Case Study

Robotics

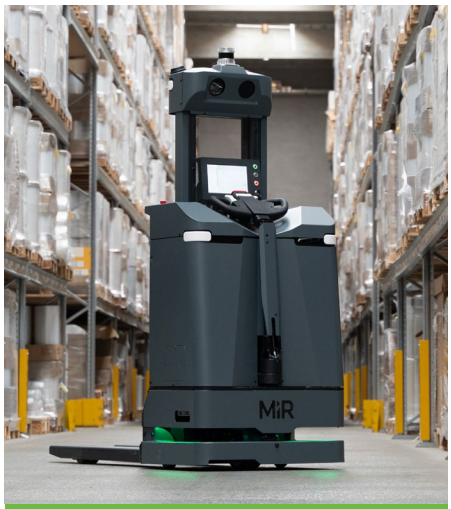
Engineering Next-Generation AMRs

From Perception to Performance: RealSense Depth Cameras Power MiR's Safe Autonomous Navigation in Industrial Environments

Spotlight on MiR

Mobile Industrial Robots (MiR) uses RealSense depth cameras to power safe, fully autonomous navigation in dynamic industrial environments. By combining 3D vision, AI and edge computing, MiR's robots can perceive complex surroundings, avoid obstacles and adapt in real time.

MiR
A Teradyne Robotics Company



MiR1200 Pallet Jack AMR equipped with RealSense D457 camera.

Warehouses and distribution centers today face mounting pressures — from labor shortages and e-commerce surges to stringent safety requirements and lean operational mandates. Annual turnover rates for warehouse workers are close to 50%, while the demand for 24/7 fulfillment, same-day delivery and just-in-time inventory intensifies. Simultaneously, safety remains a critical concern: forklift-related incidents result in nearly 100 fatalities and 20,000 serious injuries each year in the U.S. alone.

Autonomous mobile robots (AMRs) are rapidly becoming the backbone of modern intralogistics, engineered to meet the sector's challenges with consistent, predictable performance and 24/7 reliability. However, robust and reliable robot autonomy in unstructured, dynamic environments remains a challenge — one that Mobile Industrial Robots (MiR) has solved by integrating RealSense depth cameras into its perception stack.

MiR's AMRs — including its latest solution, the MiR1200 Pallet Jack — depend on RealSense 3D vision technology to enable safe, flexible navigation without requiring external infrastructure or predefined paths. With over 10,000 robots deployed globally across manufacturing, logistics and healthcare sectors, MiR has demonstrated how depth sensing and AI can work together to deliver true autonomy at industrial scale.

MiR's use of RealSense depth cameras enables the spatial intelligence its AMRs require to navigate safely in dynamic, human-centric environments.

Challenge: Safely Navigating Complex and Unpredictable Environments

AMRs face significant challenges in industrial settings, where obstacles like low-lying objects, broken or non-standard pallets, varying lighting conditions and fluctuating temperatures can compromise navigation and safety. While traditional industrial automation systems rely heavily on fixed infrastructure and static programming, MiR needed a computer vision solution that could:

- **Perceive and understand the irregular 3D environment in real time:** Traditional 2D sensors or LiDAR cannot provide the spatial understanding needed for complex navigation decisions.
- **Reliably detect and avoid obstacles,** including people and moving machinery. Dynamic environments require systems that can distinguish between different types of obstacles and respond appropriately.
- **Adapt to dynamic, non-structured environments without extensive preprogramming:** Warehouses constantly change layouts, making fixed programming impractical.
- **Minimize false positives in harsh conditions** like high humidity, fog or condensation that can affect sensor performance.

Solution: RealSense Depth Cameras for Enhanced Perception and Safety

Since its inception, MiR has relied on RealSense technology as a core sensing solution for all its AMRs, starting with the D435. MiR's mobile robots integrate a sophisticated multi-sensor approach that combines RealSense 3D Cameras, SICK microScan 3 and LiDAR scanners.

MiR's latest innovation — the MiR1200 fully autonomous AI-powered Pallet Jack — features five RealSense D457 3D depth cameras combined with an NVIDIA platform, enabling true real-time perception and decision-making.

"Without RealSense, we wouldn't have a product — we'd have a semi-automated solution at best," said Nicklas Holm Hansen, Global Commodity Manager at MiR. "Warehouses are never static. You can't rely on perfectly placed pallets or fixed conditions. Our robots need to perceive and adapt to reality, and what RealSense gives us — true perception — is the key to fully autonomous, safe and intelligent robotics."

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Key capabilities of RealSense D457 cameras:

Stereoscopic depth technology with a depth accuracy of <2% at 4 meters. RealSense D457 cameras use an infrared projector and dual imagers to create detailed 3D depth maps, providing rich environmental understanding that goes beyond simple distance measurements — critical for understanding spatial layout, identifying objects and people, and navigating safely.

AI-enhanced navigation: Supports Visual SLAM (simultaneous localization and mapping) and other AI models for autonomous adaptation to new or changing environments.

Real-time object recognition: Integration with NVIDIA computing platforms enables real-time AI processing of visual data, allowing robots to identify and classify different types of pallets, obstacles and environmental features.

Near-field performance: Complements long-range LiDAR by detecting close-proximity hazards and irregular objects — such as broken pallets — that LiDAR can miss.

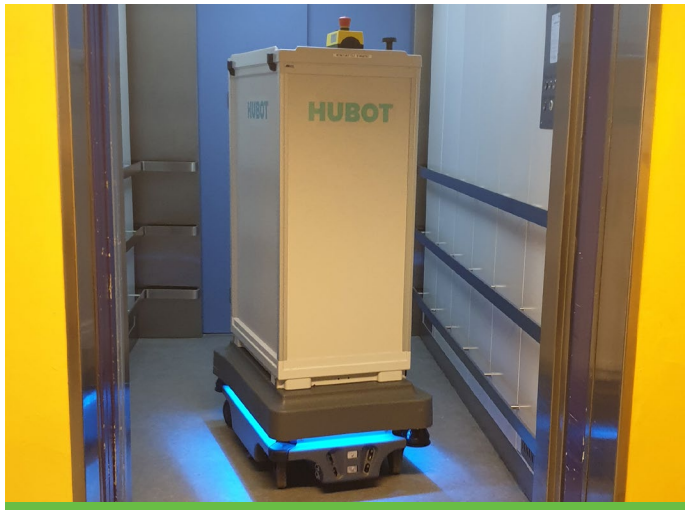
Proactive safety: Allows the robot to adjust in real time to changes in its environment without the need for pre-defined rules or fixed layouts.

MiR Customer Use Cases

Two very different MiR use cases demonstrate how intelligent automation embedded with RealSense computer vision can elevate safety, streamline operations and deliver rapid returns.

Odense University Hospital (Odense, Denmark)

Odense University Hospital (OUH) leverages three MiR robots with RealSense depth cameras to automate critical internal logistics and improve operational efficiency while maintaining a strong focus on patient safety. Two MiR100 robots transport blood samples from various departments to the lab, while a MiR250 robot delivers parcel cabinets with patient equipment, streamlining tasks previously done manually by staff.



MiR200 AMR autonomously riding an elevator, using RealSense depth cameras for navigation between floors.

Safety is paramount at OUH. Each MiR robot underwent extensive testing in collaboration with IT, hygiene and clinical teams before deployment. The robots are programmed to adjust speed, follow hallway traffic rules, avoid emergency exits, and navigate elevators and automatic doors autonomously. With over 8,000 kilometers logged without incident, MiR robots have proven exceptionally reliable in high-sensitivity healthcare environments.

Megatech Industries (Vaduz, Liechtenstein)

Megatech Industries, a manufacturer of plastic parts for the automotive sector, deployed four MiR250 AMRs with RealSense cameras to improve internal logistics, enhance safety and increase operational efficiency. The initiative aligns with the company's long-term modernization strategy and has already delivered measurable results.

One of the most impactful changes is the reduction of forklift-related incidents. MiR robots now handle the transport of finished containers from the production line to the warehouse, returning with empty containers to keep operations flowing smoothly. This automation minimizes hazardous interactions between humans and heavy equipment on the factory floor.

The MiR AMRs have also optimized logistics by eliminating delays and reducing labor-intensive transport tasks. Operators now focus on managing warehouse logistics rather than performing repetitive material movements, leading to cost savings and better resource allocation. Real-time fleet management, integrated into Megatech's existing software, allows precise mission tracking, prioritization and quick incident resolution.

The initiative has significantly reduced bottlenecks and operational costs, with an estimated annual ROI of €100,000.

Breakthrough: The Autonomous Pallet Jack

The development of the MiR1200 Pallet Jack represents a major milestone in warehouse automation that was previously

impossible with LiDAR alone.

It brings full autonomy to one of the most demanding material handling tasks.

"Creating a truly autonomous pallet jack was something the industry hadn't solved — largely because human drivers instinctively compensate for broken pallets, inconsistent colors, lighting changes and other unpredictable variables," Hansen explained. "We tackled this by training the AI with thousands of real-world scenarios. We bought broken pallets, red pallets, yellow pallets, blue pallets — stacked them all up, testing and training our AI-powered AMR to pick up a palette as efficiently as a human being, but fully autonomously. This level of autonomy is a key feature that we could not achieve with LiDAR or a different sensor."

How MiR achieved this breakthrough:

- **Comprehensive dataset training:** Thousands of scenarios — featuring damaged pallets, varying materials, lighting conditions and more — were used to train the AMR to handle real-world complexity.
- **Multi-camera architecture:** Five RealSense D457 cameras provide full 360-degree awareness, eliminating blind spots and enhancing maneuverability in tight spaces.
- **AI-powered decision-making:** NVIDIA platforms enable the robot to match or exceed human-level pallet recognition and positioning.
- **Model architecture:** Visual data from RealSense is fed into convolutional neural networks (CNNs) on an NVIDIA Jetson platform, enabling semantic segmentation and classification in real time.
- **Minimal infrastructure changes:** The MiR1200 can operate in existing facilities without the need for navigation markers or major modifications.

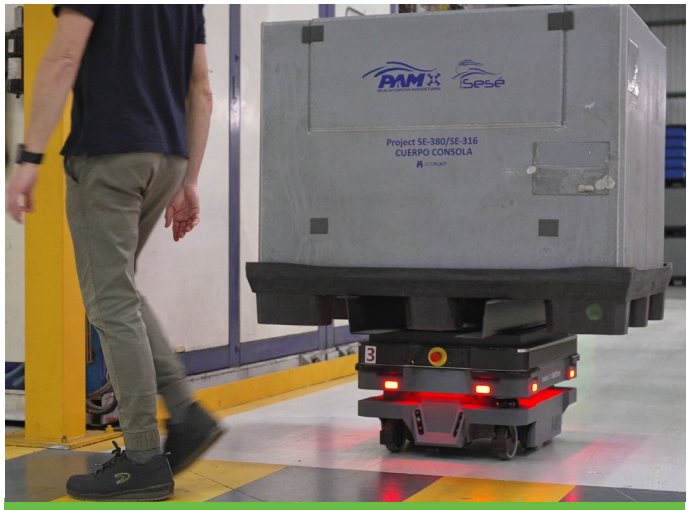
"With MiR1200, we've built a rugged pallet jack that thrives in real-world customer sites — not lab conditions," Hansen added. "This is how we unlock logistics efficiency in spaces that previously couldn't support automation."

Results: Safer Robots, Faster Deployment and New Markets

The integration of RealSense cameras into MiR systems has delivered measurable performance and operational advantages, beginning with truly autonomous navigation. Robots can identify and adapt to diverse pallet types and floor layouts, without human intervention. It has enabled wider adoption of MiR robots. RealSense-enabled AMRs now operate in warehouses, airports, hospitals and mega-factories, with deployments as large as 800+ robots per customer.

A Strategic Partnership Driving Innovation

The MiR-RealSense partnership represents a broader transformation in industrial automation. By integrating AI and evolving with RealSense's roadmap for computer vision, MiR is developing next-generation robots that are safe, intelligent and adaptable enough to work alongside humans in the complex, dynamic environments that define modern industrial operations.



MiR250 AMR navigating safely around people using RealSense depth cameras for obstacle detection.

MiR's engineering team works closely with RealSense developers to align product roadmaps; validate firmware and updates optimized for AMR use cases; test performance under industrial conditions like glare, steam or high reflectivity; and align on future sensor development for safety-rated vision components.

"RealSense isn't just a supplier; they're a strategic partner," said Hansen. "We're shaping the roadmap together so that the sensors evolve with the needs of fully autonomous mobile robotics."

Future Outlook: AI, Functional Safety and Scalable Autonomy

MiR's integration of RealSense technology marks a paradigm shift in industrial robotics, allowing AMRs to operate in controlled environments and in the unpredictable, human-centric settings that define real-world industry. RealSense cameras are essential to MiR's vision to deliver highly advanced, safe and scalable systems that not only react to their environment but anticipate it, furthering its quest to build AMR fleets that operate with minimal human oversight, automatically coordinating tasks, optimizing routes and adapting to changing operational requirements.

The MiR-RealSense collaboration is a model of how to integrate computer vision, AI and safety into a production-ready platform. Beyond enabling safer robots, they're building the foundation for the next generation of autonomous, intelligent and adaptive industrial systems.

Learn More

- **Mobile Industrial Robots (MiR)**

https://mobile-industrial-robots.com

- **RealSense Technology**

https://www.realsenseai.com