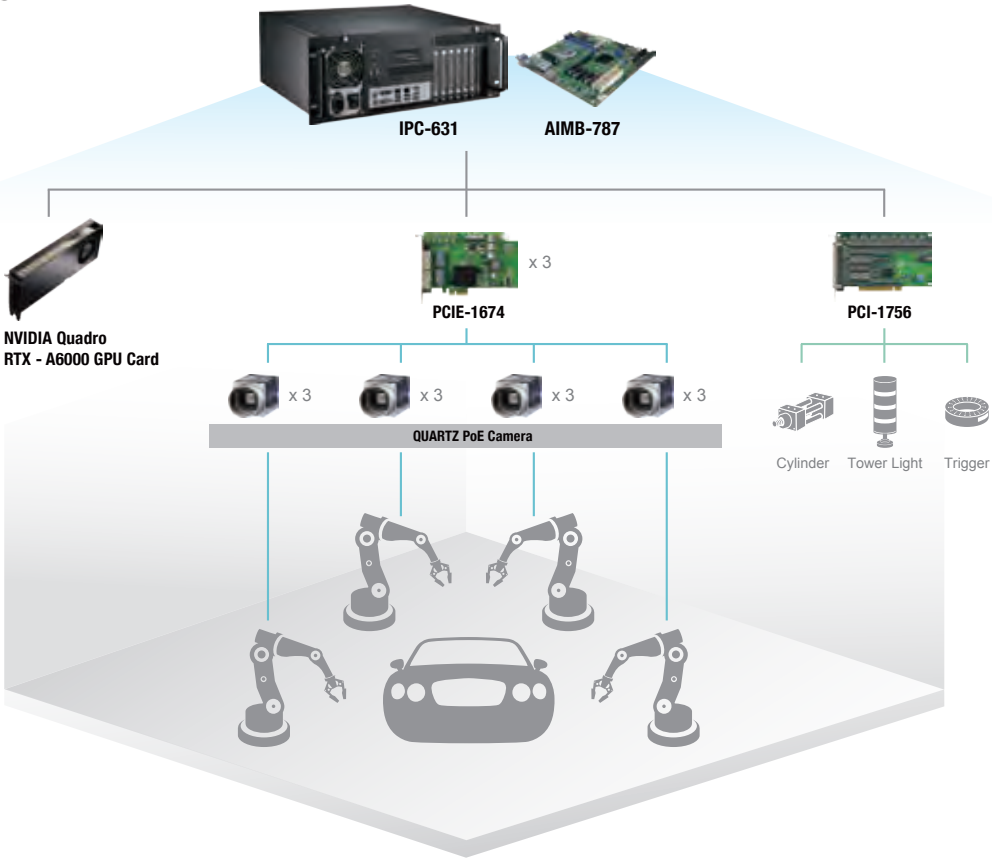
64-ch isolated digital I/O PCI card

System Description

Advantech proposed the IPC-631 front I/O 4U rackmount chassis integrated with an AIMB-787 10th gen. Intel CPU motherboard, 1 x NVIDIA Quadro RTX A6000 GPU card, 4 x CPIE-1674 frame grabber cards, 12 x PoE cameras, and 1 x PCIE-1756 DIO card as the multi-angle vision inspection and 6-axis smart robotic integrated solution.

The total AOI solution offered high speed productivity and high reliability. The AIMB-787 industrial grade motherboard powered the AOI inspection and data analysis. The IPC-631 chassis featured a front I/O design in a 4U depth rackmount case, which allowed easy installation, maintenance, and outstanding heat ventilation. Cameras captured incredible detail from every corner and each camera captures 14 frames/sec, while each high-speed GigE frame grabber card could process 56 frames/sec, in other words, each manufacturing cell working in tandem handled 10,800 frames/min in total.

System Diagram



Why Advantech?

Advantech's high speed, powerful AOI solution fulfilled the customer's expectations for production efficiency, reliability, and high-quality output, as well as compatibility, ease of integration, and the accuracy of robots on the production line. The solution also included 5G expansion, so the customer could upgrade the system and painlessly migrate to 5G industrial manufacturing going forward.

The system integrator was satisfied with Advantech's solution because it offered high compatibility, less system integration effort and provided a responsive one-stop-shopping service.

The end user customer experienced higher production efficiency, reliability, quality, and output, as well as expandability to lower capital investment.

Advantech keeps up the momentum with global automobile manufactures to meet ever-changing market needs.

Greater China

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