

# Scaling All-Weather Autonomous Robotics

## RealSense Depth Cameras Enable Cartken's Autonomous Robots in Industrial Logistics and Last-Mile Delivery

### Spotlight on Cartken

Cartken is an AI-powered robotics company building autonomous robots for industrial logistics and last-mile delivery. From day one, Cartken built its navigation system around RealSense technology, leveraging the camera's advanced stereo depth sensing to achieve safe, reliable autonomy across diverse environments.



Cartken, founded in 2019 by a team of former Google engineers, is pioneering how autonomous robots move goods. While Cartken made an initial splash with its six-wheeled delivery robots that ferry meals across college campuses and crowded Tokyo malls and neighborhoods, more recently it is scaling beyond last-mile delivery to tackle the far larger challenge of industrial logistics.

Factories, warehouses and labs face growing demand for automated transport solutions that can operate seamlessly and safely both indoors and outdoors, in all conditions, around people and vehicles. Cartken's robots are designed for exactly this: compact, flexible, AI-powered machines that take over repetitive transport tasks, freeing workers to focus on higher-value activities.

From its earliest days, Cartken built its autonomy stack on RealSense depth cameras.

"From the beginning, we built our company and our technology around RealSense," acknowledged Jake Stelman, co-founder and VP of Hardware at Cartken. "It wasn't something we switched to later; it was the best thing we could find, and it still is. RealSense gave us the robust and cost-effective perception we needed to scale globally."

### Challenge: Robots That Seamlessly Navigate Complex Environments

Autonomous robots face a complex set of perception challenges when moving between indoor and outdoor environments. Sidewalks are uneven. Ramps and curbs require three-dimensional awareness. Weather conditions — from rain to snow to desert heat — can interfere with sensors. And in industrial facilities, robots must navigate unpredictable, high-traffic environments while maintaining near-perfect reliability.

To operate safely in this range of conditions, Cartken needed a sensing solution that could withstand a wide range of environments while providing precise, real-time perception.

Existing solutions struggled to meet these requirements. Many indoor robots rely on flat, structured environments, which "really break down once you go outside," Stelman explained. LiDAR is a possible sensing solution that offers outdoor reliability but at a prohibitive cost, especially for delivery robots with tight margins.

Cartken required a sensor platform that was:

- **Cost-effective** enough to scale in consumer delivery
- **Robust** enough to survive vibration, dust, rain and temperature extremes



Cartken robots equipped with rugged RealSense sensors

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- **Flexible** enough to support robots ranging from small couriers to pallet-hauling vehicles
- **Open** enough to integrate with Cartken's proprietary AI navigation and SLAM stack

## Solution: RealSense Sensors For All-weather Resilience

To enable reliable operation in outdoor and industrial environments, Cartken's approach combines specifically designed camera models, robust packaging and advanced AI integration.

Its robots operate in rain, snow and sun, withstanding temperatures from -20 °C to +50 °C (-4 °F to 122 °F) – resilience supported by rugged RealSense models and custom environmental housing designed with RealSense engineers.

### Outdoor readiness and ruggedization

RealSense depth cameras are the core of Cartken's vision-based navigation system. Its autonomous robots utilize RealSense cameras D455 and D456, known for their outdoor performance and sturdy enclosures. The cameras include a built-in laser safety mechanism that prevents overheating or freezing damage by shutting off the laser outside safe ranges. The D456's IP65-rated aluminum shell provides protection against dust and water splashes, critical for all-weather operations.

For harsher deployments, Cartken and RealSense developed custom sealed housings with gasketing, automotive-grade connectors, and coatings, ensuring long-term reliability in outdoor industrial use.

The robots rely on RealSense depth and RGB data, supplemented by features like near-infrared projectors or auxiliary lighting, to navigate reliably in all lighting conditions — even total darkness.

"Globally, reliability is incredibly crucial, and we needed components that could withstand the harsh realities of outdoor robotics," said Stelman. "That's why we use automotive-grade

FAKRA GMSL communication protocol — not USB cameras — and Intel RealSense sensors. USB doesn't last very long when you're going over rubble and rough terrain. Together with RealSense, we created a custom solution built on the proven D430 module and D5 FAKRA processor card—ruggedized to thrive in harsh environments with IP67 sealing against dust and water, plus resistance to vibration and extreme temperatures. RealSense collaborated with us not only on the hardware packaging but also on the firmware, developing custom code so the components could communicate seamlessly and tuning the image output to fit our operations."

This deep collaboration extended beyond engineering. RealSense connected Cartken directly with its supply chain partners, accelerating the path to scale. "One of the most incredible things RealSense did for us was to open up their supply chain and manufacturing expertise," Stelman explained. "They introduced us to trusted partners, shared their testing processes and quality controls, and gave us the engineering guidance we needed to move fast. I was able to go to Asia, work with a partner RealSense had already vetted, and launch mass production in just two months. That level of support was

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Cartken works with several very large companies, including ZF, a global automotive leader. At their facilities, Cartken's robots provide around-the-clock sample transportation across a sprawling campus — moving between buildings both indoors and outdoors in every condition: rain, snow, extreme heat and extreme cold. "In that environment, and in many of our other operations, any disruption can be extremely costly," said Stelman. "That's why reliability is so critical—it ensures our robots maintain the high uptime our customers depend on."

### AI and sensor fusion

RealSense cameras are deeply integrated into Cartken's autonomy stack.

RealSense depth imagery feeds into Cartken's advanced visual SLAM system, which fuses monocular and stereo features with semantic recognition to create robust, real-time 3D maps. AI-powered navigation algorithms use this data for obstacle avoidance and safe path planning in unpredictable environments.

The open-source RealSense SDK enables Cartken to tune firmware, optimize images and adapt the platform for factory and outdoor deployments.

"Some competitors have sunk thousands of hours into building stereo vision systems from scratch," noted Stelman. "By



Warehouse worker operating a Cartken hauler robot equipped with RealSense sensors for autonomous navigation.

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leveraging RealSense, we essentially tapped into tens of thousands of engineering hours that RealSense and Mobileye had already invested. That freed us to focus on the AI and autonomy that make our robots unique.”

## Results: Reliability at Scale, in Any Environment

With RealSense at its core, Cartken has expanded from last-mile delivery to industrial automation at scale.

- **Global scale:** Hundreds of robots deployed across Europe, the U.S. and Japan, operating in temperatures up to - 30°C [-22°F] and in rain, snow and direct sun.
- **High utilization:** Cartken robots complete an average of **35,000 deliveries per month** across campuses, malls and industrial sites.
- **Distance traveled:** Nearly **1 million km [621K mi] logged**, equal to circling the Earth 25 times.
- **Worker impact:** In 2024, robots freed up **2,000 hours of labor** in industrial sites — equivalent to 250 worker shifts.
- **Industrial success:** At ZF Lifetec, Cartken’s Courier moves production samples 24/7 across buildings. It has also been the most active robot in the global fleet, completing a record 73 deliveries in a single day, a clear sign of strong utilization and performance.
- **Scalable platform:** From the 20kg [44-pound] Courier to the 300 kg [660-pound] Hauler, and soon the **Mover** pallet truck 1500 kg [3,000-pound] capacity), Cartken uses the same RealSense-powered autonomy stack across all platforms.

“We looked at everything — LiDAR, proprietary cameras — and nothing beat RealSense on performance per dollar,” said Stelman. “Margins are thin for sidewalk robots, and for industrial robots, reliability is everything. RealSense has been the key enabler that allowed us to scale both.”

Cartken continues to innovate with RealSense as it scales into heavier industrial robots, including forklifts and pallet trucks. The team is especially excited about RealSense’s forthcoming safety-certified cameras, slated for 2026, which will be critical for operating larger payloads in industrial settings.

“RealSense isn’t just a component in our robots, it’s the foundation of our autonomy,” confirmed Stelman. “We built everything around it because it was the best, and it still is. It’s what makes Cartken robots work, indoors, outdoors, at scale, around the world.”

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Cartken Hauler robot equipped with RealSense sensors, enabling safe navigation in outdoor environments.

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