

Vision AI for Embodied Intelligence

Powering Advanced Perception, Navigation, and Intelligent Behavior with RealSense Technology

Spotlight on Unitree

Established in 2016, Unitree is a pioneer in the development and marketization of high-performance robots including humanoid robots (H1 and G1), quadruped robots for industrial applications (B2), and consumer robots (Go2). These advanced machines have been applied to many industries such as petrochemicals, security, electric power, and education.

Unitree
宇树科技

"The rich depth data provided by RealSense cameras serves as valuable input for our AI algorithms."

– Corrine Kang, Marketing Manager at Unitree

Challenge

Unitree robots, designed for agility and diverse applications, need robust perception capabilities to navigate complex environments, avoid obstacles, and interact safely with their surroundings.

Solution

Unitree integrates RealSense™ cameras into its robots to enable depth sensing, object recognition, and environmental mapping functionalities, forming the foundation for intelligent robotic behaviors.

Results

By leveraging RealSense technology, Unitree robots achieve accurate object detection and avoidance, efficient navigation through 3D maps, and natural human-robot interaction through gesture recognition.

Introduction: The Need for Enhanced Robotic Perception

The robotics revolution is here: The International Federation of Robotics (IFR) reports a significant increase in robot installations, with a 32% jump in 2023 alone.¹ A staggering 90% of manufacturers anticipate using robots in their workplaces by 2030, and many other industries are following suit.



RealSense depth cameras for spatial awareness and interaction, with stereo sensors integrated into its head.

Case Study | Unitree

While many companies are vying for a share of the burgeoning robotics market, Unitree distinguishes itself by applying its robots to real-world applications such as search-and-rescue, fire control, and industrial inspections. From braving hazardous environments to automating factory workflows and seamlessly collaborating with human workers, Unitree's nimble machines are redefining the future of work.

Unitree's quadrupeds, like the Go2 series, are known for their stability and maneuverability, making them ideal for navigating uneven terrain or performing companion-like tasks. Unitree's bipedal robots, while still under development, showcase the company's progress towards human-like robots potentially suited for more complex tasks.

In order for these robots to excel in real-world scenarios, they require a sophisticated understanding of their surroundings. Constant analysis of visual and depth information is crucial for tasks like object detection, localization, and mapping, forming the foundation for intelligent robotic behavior. Powered by RealSense technology, Unitree's versatile robots possess advanced perception capabilities that enable them to perform a variety of tasks across a huge range of conditions.

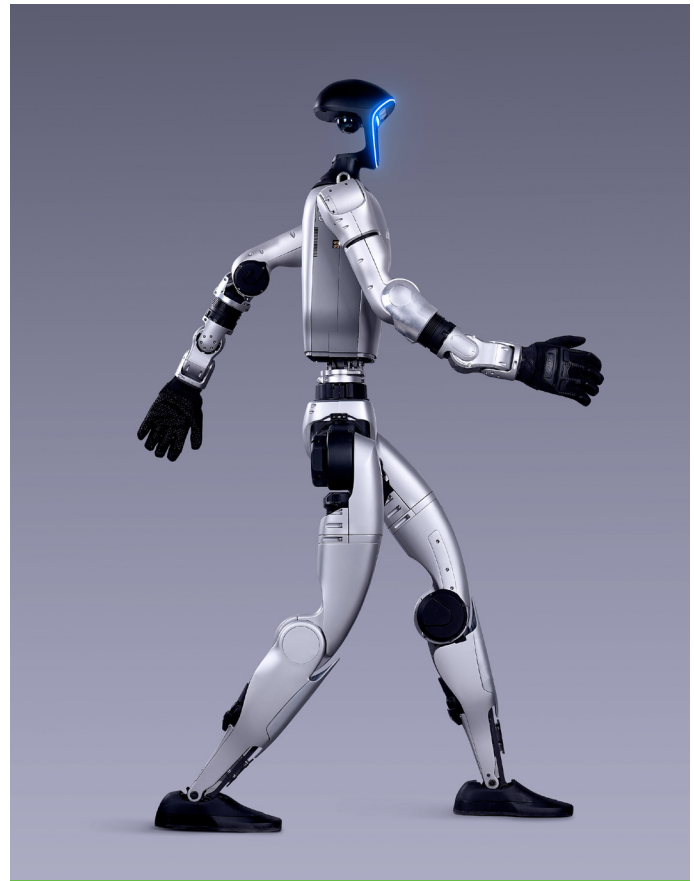
"Our robots are designed to navigate challenging terrains and perform various tasks efficiently," says Corrine Kang, Marketing Manager at Unitree. "RealSense cameras play a vital role by providing the depth-sensing foundation for accurate object detection, obstacle avoidance, and safe interaction with their environments, unlocking a new level of intelligence and functionality."

Selecting RealSense

Unitree needed low-power, high-performance sensors in a small form factor that could be easily integrated into their designs. Due to the complexity of the machine vision tasks in most robotic applications, its engineering team needed to make use of multiple sensors in each robot to gain a deeper and broader view and richer, more varied data.

Unitree solved these challenges with RealSense technology:

- **Object Detection and Recognition:** RealSense Depth Camera D455 combines depth sensing with high-resolution RGB imaging, allowing Unitree's robots to perceive the environment with both depth information and visual cues. This empowers robots with superior perception capabilities for tasks like object recognition, scene understanding, and task execution.
- **Collision Avoidance:** The high frame rate and depth accuracy of RealSense cameras provide the data needed for Unitree's robots to recognize obstructions so that they can successfully avoid collisions. This same technology allows the robots to distinguish foreground objects from background objects and measure and understand shapes. By perceiving the depth and distance of obstacles in real-time, the robots can plan optimal paths and ensure the safety of both the robot and the people in its vicinity.
- **Environmental Mapping and Navigation:** RealSense depth cameras facilitate the creation of detailed 3D maps, enabling robots to localize themselves and navigate efficiently within indoor and outdoor environments.
- **Human-Robot Interaction:** Some RealSense cameras (such as RealSense D435i) offer gesture recognition, allowing



Visual and depth information from RealSense form the foundation of coordinated robotic behavior.

for natural interactions between robots and humans. This is particularly valuable in service robotics applications.

"RealSense cameras provide a versatile solution for our robots," Kang sums up. "Depth sensing helps with object detection and avoidance, while 3D mapping allows for efficient navigation. Additionally, gesture recognition capabilities in certain models open doors for intuitive human-robot interaction."

Streamlining Development and Integration Tasks

Data from RealSense depth cameras allows Unitree's robots to distinguish foreground objects from background objects as well as to measure and understand shapes. This core capability factors into a variety of use cases. For example, factory robots use high-resolution imagery to distinguish objects. Warehouse robots use volumetric data to improve efficiency in packaging, placement, and storage applications. Industrial robots use the same technology for path planning, while pick-and-place robots rely on machine vision to accurately extract objects from bins and adjust picking pressures based on each object's identity.

For Unitree's engineering team, the RealSense SDK provides a comprehensive set of tools and libraries to apply the cameras to these case cases. Packaged software capabilities and out-of-the-box APIs enable developers to deploy multiple cameras in a single solution. By simplifying depth sensing and environment mapping tasks, the SDK frees up valuable engineering resources for higher-level development activities, accelerating time-to-market.

The Power of AI with Depth Data

The powerful Vision AI capabilities of RealSense technology play a critical role in many of Unitree's essential robotic functions. Having accurate depth data leads to faster development cycles through efficient testing and iteration of robotic algorithms.

However, the choice of RealSense technology goes beyond just depth sensing. Unitree leverages the cameras' compatibility with Intel platforms, a diverse product lineup, and a robust developer ecosystem. For example, Intel offers vision processing units (VPUs) that can accelerate AI workloads, while the Intel oneAPI initiative and Deep Learning Reference Stack provide open-source frameworks and tools, forming a cohesive technology stack for vision tasks like image recognition and object detection.

"The rich depth data provided by RealSense technology serves as valuable input for our AI algorithms," Kang says. "By providing reliable sensor data, RealSense reduces the time spent debugging and refining algorithms, leading to faster iterations and improvements."

According to Kang, compatibility with many other platforms translates not only into faster, more comprehensive development capabilities but also into potentially lower maintenance costs and a streamlined technical support process. "The integration of RealSense depth cameras with AI technologies enhances the capabilities and intelligence of our robots, enabling them to perceive, understand, and interact with their environments more effectively," Kang confirms.

A Valued Partnership: Working with RealSense

Unitree acknowledges RealSense as a key partner in its journey towards developing advanced and innovative robotic solutions. According to Kang, working with Intel lends credibility to Unitree's offering and enhances its perceived value in the marketplace.

"Intel is a globally recognized and respected technology company known for its innovation, quality, and reliability," she points out. In addition, RealSense has been a valuable technology partner, offering the support we need and demonstrating a commitment to continuous improvement and collaboration. Their responsiveness and guidance have been instrumental in the successful integration of RealSense technology cameras into our robots, ultimately helping us deliver high-quality products to our customers."

Shaping the Future of Robotics

This journey of continuous innovation and improvement is a collaborative effort. Kang and her team appreciate the support of RealSense as they work together to shape the future of robotics and AI. "The integration of advanced perception technologies from RealSense is propelling the robotics industry forward," Kang concludes. "We are excited to see what the future holds as we continue to develop intelligent and capable robots that have a positive impact on our daily lives."



Close-up of the sensor-equipped head, enabling 3D perception for navigation and interaction.

"The integration of RealSense depth cameras with AI technologies enhances the capabilities and intelligence of our robots, enabling them to perceive, understand, and interact with their environments more effectively."

– Corrine Kang, Marketing Manager, Unitree

Technical components of the solution

- RealSense Depth Camera D455
- Unitree H1, G1, B2, and Go2

Learn More

• Unitree

<https://unitree.com>

• RealSense Technology

<https://www.realsenseai.com>

¹ International Federation of Robotics (IFR), 2024.