From Perception to Action

The Landscape of Physical AI & Next-Generation Robotics

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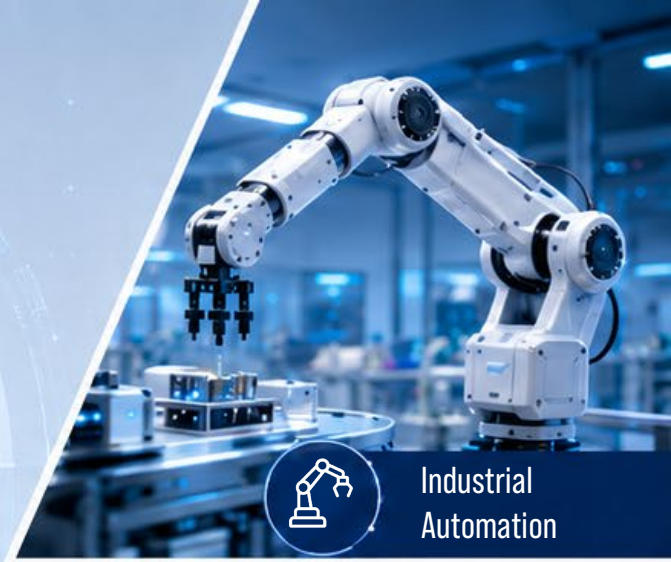


AAEON's Mission

Company Overview

Established in 1992, AAEON is a global designer and manufacturer of industrial computing and Edge AI solutions. With decades of engineering expertise, AAEON delivers reliable, high-performance platforms that power intelligent, mission-critical applications across industries worldwide.

Service Capability

Backed by extensive industry expertise, AAEON provides end-to-end OEM/ODM services worldwide, covering everything from concept development and engineering to mass production and after-sales support.

Mission & Physical AI Focus

AAEON's AI edge computing platforms support smart city, retail, and manufacturing applications, improving efficiency and enabling real-time decisions for autonomous, synchronized operations.

> *Turning trusted edge computing into real-world **Physical AI**.*

What Is Physical AI?

Bridging perception, intelligence, and real-world action.

Cloud AI

Processes application data remotely

Edge AI

Perceives and understands localized context.

Physical AI

Turns AI decisions into autonomous, real-world actions.

AAEON provides the **critical hardware layer** that connects **real-time perception**, AI decision-making, and **physical execution**.

AAEON

From Perception to Interaction

In recent years, the shift of AI operating on the cloud to the edge had a profound impact on where application data could be processed. While this allows a system to perceive and understand the context of its environment, physical AI dictates exactly how a system adapts and interacts with its surroundings to execute actions.

1

Perception

Ingest raw data from cameras, sensors, and subsystems

2

Reasoning

Run deep learning models to understand the data in context

3

Decision-Making

Calculate optimal action based on scenario and training data

4

Action

Translate the planned strategy into real-time, deterministic command signals

5

Real-World Interaction

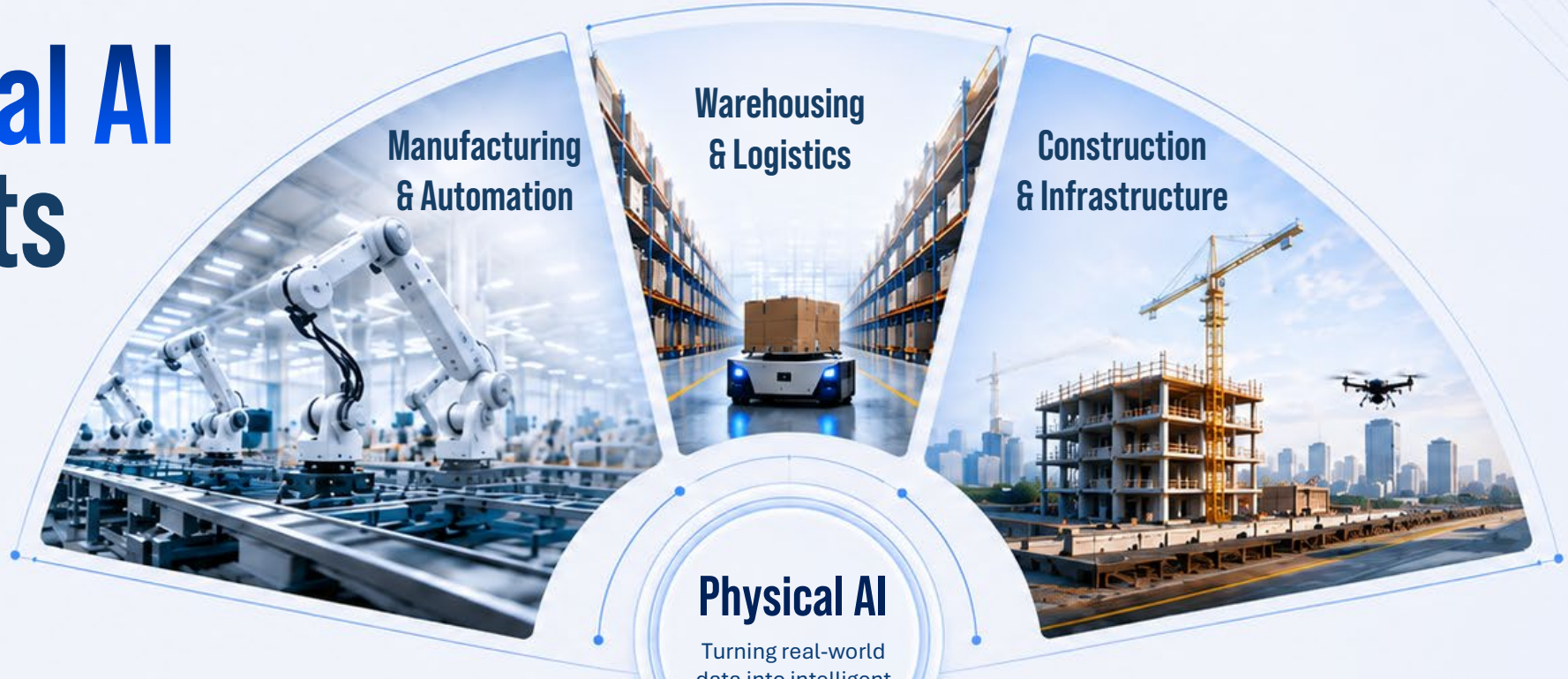
Actuators physically alter the machine's position/manipulate an object in the environment

Edge Computing Power

Physical AI in Motion

Secure • Reliable • Real-Time

Physical AI Markets



Physical AI

Turning real-world data into intelligent action.

Extended Markets

Healthcare & Medical Robotics

Agriculture & Smart Farming

Inspection & Monitoring

Retail & Smart Spaces

Security & Public Safety

Autonomous Mobility

eBook

Case Studies

Real-world applications of Physical AI delivering intelligent solutions across diverse industries.

01 Humanoid Robot

Distributed intelligence for synchronized action.

02 Intelligent Pick-and-Place Robotic Arm

Compact vision-guided automation.

03 Robotic Football Team

Autonomous teamwork in motion.

Use Case 01

Humanoid Robot

Overview

A leading research enterprise came up with a plan to implement a distributed computing architecture that could make their service robot a practical solution for real world use. To achieve this, they adopted AAEON's GENE-ARH6 as the component responsible for translating high-level AI decision-making into synchronized physical actions.

Addressing System-Level Challenges

System Challenge

The robot needed to both ingest and analyze video and sensor data to make higher-level decisions and physically execute tasks based on this analysis. To do so, they turned to a distributed architecture:

Solution: Distributed Architecture

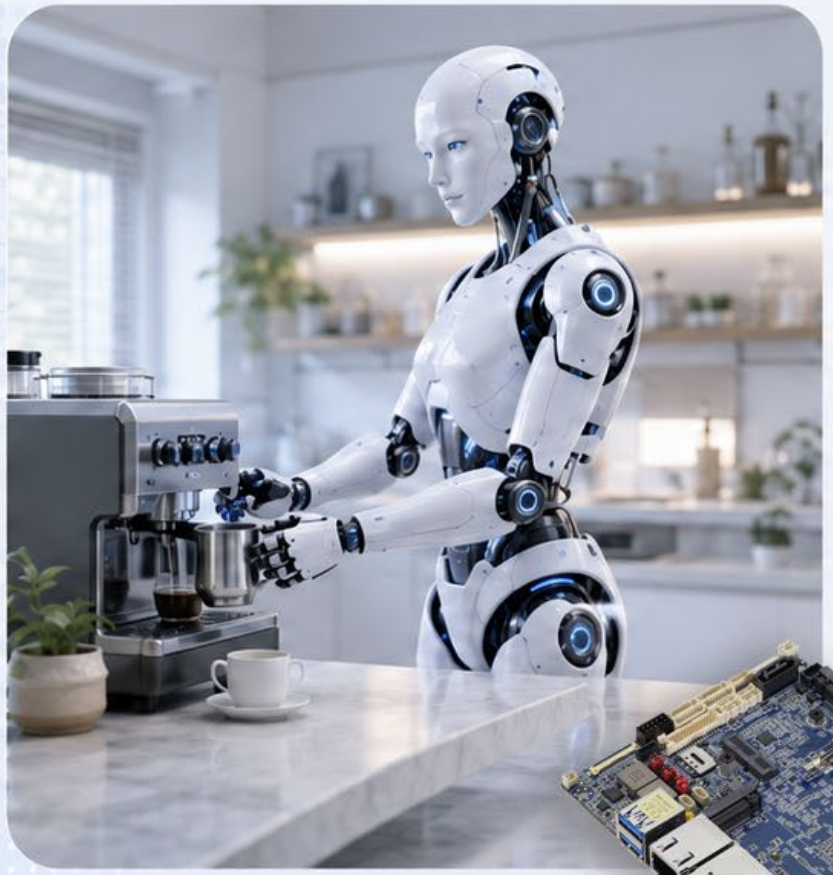
NVIDIA Jetson AGX Orin

An embedded system powered by the NVIDIA Jetson AGX Orin module to act as the robot's "brain", responsible for high-level decision-making.

AAEON's GENE-ARH6

AAEON's GENE-ARH6 to serve as the robot's "nervous system", responsible for coordinated, precise task execution.

Application Architecture



GENE-ARH6

Intel Core Ultra 7
255H processor

USB 3.2
Gen 2

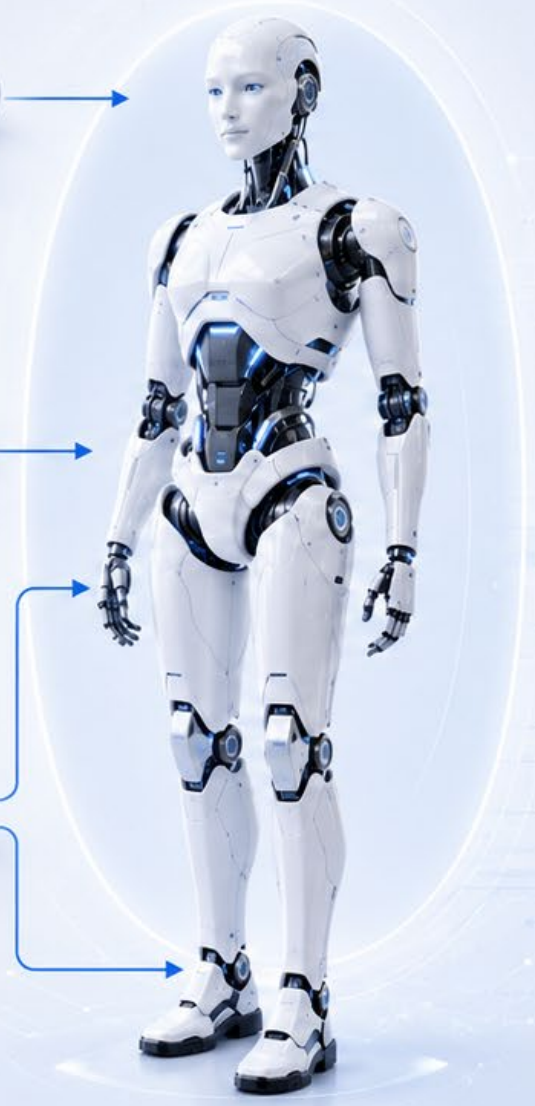
Cameras

USB 2.0

Inertial
Measurement
Unit

EtherCAT
Control Loop

Servo Drives



Why AAEON's GENE-ARH6

Built for real-world robotics that demand intelligence, responsiveness, and reliability.

Intel Core Ultra Series 2 Processing

Useful for time-sensitive tasks and predictable execution, while also handling lightweight AI tasks.

Real-Time Sensor Integration

Could interface with IMU to receive orientation and motion sensor data for stability, as well as multiple cameras to provide faster feedback loops.

Deterministic Motion

Equipped with both Intel Ethernet Controller I226 NICs and strong driver support for an EtherCAT master stack, the board made synchronized communication with servo drives across the robot's limbs possible via a high-speed EtherCAT control loop.

Use Case 02

Intelligent Pick-and-Place Robotic Arm

Overview

An industrial automation specialist sought a small and efficient embedded platform for the next generation of their “pick-and-place” robotic arms.
After exploring a number of options, they chose AAEON’s UP 710S, a credit card-sized developer board equipped with a segmented, wafer-based industrial I/O.

Key Requirements

Compact Form Factor

The platform had to fit inside the robotic arm’s limited internal space.

Camera, Sensor, and Legacy I/O Support

The system needed to connect with cameras and sensors while also interfacing with existing industrial subsystems.

Efficient Multi-Task Processing

The processor had to handle multiple simultaneous tasks without excessive power consumption or heat generation.

Vision Processing Capability

The graphics performance needed to be strong enough to identify small components from a single image.

Application Architecture

HD Cameras — USB

Actuators — PWM

PLCs — LAN/RS-232

Sensors — GPIO

UP 710S

Intel® Processor N97

Why AAEON's UP 710S

Compact. Intelligent. Built for the next generation of robotics.

Compact & Slim

Measuring just 85mm x 56mm, the UP 710S was perfect for discrete deployment within the robotic arm's space-constrained housing.

High-Resolution Camera Support

The UP 710S's three USB Type-A ports supported multiple high-resolution USB cameras for single-frame component detection.

Intel® Processor N97 CPU

The UP 710S's quad-core CPU offered a high single-core frequency at just 12W, making it able to perform the computational tasks required to calculate motion trajectories.

Accelerated Vision Processing

The board's Intel® UHD Graphics with OpenCL support offered 24 execution units, more than sufficient for part recognition, convolution, and feature extraction.

Versatile I/O for Precise Control

Dedicated wafer connectors for interfacing with PLCs, HMIs, and specialized industrial controllers.

Use Case 03

Robotic Football Team

Overview

VDL Robot Sports developed a ‘team’ of five autonomous robots able to play football as a cohesive unit in the Middle Size League of the annual RoboCup football competition.
Using the BOXER-8651AI for their most recent tournament, VDL Robot Sports progressed to the semi-finals, only losing to the team that would go on to win the whole tournament.

Key Challenges:

Low-Latency MCU Communication

The system needed fast communication with the MCUs controlling the robots' sensors and actuators.

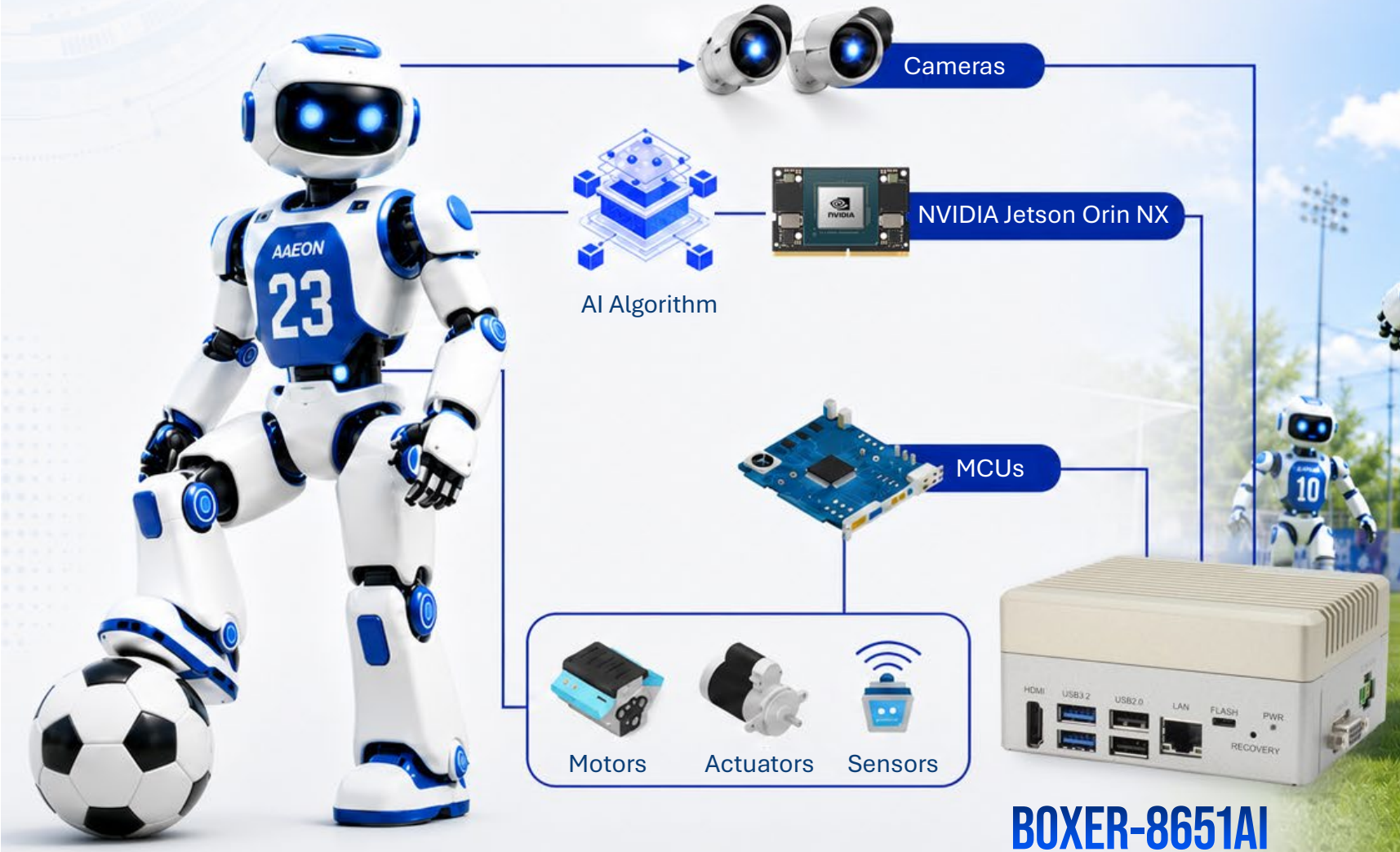
Multi-Camera Vision Support

Accurate mapping and obstacle detection depended on high-quality visual data from multiple cameras.

Mobility and Environmental Resilience

The computing platform had to remain compact, lightweight, and durable without affecting the robots' speed or maneuverability.

Application Architecture



Why AAEON's BOXER-8651AI

Compact, powerful, and built for real-time intelligence. The BOXER-8651AI delivers the performance, reliability, and connectivity needed for next-gen robotics on and off the field.

NVIDIA Jetson Orin NX

With the powerful NVIDIA Ampere architecture GPU offering up to 100 TOPS of AI performance, the system could execute multiple simultaneous AI models with minimal latency.

MCU Communication

The Ethernet interface was used to communicate with other MCUs responsible for controlling the various sensors and actuators of the robot.

Stereo Camera Support

Dual USB 3.2 Gen 2 ports accommodated stereo cameras to obtain visual data, which was crucial for mapping and obstacle detection.

Environmental Resilience

Anti-shock and vibration resistance features ensured durability, given the frequent changes in direction it faced throughout matches.

Compact & Light

At just 105mm x 90mm x 52mm and weighing just 2.4 lb, the system did not impact the robot's mobility, maneuverability, or speed.

Dimension

105mm x 90mm x 52mm
(4.13" x 3.54" x 2.05")

Physical AI Platform Highlights

AAEON works closely with leading AI technology providers to deliver platforms that help integrators maximize perception, reasoning, and real-world execution with precision and reliability.

CEXD-INTRBL

Open robotics system for perception and sensor-rich data ingestion

BOXER-8645AI

Jetson AGX Orin platform for reasoning, SLAM, and rugged robotics

UP Xtreme PTL Edge

Intel Core Ultra edge controller for action and deterministic control

	CEXD-INTRBL	BOXER-8645AI	UP Xtreme PTL Edge
Primary Role	Perception & Ingestion	Reasoning & SLAM	Action & Deterministic Control
Cognitive Engine	Intel Core Ultra Series 3	NVIDIA Jetson AGX Orin (275 TOPS)	Intel Core Ultra Series 3
Sensory Integrations	GMSL, LiDAR, Infrared, Depth	GMSL2, GNSS, 9-Axis Sensors	High-res cameras, industrial sensors
Kinetic & Ecosystem Features	Open Robotics System architecture	Isolated CANBus	PLCs, Motor Controllers, ROS 2 (Ubuntu 24.04)

AAEON

Turn Perception into Action.

AAEON enables the next generation of Physical AI solutions that perceive, reason, and act in the real world.

From intelligent robotics to edge AI platforms, we provide the technology and expertise to help you build, deploy, and scale what's next in automation.

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