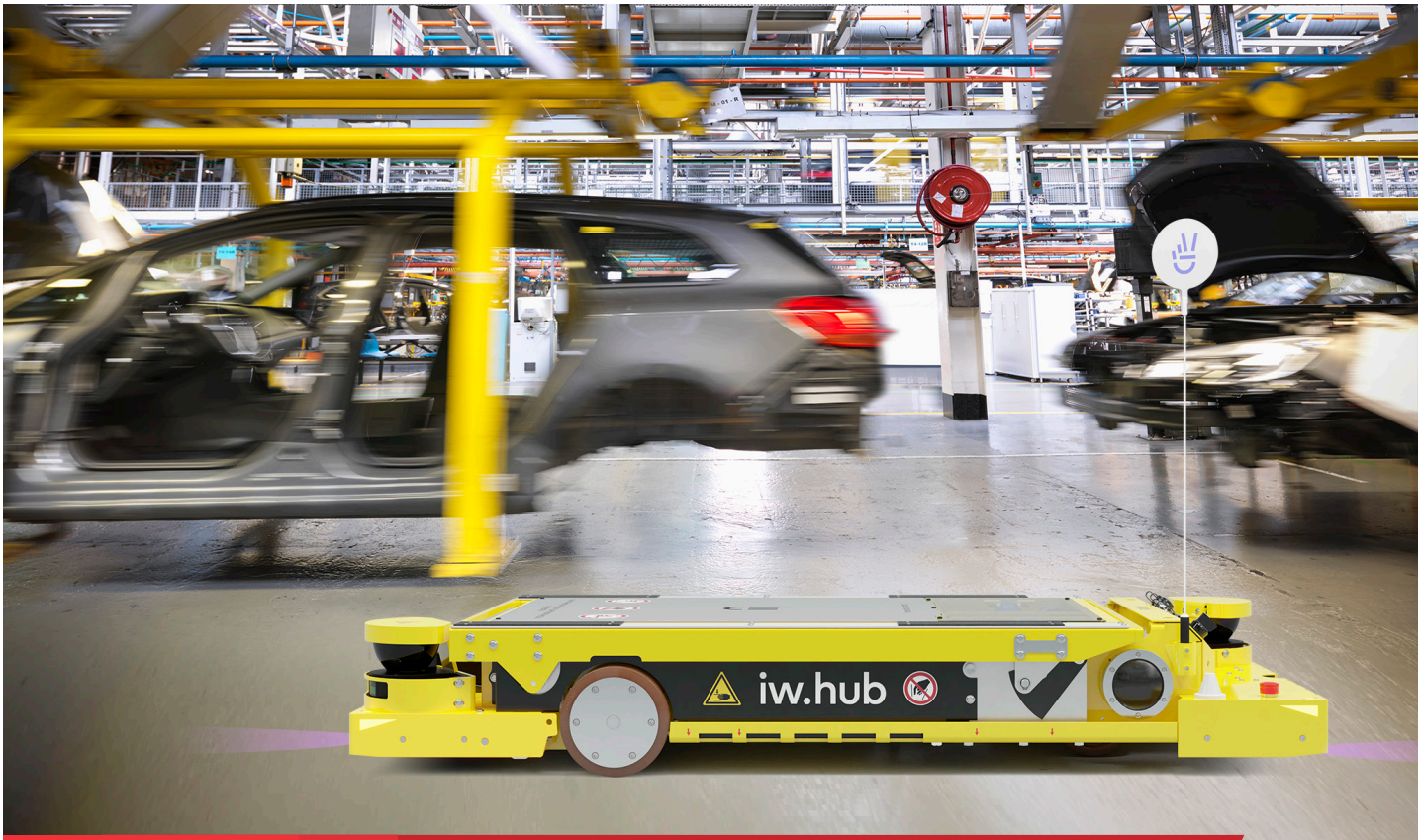
ADLINK
LEADING EDGE COMPUTING



Improving Production Processes with Autonomous Mobile Robots



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Improving Production Processes with Autonomous Mobile Robots

Offer Customers the Power of Choice

Key to the success of the BMW Group is letting their customers "decide for themselves what they want and desire."[1] This is manifest in giving customers the power to choose between an average of 100 different options across the 40 car models BMW produces.

Essentially, each customer order is different, requiring BMW's production processes to be highly flexible and dynamic. BMW's production of build-to-order cars requires a logistics process which guarantees that the right parts arrive at the right assembly line at the right time. Every day, 230,000 different types of parts are organized into trays to produce 10,000 cars.[2]

Many of these parts are transported to assembly lines using automated-guided vehicles (AGVs). Lacking robotic arms, intelligence, and flexibility, the AGVs are unable to load themselves or plan and navigate routes because they cannot perceive their surroundings.

To increase efficiency in logistics, BMW decided to replace the AGVs with a fleet of autonomous mobile robots (AMRs) capable of handling and transporting production material without human intervention. The company's wholly-owned subsidiary, idealworks was tasked with bringing the power of artificial intelligence (AI) to logistics processes, starting with the design of autonomous robots (Figure 1). idealworks turned to NVIDIA and ADLINK for support in developing the necessary software stacks and robust, edge AI computing platform.

Today, cloud-based fleet software manages the autonomous robots, assigning tasks based on their availability and location, thereby increasing their efficiency, productivity, and ability to work collaboratively with one another – and with humans.

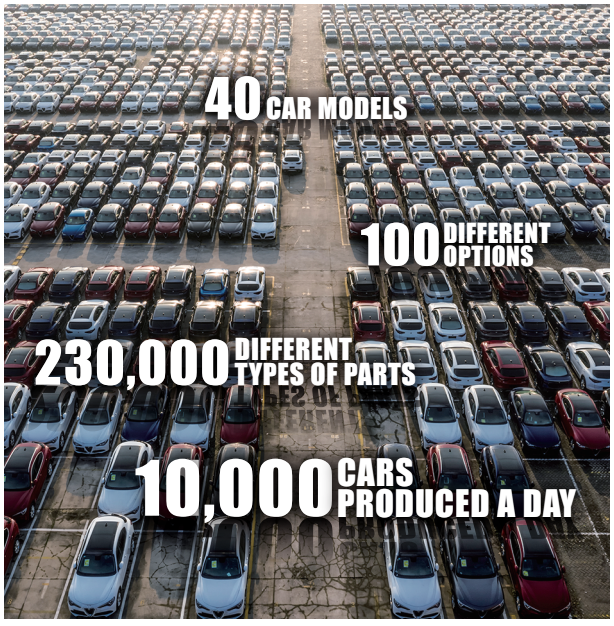


Figure 1. Autonomous mobile robots help deliver the right parts at the right assembly line at the right time in highly flexible and dynamic production processes.

Business Challenge: Improve Material Flow Efficiency

The massive variability in production presents a huge logistics challenge, in that every day, tens of millions of parts must be transported around, e.g., BMW's assembly lines. Moreover, the assembly line environment is very dynamic and often congested, presenting additional material flow difficulties. The company sought to leverage AI and robotics technologies to take their just-in-time, just-in-sequence manufacturing processes to new heights.

Technical Challenge: Design AI-Based Robots

idealworks designed autonomous robots from the ground up, combining a performant AI software stack and compact, high-performance computing hardware that can reliably and quickly perform data-intensive, complex AI computation while withstanding the harsh assembly line conditions. AI algorithms enable simultaneous localization and mapping (SLAM), navigation and guidance, collision avoidance, and object pose estimation.

> "The iw.hub supports customers, such as a Munich-based automobile manufacturer, in optimizing their logistics. All AGVs and AMRs from any manufacturer that use the VDA 5050 communication standard can be integrated into idealworks' fleet management software."
>
> ***Markus Bauer,*** *COO, idealworks*

Solution

idealworks developed the AMR, iw.hub, and the fleet management software, AnyFleet, which complies with the VDA 5050 standard for unified operation of AGVs, forklifts, and AMRs from different manufacturers in the same working environment.

Ruggedized Robots

The AI-based robots required high-performance computing platforms that could operate reliably in stringent industrial conditions, like high vibration and physical impact. idealworks decided to build a custom solution and selected ADLINK to develop the compact, DLAP-401 edge AI platform.

The compact DLAP-401 computing platform addresses size, weight, and power (SWaP) constraints of transport robots, like running on a single battery charge for at least a full shift. The platform performs time-sensitive AI computations to plan routes and navigate safely on high-traffic factory floors while avoiding deadlock situations. DLAP-401 supports passive cooling or active cooling with easy-to-remove fans to simplify maintenance.

With input from idealworks, ADLINK engineered, tested, and manufactured a specialized industrial housing that is impact-resistant and drop-proof. The compact, ADLINK edge AI platform connects to idealworks' hardware via custom connectors.

AI Performance

To deliver very high levels of computing performance, the ADLINK DLAP-401 (Figure 2) is powered by the NVIDIA® Jetson AGX Xavier™ system-on-module (SOM), which enables the robots to process data from several sensors, including lidars and cameras, to operate autonomously:

- identifying obstacles
- avoiding collisions
- navigating safely
- changing routes on the fly
- docking in tight spaces
- learning from the environment

The NVIDIA Jetson AGX Xavier module delivers up to 32 TOPS of accelerated computing capability, delivering the power that AI algorithms need in these applications to perform perception, 3D pose estimation, localization, path planning, and actuation in real time.[3]

Autonomous systems are complex and require different levels of specialized processing or dedicated processing capabilities to meet application performance and power requirements. Jetson AGX Xavier provides developers with an array of processing blocks combined with software flexibility that are designed specifically for autonomous machines.

Software Architecture

idealworks' fleet of autonomous robots are based on a single-software architecture that runs on the open NVIDIA Isaac robotics platform. The Isaac SDK provides a comprehensive set of tools, libraries, and pre-trained DNN models. The robots were tested and validated using Isaac Sim for navigation.[4]



Figure 2. ADLINK DLAP-401 powered by the NVIDIA® Jetson AGX Xavier™ system-on-module delivers very high levels of computing performance for iw.hub.

Robotics combines many different disciplines including low-level hardware driver, safe planning algorithms, fast and accurate computer vision, deep neural networks, and high-level AI. The Isaac SDK is an extensive framework that runs on a high performance engine and comes with a collection of high-performance algorithms. For example, the algorithms provide planning and perception for navigation and manipulation, and support for key hardware components and robotic peripherals. It also allows for the addition of custom behaviors and capabilities, accelerating robot developments that normally take months, if not years, of engineering effort to succeed.

Solution Benefits

With help from embedded hardware specialists ADLINK and NVIDIA, idealworks developed a customized solution for autonomous robots. The solution delivers AI at the edge in a robust hardware enclosure to protect the computing platform in demanding industrial environments.

With the implementation of idealworks' autonomous robots, employees are no longer needed to perform repetitive loading tasks, allowing them to focus on their core competencies. For a two-shift operation, it is estimated this installation will pay for itself in a year.[5]

Edge AI Solutions

ADLINK is committed to delivering AI solutions for the edge, featuring heterogeneous computing architecture and hardware acceleration for deep learning, inference, machine learning, automated optical inspection, and other decision-making workloads. For information about edge AI platforms, please visit https://www.adlinktech.com/en/Inference_platform.

ADLINK

ADLINK is a global leader in edge computing. Our offerings include robust boards, real-time data acquisition solutions and application enablement for AIoT. We're an NVIDIA Jetson Elite Partner and a contributor to standards initiatives such as OCP, OMG and ROS 2 TSC. More information at www.adlinktech.com.

idealworks

At idealworks, we are accelerating the adoption of autonomous logistics. Leveraging the latest technology, and a steadfast software first approach — we are building the most intelligent, flexible and collaborative logistics services. From hardware to software, everything we do is validated in real production environments and is centered on supporting our customers to improve safety, efficiency, and reliability across their facilities. More information at idealworks.com

NVIDIA

NVIDIA's (NASDAQ: NVDA) invention of the GPU in 1999 sparked the growth of the PC gaming market and has redefined modern computer graphics, high performance computing and artificial intelligence. The company's pioneering work in accelerated computing and AI is reshaping trillion-dollar industries, such as transportation, healthcare and manufacturing, and fueling the growth of many others. More information at https://nvidianews.nvidia.com/.

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