Case Study

Technology

Scaling Rugged Vision for Mobile Industrial Machines

Solectrix's SXVPU and the RealSense Depth Camera D457 deliver low-latency, edge AI perception for forklifts, robots, and industrial vehicles in harsh environments.

Spotlight on Solectrix

Solectrix GmbH is a German-based, full-service provider of innovative, high-end embedded electronics solutions, serving medical technology, automotive (AI, ADAS), and industrial sectors with custom hardware, software, and FPGA development, from concept to small-series production, adhering to strict standards like ISO 13485 for medical devices and ISO 9001/Automotive SPICE for automotive applications, ensuring quality and ruggedness for challenging environments.

solectrix
high end electronics solutions

"We wanted a platform that's as robust as our customers' machines," said Stefan Schütz, CEO of Solectrix GmbH. The SXVPU with RealSense depth cameras gives us low-latency, high-quality 3D vision that we can adapt to many different vehicles and use cases."

– Stefan Schütz, CEO, Solectrix GmbH

Mobile industrial machines are under pressure to do more: operate autonomously, detect hazards in real time, and keep people safe in some of the toughest conditions on earth. Forklifts in busy warehouses, agricultural machines in dust and mud, and construction vehicles on rough terrain all depend on reliable 3D perception — but traditional architectures often force hard trade-offs.

Fully decentralized smart cameras can be powerful but expensive and hard to scale. Large centralized ECUs can be cost-effective, yet struggle with the bandwidth and latency of multiple high-resolution cameras spread around a vehicle.
Solectrix, a German specialist in embedded vision and high-end electronics, set out to build something different: a smart vision subsystem that provides high-performance 3D perception at the edge, scales across vehicle platforms, and thrives in harsh industrial environments.

At the heart of that subsystem are two key components:

- **The Solectrix Smart eXtensible Vision Processing Unit (SXVPU)** — a rugged AMD Kria™ SOM–based vision computer with AI acceleration and ultra-low-latency processing.
- **The RealSense™ Depth Camera D457** — a GMSL/FAKRA stereo depth camera in an IP65 enclosure with an integrated IMU, designed for industrial and outdoor robotics.

Together, they form a scalable reference platform for modern industrial perception systems.

Challenge: Safe Autonomy in Tough Places

Today's mobile machines operate in environments where failure isn't an option. Dust, moisture, vibration, temperature swings, and shock are normal operating conditions, not edge cases. Perception systems must detect people, obstacles, and hazards in milliseconds to support emergency stops, speed reductions, or virtual safety zones.

Cameras may be mounted far from the compute unit — on masts, rear bumpers, booms, or articulated arms — driving stringent requirements for long cable runs, robust connectors, and EMI resilience. At the same time, OEMs need architectures they can reuse across fleets of forklifts, industrial trucks, agricultural machines, and construction vehicles without redesigning the perception stack for every model.

Solectrix needed a vision platform that combined:

- Low-latency, high-resolution processing and AI at the edge
- Rugged, cost-effective cameras that can be placed wherever safety demands
- Reliable, automotive-grade connectivity over long distances

Solution: SXVPU + RealSense Depth Camera D457

Solectrix designed the SXVPU as a semi-centralized vision subsystem. Instead of putting full intelligence into every camera or routing all raw data into a monolithic ECU, the SXVPU concentrates image processing, AI, and sensor fusion into a rugged, compact box while keeping cameras straightforward and robust. On the sensor side, Solectrix selected the RealSense Depth Camera D457 as a key building block for industrial 3D perception.

Results:

For Solectrix, pairing SXVPU with RealSense depth cameras is about building a scalable, rugged perception platform that customers can rely on for years to come—one that helps them move step by step from today's assistance systems toward safer, more capable, AI-enabled machines.

"RealSense depth cameras and SXVPU give us a robust core to build on," Stefan Schütz concluded. "From here, we can help our customers scale from assisted operation today to more autonomous, AI-powered machines tomorrow."

RealSense Depth Camera D457: Rugged 3D Vision over GMSL/FAKRA

The D457 is RealSense's first GMSL/FAKRA depth camera, built specifically for long cable runs and automotive-style locking connectors. Its IP65-rated enclosure is dust-tight and protected against water jets, making it suitable for both indoor industrial and outdoor mobile robotics.

The camera provides global-shutter stereo depth up to 1280 × 720 at 90 fps and RGB up to 1280 × 800 at 30 fps, with typical depth error under 2% at 4 m and an ideal operating range around 0.6–6 m for many vehicle scenarios. A wider baseline and matched depth/RGB fields of view (about 87° × 58° for depth and 90° × 65° for color) deliver precise 3D information across the machine's working envelope, while the integrated IMU refines depth when the camera is moving.

Just as important, the GMSL/FAKRA link supports cable lengths of roughly 15 meters with lower latency and better EMI performance than USB, and higher bandwidth than standard Ethernet — enabling cameras to be placed where they're needed for safety, not where short cables allow.

"GMSL/FAKRA was a big advantage for us," Schütz said. "It let us place cameras where safety demands, not where cabling limitations allow."

The SXVPU combines an AMD Kria™ SOM and FPGA fabric with a dedicated AI accelerator, delivering tens of TOPS of performance for neural network inference and high-throughput image processing.

How It Works: A Zonal Vision Architecture

From an OEM's perspective, the SXVPU + D457 combination behaves like a ready-made perception module.

1. Cameras around the vehicle

D457 cameras are mounted where each application needs coverage: front and rear for collision avoidance, on the sides for blind spots, or elevated for a bird's-eye view. Each camera connects directly to the SXVPU via GMSL2/FAKRA, delivering synchronized depth and RGB streams with low latency even over long, vibration-prone cable runs.

2. Edge processing in the SXVPU

Inside the SXVPU, the Kria SOM ingests multiple camera streams in parallel. The FPGA fabric handles preprocessing — synchronization, rectification, filtering — before frames reach the AI accelerator. Neural networks then detect people, vehicles, pallets, obstacles, drivable space, and other relevant objects and zones around the machine.

Processing happens before compression, so image quality for AI and control logic is preserved. Encoders on the SXVPU can still generate H.264/H.265 video up to 4K for monitoring, teleoperation, or recording, without compromising the ultra-low-latency perception path.

3. Integration and customization

Solectrix provides a development kit that includes an SXVPU main unit, reference camera setups, and example AI pipelines. OEMs can plug in their own models, add sensors such as LiDAR, radar, or ToF, and tune perception behavior to match each machine type and safety concept.

"The comprehensive tools and workflows make it easy for our customers to adapt SXVPU," Schütz noted. "They can start with a reference setup and evolve to their own applications, without dealing with low-level plumbing."

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Impact: Safer, Smarter, More Scalable Machines

By standardizing on the SXVPU and RealSense D457, Solectrix and its customers gain:

- **Real-time safety** – Sub-10 ms perception pipelines support rapid reactions for collision avoidance, driver assistance, and virtual safety zones, powered by high-quality depth and global-shutter RGB even in dynamic scenes.
- **Rugged operation** – IP65/67-level protection on the SXVPU and IP65 on the D457, plus automotive-grade GMSL/FAKRA cabling, support 24/7 operation in dust, moisture, vibration, and temperature extremes.
- **Lower system complexity and cost** – A single SXVPU can replace multiple smart cameras and a separate switch, while using robust but straightforward cameras instead of fully embedded vision sensors.
- **Flexibility across platforms** – The same architecture can be reused for forklifts and industrial trucks, construction machinery, agricultural equipment, mobile robots, and AMRs, shortening the path from prototype to series production.

"We can apply one scalable building block to many different machine platforms," Schütz said. "That's powerful for our customers — they get consistent performance and a shorter path from prototype to series production."

The Road Ahead

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- **Solextrix**

https://solectrix.de/en/

- **RealSense Technology**

https://www.realsenseai.com