Industrial Equipment Manufacturing
Success Cases

Electronic Manufacturing
Semiconductor
Food and Beverage
Components
Automated Guided Vehicle
Test and Measurements

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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 high-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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High Integration DAQ Compact Computer for Industrial Measurement Systems
Automated Solution for 4K Video Output Inspection
Automotive Connector Testing Equipment
Advantech Notebook Industry Display Inspection Solution
A Production Line Solution for Mobile Phone Ceramic Covers

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.

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.

Project Implementation

ACP-4020
4U Short Depth Intelligent Rackmount Chassis

AIMB-785
LGA1151 6th/7th Generation Intel® Core™ i7/i5/i3/Pentium/Celeron ATX with Triple Display, DDR4, SATA III

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.
Advantech’s 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 auxiliary 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-5129 / PCE-5B12-07
PICMG 1.3 CPU card supporting 6th / 7th 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-785
ATX Workstation Motherboard Supporting Xeon E3-12XX v5/v6

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

![System Diagram](image)

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

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.

Why Advantech?

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

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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 conveyor 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/output 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

![System Diagram](image)

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 Package

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

- **ESRP-CNC-UNO1372**
  Equipment connectivity data gateway with WebAccess/CNC, 1 x HDMI, 1 x USB 3.0, 2 x LAN, 2 x COM

- **ESRP-SCA-UNO2484**
  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**

![System Diagram](image)

**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.
An 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 production 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

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**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 using 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 an ACP-4020 industrial computing platform for analysis.

**System Diagram**

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.

**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.
Advantech’s 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**

- **AIMC-3422**
  Micro Computer with Intel® Core™ i7/i5/i3 Processor, Intel® H110 Chipset, 4 x Expansion Slots, and 300W 80PLUS PSU

- **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 AIMC-3422 Micro computer with Intel® Core™ i7/i5/i3 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.
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 PCI/GPIB slot and compatibility with NI programs was required.

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

Project Implementation

**Location:** Shanghai, East China

**Background**

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**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.
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-784
LGA1150 4th Generation Intel® Core™ i7/i5/i3/ Pentium ATX with DVI/VGA, DDR3, and SATA III

PCIE-1840
16-Bit, 4-Ch, High-Speed (up to 125/80 MSPS) DSA Card

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 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 PCIe4, 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

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 fulfill the urgent needs of this customer. 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.

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 DI/O 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.

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

FP-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.
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
Compact Vision System, Supports Intel® 6th / 7th Generation Core i CPU, 4-ch Camera Interface for GigE PoE

QCAM-GM0640
0.3-MP Industrial Camera with PoE

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 compact vision system with an 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-GM0640 0.3-MP industrial cameras with PoE 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 meet 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**

![System Diagram](image)

**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.
A Solution for Screw Inspections

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’s 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.

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.

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-7220
Quiet Desktop/Wallmount Chassis Ready for ATX Motherboard

AIMB-584
4th Gen Intel® Xeon® E3/ Core™ i7/i5/i3 LGA1150 MicroATX with Q87/C226, CRT/DVI/aDP/LVDS/DP, 6 COM, Dual LAN, SATAIII

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-7220 chassis with an AMB-584G2 motherboard (featuring a Core i7-4770S 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.

System Diagram
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.

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 VDC input, 24 VDC 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

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

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

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.

IPC-7132
Desktop Wall-Mount Chassis for ATX/mATX Motherboard and 10-slot Backplane

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-7132 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 I/O 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.

System Diagram

![System Diagram](image)

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.
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!

Advantech Defect Inspection Solution for Passive Component Testing Machine

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

Location: Suzhou

Background

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Project Implementation
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 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, IPC-610 chassis with AIMB-785QG2 main board has 3PCI, 3PCIE*4, 1PCIE*16, and I7-6700 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

**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**

<table>
<thead>
<tr>
<th>AIIS-3410P</th>
<th>QCAM-GM2440-035CE</th>
<th>VisionNavi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compact Vision System, Supports Intel® 6th generation Core i CPU, 4-CH Camera Interface for GigE PoE</td>
<td>PoE industrial camera with a resolution of 0.3-15 megapixels</td>
<td>Flowchart-based Machine Vision Software</td>
</tr>
</tbody>
</table>

**Location:** Taiwan
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-MVS-AIIS3410 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.
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 entire 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.

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

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

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 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

![System Diagram](image)

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

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-2483G**
Intel® Core™ i7/i3/Celeron, Regular-Size, w/ 4 x GbE, 2 x mPCIe, HDMI/VGA

**UNO-2272G**
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

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 Description
Advantech’s UNO-2483G 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-2483G. Because the system is compact (252 x 149 x 62 mm) and lightweight (1.6 kg), UNO-2483G 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.

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

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-6322GN
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

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 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

![System Diagram](image)

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.
Data Acquisition Solution with a 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

AiMC-3201
Micro Computer with Intel® Core™ i7/i5/i3 CPU, 2 x Expansion Ports (PCIe), and 250W 80Plus PSU
System Description

Advantech’s DAQ solution includes an AiMC-3201 microcomputer 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.
A 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 with Front-Accessible, Multi-system Redundant Power Supply

PCE-5819
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.

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.
A 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

![System Diagram](image)

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.

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
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
Volatil 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® processor

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

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

**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.

**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 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 New

**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

![System Diagram](image-url)

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

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.

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.

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.

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

PC-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.

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.