## **Robot Solutions and Services**



ROS2 Suite

Enabling an Intelligent Planet

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## **Rise of the Robots**

As industrial robots become more popular and in being used in a variety of industries, including manufacturing, entertainment, defense, logistic and healthcare. As a result, industrial robotics market size is estimated positive grow. One of major factors drives the growth is due to the increased investments and the funding in related technology. Another significant factor push the growth of the global robotics market is the growing utilization of robot itself in different types and in different segments.

Global robotics market growth

270%

(USD 110.7 billion) by 2026

Robot Arm More than \$74.35B AMR/AGV More than

bv 2027

j

Patrol Robot More than \$8.88 by 2027 Cobot More than **8 6 6** by 2030

#### **Industrial Robots Market Demand**

#### Edge Al Management

Allow data processing at edge and empower safer navigation

#### Sensors Faster decision

Faster decision making or identify abnormal situation with task best route choice

Machine Vision &

## Teleoperation & Data Security

Reliable wireless connection benefit remote management

Sources: Statzon's global robotics data, Research and Markets' global AGV/AMR and inspection robots data, Grand View Research's global collaborative robots data Data Bridge Market research's global robotic arm data

**Real Time Operation** 

Data analysis and asset

OS solution

management with real time

## **Robot Solutions and Services**

Future-proof robots are expected to possess situational awareness while also being capable of detecting and interacting with the environment in real time. These abilities, which ensure that robots can interact smoothly with the environment, will be critical for robot development. Al acceleration cards, sensors, real-time motion control systems, and wireless communication are key elements for implementing these abilities. With Advantech's Robot Design-in Services, which range from embedded hardware platforms, the ROS2 Suite, and real-time control to security, OTA software updates, and peripheral integration, will accelerate robot application development.



## **AI Robot Solutions**

In the application development of imaging and AI in robotics, most applications will be applied to image-related analysis and processing, which includes three elements: cameras, image computing acceleration cards, and AI development software. Advantech provides Intel and NVIDIA GPU MXM Type A 3.1 solutions, Edge AI Suite software with integrated Intel and NVIDIA AI SDK, and multicamera interfaces that help realize your application with predesign and professional services in image AI for robotics applications.



## **Robot Wireless Connectivity**

Wireless connectivity is crucial in robotics applications, with three key elements being stable connectivity, high-speed transmission, and low-latency communication. We have thus adopted Wi-Fi 6/6E as the main wireless communication options to address these three requirements, and AIW's products can meet this demand. In robotics applications, stable connectivity for mobile devices is crucial, which is why we also offer Wi-Fi fast roaming technology.



Higher Data Rates Enables a 25% data rate increase (throughput) in Wi-Fi 6 (802.11ax) access points and devices



Increased Capacity 160 MHz channel utilization capability increases bandwidth to deliver greater performance with low latency



Numerous Devices Wi-Fi 6 leverages OFDMA (Orthogonal Frequency Division Multiple Access) to split the load when a signal is sent



Energy Efficient TWT, a new Wi-Fi 6 feature enables devices to schedule communication with the wireless network



## **Robot Development ROS2 Suite**



## **Robot Real-Time Control**

Real-time control is a necessary condition in automatic control, and it is especially crucial in the application of robots. It is mainly used in robotics applications such as motion control, image transmission and processing, automatic walking, and object handling, as well as in real-time transmission and time calibration. Advantech provides operating system and system integration applications at the layer level for real-time control services, with integrated platforms for multiple simultaneous requirements and accelerated robotics application development.

#### **Motion Control**

Enable SoftMotion with CODESYS runtime package
Windows real-time configured control by CPU core dedication

#### **Vision Control**

 Realize video stream processes on resource arrangement with Intel TCC

#### **Autonomous Navigation Control**

 Provide movement control on task priority management with Preempt RT

#### **Real-Time Communication**

• Time and data synchronization with IEEE TSN integrated

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#### Real-Time System Level -

**CODESYS** for EtherCAT

• SoftMotion • SoftPLC <@⇒

Real-Time TSN / TCC

← Time-Sensitive Networking (TSN)

 Intel<sup>®</sup> Time Coordinated
 Computing(TCC)

#### Real-time OS Level

• Out-of-tree PREEMPT\_RT

ubuntu patch

Supports x86 and Arm

#### Windows with RT Kernel

- Soft Real-Time in version
   21H2
- Advantech Power Suite

8

## **Robot Security Services**

In robotics, AI, and common IoT applications, security has become an increasingly important issue. Advantech works with Canonical to provide Robot Security Services powered by Ubuntu security functions, such as secure boot, full disk encryption, hardening for CIS, and firewall with certified devices, all of which protect our robotics equipment from cyberattacks when connected to the internet, thus ensuring stable operation. Ubuntu provides Ubuntu Desktop, Core, and advanced services, which helps customers seamlessly build a set of long-term stable operation and management solutions. All these services can be quickly completed and deployed through Advantech's Ubuntu-certified devices for robot applications.

Easy deployment for IoT

Flexible for AI development

Long-term support

## ADVANTECH × UDUNTU®

### **Secure Boot**

Ensures the code launched by firmware is trusted



#### **Partition Encryption**

Protect both the confidentiality and integrity of a device's data following physical access to a device, or after its lost or stolen



**How Do We Secure Your Robots** 

## Hardening Tool for CIS

Use CIS benchmark to check whether system configurations satisfy security baselines. Automated audit and compliance



#### **Uncomplicated Firewall** (UFW)

The default firewall configuration tool for Ubuntu is UFW. This provides a userfriendly way to create an IPv4 or IPv6 host-based firewall

Fully-supported, full-stack secured, software/hardware certified IoT solution

## **OTA Update & Container Management**

As different robots are often deployed at different sites, their OS and peripherals require continuous attention and real-time troubleshooting capabilities. Advantech provides a set of RESTful API/SDKs hosted locally or on Microsoft Azure to ensure security and scalability of business and fleet operation. This applies to solutions within private networks or connected to the Internet. Users can leverage API/SDKs to integrate advanced device management capabilities into their robot applications.

#### Over-the-air (OTA) update of firmware/driver/application



- Upload
   Upload
   DeviceOn
   Status & Progress Update

   Online packing tool
   OTA module
   Batch Deploy

   On-prem/ cloud repository
   Image: Cloud repository
- · Firmware, software, and OS
- Customizable rules and script
- On-demand/scheduled, 1-1 or 1-many batch operation
- Secured process by digital signature and MD5 file checksum

#### On-demand and scheduled batch reboot, screenshot, and KVM

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- Manages 10,000+ devices
- Remote control
- · Real-time monitoring
- Remote diagnostics
- · Notification and alert



- Reduced time for AI deployment from months to minutes
  - Reproduce, scale up, and manage AI application with ease
  - Al brings solutions to production faster
  - Hardware and OS agnostic

Container management: build once and run everywhere

## **Robot Design-in Services**

As embedded design expert, Advantech's Robot Design-In Services will help you realize entire robot systems that are efficiently designed. Apart from embedded hardware platforms, we also provide software, peripheral integration, and robot onboarding solutions. The complete design-in services cover operating systems, machine learning AI, the ROS2 Suite, and robot management tools are ready to engage with different types of robotics applications. If you are dealing with robot development, our Robot Design-In Services can definitely help you accelerating development.



# **Collaborative Robot**

- Multi-camera image analysis
- High performance for acting and communicating : Up to 6-axis control, motor control
- Machine learning and training for efficiency enhancement

#### **Solutions Highlights**



#### High Performance Edge Computer

ARK-3534 12<sup>th</sup>/13<sup>th</sup> Gen Intel Core i3/i5/i7/i9 Intel TCC & TSN Support

ROS2 Suite codesys

#### Performance Boost

Up to 24 cores Dual channel DDR5 SO-DIMM ECC/ non-ECC memory up to 64GB support

#### Rich I/O for Quick Application Integration

4GbE, 8 x USB, 8 x COM, Audio, Dual HDMI, Remote switch, 16 bit DIO(Optional), 2 x CANBus (Optional)



#### NVIDIA Quadro GPU cards RTX A2000

NVIDIA Ampere GPU Gen 4 PCIe x16



PCIe GPU Card VEGA-P110 Intel Arc A370M Gen 4 PCIe x16

#### Supports AI Accelerate GPU Card

Dedicated power and thermal design for AI-accelerated GPU cards: NVIDIA RTX-A2000, Intel<sup>®</sup> Arc<sup>™</sup> graphics solutions, etc.

#### China

### Collaborative Robot with Al Accelerate Analysis



#### System Diagram

#### Challenges

- · Request for high computing power for analysis and quality sorting
- Different device connectivity with various I/O Interfaces
- · Harsh environment usage required

#### Solutions

- Supports both high performance CPU and GPU computing power to improve efficiency and accuracy
- Provides versatile I/O options for multiple device connections
- Wide power input (9-36V) and operating temp. (-20~60°C)

#### **Benefits**

- Provides complete power and thermal solution for CPU & GPU system integration
- Designed to support multiple I/Os and flexible expansion ability to meet different types of application requirements
- Rugged design with wide power input and operating temp. to support stable system computing in harsh environments



## **Patrol Robot**

- Palm-sized, Core-I level performance & flexible operation with AI acceleration
- Multi-purpose cameras & different types of I/Os or sensor solutions
- LiDar / PTZ / thermal / infrared camera
- Ultrasonic / weather / altitude sensors
- Wheel control, battery design for autonomous purposes
- High reliability in harsh environments

#### **Solutions Highlights**



#### High-Performance, Low-Power SBC

MIO-5377 12<sup>th</sup>/13<sup>th</sup> Gen Intel Core i3/i5/i7 Intel TCC & TSN Support



#### 5G LTE Mini-PCIe Card FM-350

TDD LTE/FDD LTE/WCDMA/GPS Supported Regions: Global -30 ~ 75 °C/-40 ~ 85 °C



#### Memory Module SQR-SD5N

SODIMM DDR5 4800MHz up to 32GB

#### Performance Computing Power with Integrated AI

- 3.5"(146x102mm) SBC with up to 96EUs for parallel AI workload
- Optional MXM GPU module through USB4 (Type C)

## Multiple & High Speed I/O, Sensors within one Main board

- 1 x USB 4 (Type C), 1 x USB 3.2 (Type C), 4 x USB3.2, 2 x USB2.0, 2 x GbE
- 6 x COM (1Mbps)
- 3 x I2C (1Mbps), 2 x CANBus

#### Support Indoor/ Outdoor and Reliable Design

- Temp. -40 ~ 85°C
- 12-24 VDC wide-range power input
- TDP 15W/ 28W, fan/fanless

#### China

Inspection Robots with GPU Module Cards in Power Substations

#### Challenges

- Palm-sized, minimum Core i computing power, with flexibility for AI acceleration for different user scenarios & easy assembly
- Multi-camera, sensor, and I/O applications
- · Must work outdoors with high reliability

#### Solutions

- 3.5", USB4 Type-C flexible choice for MXM GPU modules and convenient assembly
- Various I/Os and sensor interface design on one board
- Wide power input (12-24V), wide operating temp. (-40~85°C)
- DeviceOn remote management with validated wireless modules

#### **Benefits**

- 3.5 SBC and flexible selection on AI acceleration modules for different applications to save space, shorten development schedules, and reduce costs
- Multiple high-speed I/Os in one board to save costs to find other solutions and reduce integration efforts
- Rugged design with wide power input and wide operating temp to operate under harsh environments

#### System Diagram



# High-end & Multi-task AMR

- On-device real-time monitoring and analytics
- Vertical I/Os and ROS2 ready
- Data communication services required for edge AI ecosystems

#### **Solutions Highlights**



#### Powerful Edge Al System

AIR-030 NVIDIA Jetson AGX Orin SoM built-in

ROS2 Suite

#### Scalable AI Performance Up to 275 TOPs

- · Adopts latest NVIDIA Jetson AGX Orin SoM built-in
- 8 times performance better than AGX Xavier
- NVIDIA Ampere™ GPU, 2048 NVIDIA® CUDA® cores, 64 Tensor cores

#### Versatile I/Os and Expansion Slots for Device Connectivity

- 4 x USB3.2, 1 x Type C, 3 x 2.5GbE (optional PoE), 4 x COM, 1 x CANBus, 1 x DI/O
- Supports Wi-Fi, 5G via M.2 for ultra-high-speed data transmission
- Expanable extension layer for multi-function cards via PCIe x16 slot

#### **Quick AI Deployment System**

- Pre-load Ubuntu 20.04 image, JetPack 5.0 SDK above
- ROS2 and Edge AI Suite ready for robot applications

Wireless Module AIW-163 Wi-Fi 6 & BT 5.2 M.2 2230 A-E key



PoE Module MIOe-PSE-DPA1

PoE Dual Port 15.4W/each

#### China

### Al-Enabled AMR for Video Analytics

#### Challenges

- Request for high computing performance and multiple tasks
- · High-speed data transmission for real-time data monitoring and analysis
- Dynamic environment usage required

#### Solutions

- · Adopts NVIDIA Jetson AGX Orin delivers up to 275 TOPS of AI performance
- Provides versatile I/Os for multiple devices connections
- Wide power input (9-36V), wide operating temp. (-10~60°C), and heavy industry compliance

#### **Benefits**

- Quick AI deployment system bundles with Ubuntu 20.04, ROS2 Suite, and NVIDIA JetPack SDK
- Robust industrial design provides stable operation in harsh environments
- Rich I/Os support high-resolution camera connections, industrial protocol communication, and wireless connectivity

#### System Diagram



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## AMR

- Dedicated AI accelerators with low latency and scalability
- MCU enables real-time motor control
- ROS 2 with DDS for timely communication and interoperability

#### **Solutions Highlights**



#### Ultra-Compact Barebones Box PC

EPC-R7300 NVIDIA<sup>®</sup> Jetson Orin™ NX and Orin™ Nano

ROS2 Suite

#### Wireless Module AIW-163

Wi-Fi 6 & BT 5.2 M.2 2230 A-E key

#### Wireless Module AIW-357

5G Sub 6 with GNSS M.2 3052 Key B Made in Taiwan

#### Ready-to-use Barebones PC: BUILD & SCALE FAST

- · Production carrier board for easy prototyping and mass deployment
- Jetson Orin family module compatibility for up to 100 TOPS AI capability
- JetPack<sup>™</sup> 5.1 SDK supported

#### **Compact Footprint for Limited Space Application**

- Easily deploy the PC in diverse applications without sacrificing space
- Modular thermal design for each module to fit in with the unified barebones design

#### Expandable I/O Design Fulfills Diverse Application

#### Requirements

- $\bullet$  M.2 expansion for boot and wireless connectivity: Key M for NVMe, Key E, and Key B for wireless
- Application-oriented UIO40-Express I/O expansion
- Connecting edge devices and peripherals via USB, RS-485, GPIO, CAN, and LAN

#### China

Cost-effective and Efficient Solution for Industrial Cleaning Robot

#### Challenges

- Thorough planning ensures no interruption to core warehouse activities
- Lightweight and longer-battery-life solutions secure six hours of autonomous cleaning on one charge
- To ensure operational safety, the cleaning robot needs to be capable of instant reaction to obstacles

#### **Solutions**

- Mapping, data logging, storage and real-time monitoring through wireless connection
- · Low power consumption to increase efficiency per charge
- Two USB industrial cameras inputs and up to 100 TOPS native AI inference capability to assist instant reaction

#### **Benefits**

- Cost-effective and can be easily scaled as digital 3D map data is easy to transfer than human experience
- Manage OTA update of firmware/application/OS/security patches at scale
- The cleaning performance is consistent and can be traced transparently through digital logging

#### System Diagram



# **Manipulation Robot**

- Al-assisted computing capability for Al training and inferencing
- 3D sensing capability: object detection and obstacle detection
- Accelerate deployment with COTS solution

#### **Solutions Highlights**



#### GPU-accelerated THIN Motherboard

AIMB-288E

12<sup>th</sup> Gen Intel Desktop Core NVIDIA RTX MXM GPU Module

#### CPU & GPU Accelerated Computing

- 12<sup>th</sup> Gen Intel Desktop Core, 16 cores and DDR5 memory
- NVIDIA RTX T1000 or A2000 integration up to 8.6 TFLOPS
- CPU & GPU integration ready to use

#### Versatile I/O and Expansion

- 2 x GbE, 6 x USB, 2 x COM for cameras and LiDAR
- M.2 M-key for NVMe storage
- M.2 B-Key for 4G/LTE wireless connectivity

#### All-in-One Kit Simplify Integration

- Kit offering with integration of CPU, GPU, memory, SSD, and QFCS2.0 cooling system
- 42mm (<1U) height and 24V DC input ease chassis design
- Supports Window 10 LTSC or Linux Ubuntu

#### Memory Module SQR-SD5N

SODIMM DDR5 4800MHz up to 32GB



Storage Module SQF-CM8 920

PCIe Gen3x4 M.2 2280

#### Japan

Upgrade Manufacturing Efficiency for Manipulation Robot

#### **System Diagram**

#### Challenges

- Enhancing manufacturing efficiency and reducing the impact of human resource shortages
- Al-enabled equipment with sensing capability for object and obstacle detection
- · Wireless design for free movement

#### Solutions

- AIMB-288E motherboard supports 12<sup>th</sup> Gen Intel Core data processing and NVIDIA Quadro T1000 GPU accelerator
- Versatile I/O interface for camera and sensor connection
- 19-24V DC power input and compact size for space limited system requirement

#### **Benefits**

- Delivers extreme performance with CPU and GPU design-ready and ultra-thin cooling system
- Simplifies system integration with all-in-one design and 1U THIN cooling system
- 0~60°C operating temperature for unmanned environments



# **Robot Arm**

- Time-critical requirements for fast boot-up to operate
- 2.5GbE efficient and wide networking bandwidth
- Quality & reliable for long-term safe & stable operation

#### **Solutions Highlights**



#### Secure IP Enabled COMe Compact Module

**SOM-6883** 11<sup>th</sup> Gen Intel<sup>®</sup> Core™ U-Series



#### Memory Module SQR-SD4N

SODIMM DDR4 3200MHz up to 32GB

#### Fast Boot BIOS

BIOS modifications and optimizations enable optimizing the boot up speed to less than 3 seconds

#### Reliability & Multi I/O Configuration

Power on/off cycling testing and component quality control for operational reliability.

Versatile I/Os for multiple device connections, up to 2.5G wide data bandwidth for huge data spheres

#### Quality & Services

Prompt technical support and well-organized quality planning for VIP quality control processes

Europe

### Reliability & Production Efficiency for Robot Arm

#### Challenges

- Request for ultra-fast boot (<3 s) for quick start-up operations
- High reliability for power on/off cycles (20,000 times)
- · Different device connectivity with various I/O interfaces
- Strict quality control 200 DPPM (under 0.002% fail rate) with precise on-time delivery schedule

#### Solutions

- · Supports Advantech Slim Boot BIOS for specific requirements
- · Circuit design and component selection for stable power cycling test
- · Provides versatile I/Os for multiple device connections
- Provides agile production service

#### **Benefits**

- Provides Advantech Slim Boot for customers, enabling fast boot-up within 3 s, helping customers get realize fast product start up
- The most suitable design for applications requiring high reliability standards and requirements for robotics
- Designed to support multiple I/Os and flexible expansion to meet different requirements

#### System Diagram





## What's Your Idea for the Next-Gen. Robots?

Let's Discuss it in the AIM-Linux Community

#### **Regional Service and Customization Centers**

| China Kunshan<br>86-512-5777-5666   |  | <b>Taiwan</b> Taipei<br>886-2-2792-7818  |  | Netherlands Eindhoven<br>31-40-267-7000   |  | Poland   <sup>Warsaw</sup><br>00800-2426-8080  |   | U   | <b>USA</b> Milpitas, CA<br>1-408-519-3898  |  |
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