

INDUSTRY OVERVIEW

The information and statistics set out in this section and other sections of this document were extracted from different official government publications, available sources from public, market research and other sources from independent suppliers, and from the independent industry report prepared by CIC. The information from official government sources has not been independently verified by us, the Joint Sponsors, [REDACTED], any of their respective directors and advisors, or any other persons or parties involved in the [REDACTED], and no representation is given as to its accuracy.

THE GLOBAL INTELLIGENT ROBOT MARKET

The intelligent robot industry is undergoing a significant transformation, fundamentally reshaping global industries and redefining human lifestyles. As intelligent technologies achieve new levels of sophistication, intelligent robots are steadily evolving to master increasingly complex and nuanced tasks. Their impact spans across critical sectors, from enhancing manufacturing processes in industrial applications, to transforming customer experiences in service sectors, to advancing capabilities in healthcare delivery, and creating innovative solutions in education and entertainment.

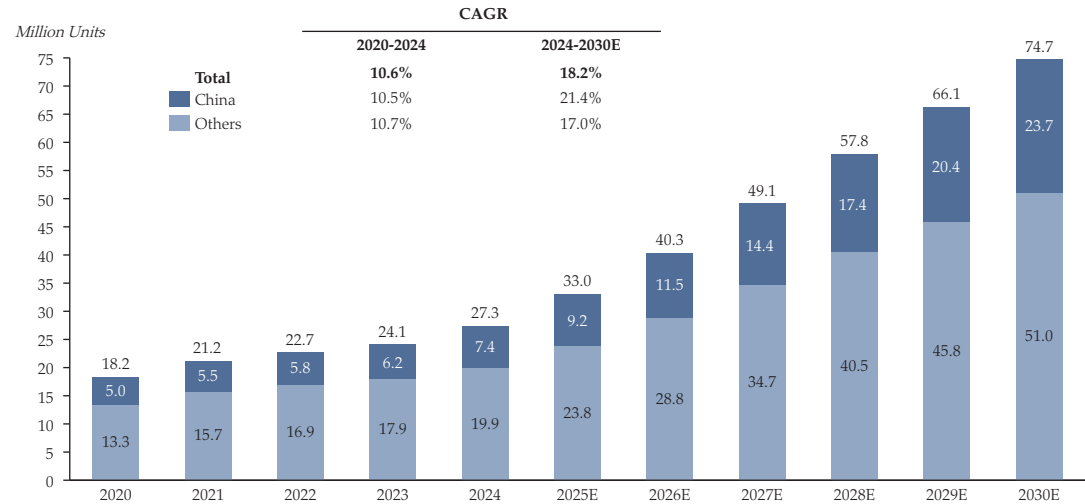
The intelligent robot industry can be broadly divided into three segments along the value chain. The upstream segment includes suppliers of core hardware and software components such as chips, reducers, controllers, servo systems, and spatial sensing solutions, which together constitute the essential building blocks enabling intelligent robot perception, decision and motion. The midstream segment consists of intelligent robot manufacturers and system integrators. The downstream segment encompasses diverse end-use industries and application scenarios, such as industrial automation, logistics and warehousing, household cleaning, service, medical assistance and educational. Companies across the intelligent robot value chain generally compete within their respective segments and sub-sectors, each characterized by distinct market dynamics, technological focuses, and competitive landscapes.

The global intelligent robot market has experienced robust growth, with global intelligent robot shipment volume increasing from 18.2 million units in 2020 to 27.3 million units in 2024, representing a CAGR of 10.6%, and is expected to continue growing a CAGR of 18.2% to reach 74.7 million units in 2030. China is a crucial market for global robot applications. The depth and breadth of the Chinese market continue to provide key momentum for the development of the intelligent robot industry, and is increasingly becoming an important force driving global intelligent robot industry’s technological advancement and industrial upgrade. China’s intelligent robot shipment volume increased from 5.0 million units in 2020 to 7.4 million units in 2024, representing a CAGR of 10.5%. From 2024 to 2030, it is expected to grow rapidly at a CAGR of 21.4%, with expected shipment volume reaching 23.7 million units in 2030.

The growth of the intelligent robot market has also driven the expansion and upgrading of the upstream supply chain. Growing shipment volumes and more diversified application scenarios have raised requirements for perception accuracy, motion control, system reliability, and cost efficiency. These rising demands are accelerating technological iteration across core upstream domains and increasingly highlighting the importance of upstream technologies in supporting intelligent robot performance improvement, while also expanding the market opportunities for upstream component and solution providers as the industry develops.

INDUSTRY OVERVIEW

Global and China’s Intelligent Robot Market Size, in Terms of Shipment Volume, 2020-2030E



Source: International Federation of Robotics, CIC Report

Note: Intelligent robots include household robots, service robots, collaborative robots (6-axis and above), AMR (Autonomous Mobile Robots) and humanoid robots

INTELLIGENT ROBOT SPATIAL SENSING SOLUTIONS MARKET

Overview

Intelligent robots constitute one of the most important application domains for spatial sensing technologies. As AI technology advances, intelligent robots are evolving beyond simple task execution toward “embodied intelligence,” which refers to a sophisticated integration of sensing, cognition, and action capabilities. At the core of this evolution, spatial sensing emerges as the fundamental competency, enabling robots to understand their environment, position, and task progress in real-time, with successful commercial applications already seen in intelligent robots such as robot vacuums, yard robots, and collaborative robots. As these systems operate in increasingly complex dynamic environments, the demands on spatial sensing capabilities continue to grow, particularly in handling challenging scenarios such as transparent or reflective surfaces and materials of varying hardness. The next generation of spatial sensing systems is expected to deliver not only high precision and robustness, but also breakthrough capabilities in real-time processing, multi-modal fusion, semantic understanding, and efficient deployment, with processing capabilities increasingly shifting from cloud-dependent to edge-based real-time inference. This evolution from merely “seeing” to “understanding” and “responding” to environments positions spatial sensing as a critical enabler of practical robotic applications, driving both increased market penetration and per-device value across intelligent systems.

Technical Framework and Key Features

Intelligent robot spatial sensing technology refers to the technical system that enables intelligent robots to acquire and analyze information about their immediate space and surrounding environment in real-time, while interacting with it. This technology serves as a crucial link for robots to establish cognitive connections with physical space and time, laying the foundation for subsequent functional implementation and task completion of intelligent robots. And high-precision spatial sensing solutions represent the advanced segment of the field, typically comprising integrated hardware and software components and related supporting services, such as sensing hardware, spatial sensing algorithms, and system integration. Such solutions typically deliver centimeter-level or better measurement accuracy, strong robustness across varying lighting conditions and surface materials, and reliable performance in complex dynamic environments. These capabilities support high-quality localization, mapping, obstacle avoidance, and path planning, enabling intelligent robots to perform more sophisticated autonomous functions.

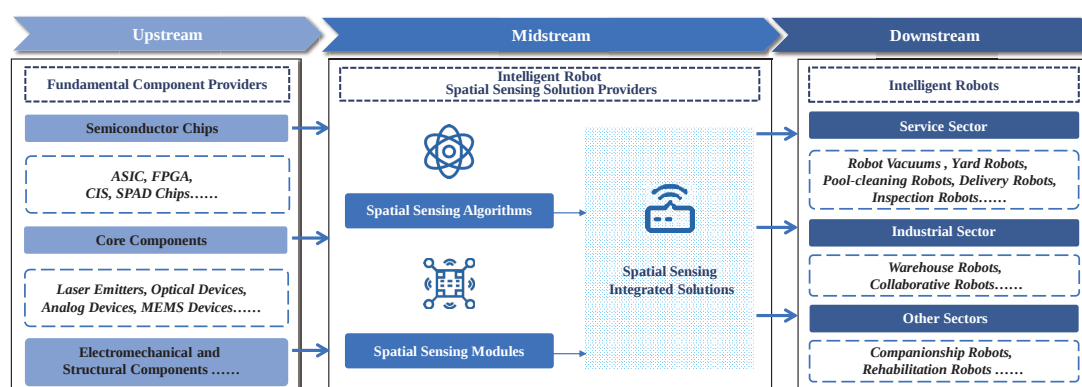
INDUSTRY OVERVIEW

Intelligent robot spatial sensing primarily obtains environmental information through multi-modal sensors, with LiDAR emerging as the leading technology alongside cameras, inertial measurement units (IMUs), ultrasonic sensors and infrared sensors. Different LiDAR technologies serve distinct needs: triangulation-based LiDAR offers compact, energy-efficient solutions for near-range detection; direct Time-of-Flight (dTOF) LiDAR provides faster response and stronger anti-interference capabilities; and line laser scanning excels in edge cleaning and near-field obstacle detection — as demonstrated in robot vacuums, one of the earliest mass-market applications. These three technological pathways each possess distinct advantages in practical applications, catering to differentiated product positioning and functional requirements, and collectively form a complementary and symbiotic market landscape across varying performance tiers and cost segments. LiDAR’s superior precision, anti-interference capabilities, and environmental adaptability for real-time distance measurement and dynamic target tracking have driven its adoption in intelligent robots, with penetration rates continuing to grow. The complete spatial sensing solution encompasses an industrial ecosystem integrating both hardware and software components, from advanced sensors and sensing algorithms to system integration and supporting services, where sophisticated software solutions play a crucial role in processing sensing data and enabling accurate decision-making capabilities.

As these solutions continue to mature and evolve, several key technical characteristics have emerged: (1) AI-Driven Algorithms: AI serves as the core engine, enabling environmental understanding, semantic recognition, and self-adaptive capabilities, while significantly raising algorithmic requirements for precision, real-time performance, and robustness in complex tasks like data fusion, object recognition, and 3D mapping; (2) Multi-Sensor Fusion: Integration of LiDAR, visual cameras, IMUs, and other sensors to achieve more stable and accurate spatial sensing capabilities; (3) Specialized Chip Development: Industry transition toward self-developed and customized chips, which offer superior computing efficiency, power consumption control, and system integration compared to general-purpose chips, becoming a crucial foundation for practical sensing solutions.

Value Chain Structure

The following diagram illustrates the value chain of intelligent robot spatial sensing solutions industry:



Source: CIC Report

The upstream segment comprises fundamental components. The core value of midstream solution providers lies in transforming upstream components into integrated modules and systems capable of real-time environmental perception, high-precision positioning, map construction, and intelligent obstacle avoidance. Their technical route selection, self-developed algorithms and chips, component adaptation, and system integration capabilities have become key anchors for industry chain efficiency and value distribution. The downstream segment consists of intelligent robots across service, industrial, education, entertainment, and medical sectors.

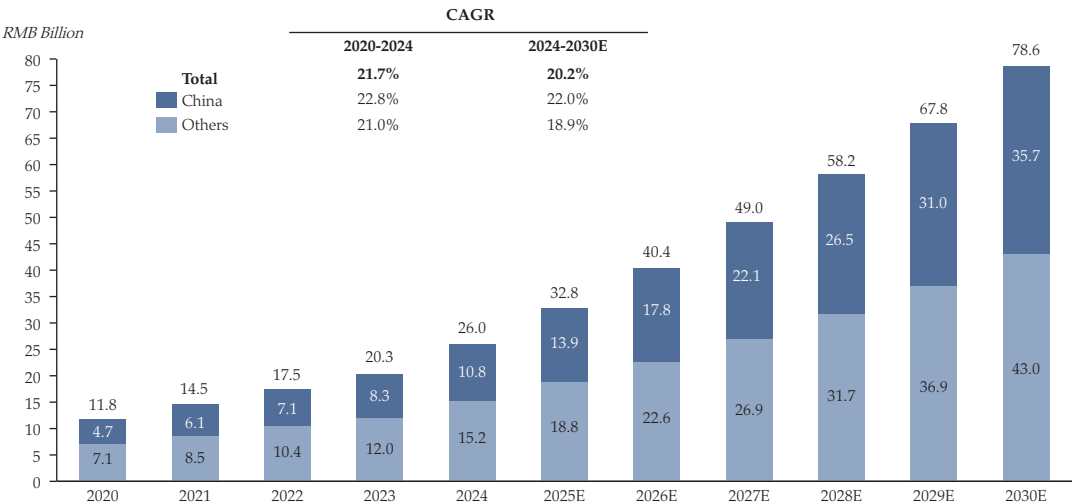
INDUSTRY OVERVIEW

Market Size

The global intelligent robot spatial sensing solution market continues to expand, driven by both increasing per-unit value due to enhanced spatial sensing capabilities and growing penetration rates of spatial sensing functions in intelligent robots, evolving from “optional features” to “standard configurations” across scenarios. In the household robot segment, application scenarios have extended from indoor cleaning to lawn mowing, underwater cleaning, and other areas. The mature robot vacuum market shows strong demand for high-precision, reliable autonomous navigation, while emerging markets such as yard robots, pool-cleaning robots and humanoid robots are expanding their installed base through channel and category penetration, demonstrating an overall market trend of “volume growth + structural optimization.” The global intelligent robot spatial sensing solutions market size grew from RMB11.8 billion in 2020 to RMB26.0 billion in 2024, representing a CAGR of 21.7%. From 2024 to 2030, the market size is expected to grow rapidly at a CAGR of 20.2%, reaching RMB78.6 billion by 2030.

As one of the major global markets for intelligent robots, China demonstrates strong momentum in the intelligent robot spatial sensing solution sector. On the supply side, Chinese manufacturers are continuously optimizing delivery cycles, cost control, and product iteration speed, benefiting from comprehensive localized supply chains, scaled manufacturing, and standardized module systems to meet robust downstream demand. Meanwhile, the synergy between online and offline sales channels, well-structured price positioning, and gradual expansion into multi-scenario applications jointly drive the growth in intelligent robot installations and configuration upgrades, further expanding the market size for intelligent robot spatial sensing solutions. China’s intelligent robot spatial sensing solution market size grew from RMB4.7 billion in 2020 to RMB10.8 billion in 2024, representing a CAGR of 22.8%. From 2024 to 2030, the market size is expected to grow rapidly at a CAGR of 22.0%, reaching RMB35.7 billion by 2030.

Global and China’s Intelligent Robot Spatial Sensing Solutions Market Size, in Terms of Sales Revenue, 2020-2030E



Source: International Federation of Robotics, Companies’ public disclosures, CIC Report

Robot vacuums represent one of the most widely adopted intelligent robot categories, with LiDAR solutions becoming the mainstream choice for spatial sensing due to superior precision and adaptability. The global robot vacuum LiDAR market size grew from RMB0.8 billion in 2020 to RMB1.3 billion in 2024, representing a CAGR of 11.1%. From 2024 to 2030, the market size is expected to grow rapidly at a CAGR of 25.5%, reaching RMB5.0 billion by 2030.

INDUSTRY OVERVIEW

Market Drivers and Future Trends

The key market drivers in the intelligent robot spatial sensing solutions industry include the following:

- **Embodied Intelligence Driving Sensing as Standard:** The trend toward embodied intelligence is making spatial sensing capabilities a cornerstone for robots’ environmental interaction, intent understanding, and autonomous decision-making capabilities. As intelligent robots accelerate penetration into household, service, industrial, and logistics scenarios, with spatial sensing is becoming increasingly sophisticated in complexity and technical capability.
- **Rapid Growth in Downstream Demand:** Robot vacuum penetration rates remain low compared to other household appliances, with China having only 42 units per thousand households in 2024, expected to reach approximately 94 units by 2030. Additionally, emerging intelligent robots in new scenarios create rigid demand for spatial sensing capabilities, continuously expanding market size.
- **Technological Breakthroughs Driving Sensing Capabilities:** Continuous advancement in AI algorithms, multi-sensor fusion, edge computing, and integrated hardware-software service capabilities significantly improves the precision and robustness of environmental modeling, real-time positioning, and obstacle recognition, providing key technical foundations for various robots’ autonomous operation in complex scenarios.
- **Ongoing Policy Support:** The clear policy orientation and sustained capital investment have established a stable and supportive environment for the long-term development of spatial sensing technology. The Catalogue for the Adjustment of Industrial Structure (2024 Edition) (《產業結構調整指導目錄(2024年本)》) identifies robots, sensors, high-precision positioning devices, vision systems and AI chips as encouraged areas, strengthening policy support for the industrial application of intelligent hardware and core sensing components.

Competitive Landscape

Market participants in the global intelligent robot spatial sensing solution industry fall into two main categories: The first consists of robot companies with self-developed spatial sensing solutions. They primarily serve their own product ecosystems and maintain advantages in system coordination and specialized scenario adaptation. The second category comprises intelligent robot spatial sensing solution providers, ranging from smaller providers focusing on single components (algorithms, modules, sensors) to integrated providers offering comprehensive system-level solutions. These providers combine spatial sensing algorithms with integrated hardware-software capabilities, utilizing open architecture and cross-platform compatibility to deliver scalable solutions across multiple brands and scenarios. Robot companies with self-developed spatial sensing solutions usually engage intelligent robot spatial sensing solution providers for their products, as these providers offer more specialized expertise, more cost-effective pricing, and the ability to support diverse product lines. This allows manufacturers to leverage external capabilities while maintaining flexibility across their product portfolio and optimizing development costs.

Advanced algorithms constitute the foundation of spatial sensing systems, determining the precision and robustness of environmental perception, real-time positioning, and scene understanding. Deep integration of algorithms and computing power at the architectural level enables spatial sensing systems to accommodate expanding application scenarios and the ongoing increasing requirements for precision, efficiency, power consumption, and cost-effectiveness. Self-developed chips better facilitate such deep integration; accordingly, leading solution providers have progressively extended upstream into chip development. These self-developed chips not only enhance computational efficiency and reduce power consumption but also strengthen supply chain stability and cost control. When addressing large-scale deployment across diverse robot models and scenarios, solution providers with high-performance, highly compatible, and scalable solutions help customers enhance product intelligence and user experience while ensuring reliable delivery amid accelerating technological advancement.

INDUSTRY OVERVIEW

In the global market for intelligent robot spatial sensing solution providers, the Company ranks No. 1 by revenue from intelligent robot spatial sensing solutions. Few spatial sensing solution providers globally possess self-developed chip capabilities. Among these, the Company stands as the largest provider of intelligent robot spatial sensing solutions with proprietary chip technology.

Ranking of Global Intelligent Robot Spatial Sensing Solution Providers, by Revenue in 2024

Ranking	Company	Revenue from Intelligent Robot Spatial Sensing Solutions in 2024 (RMB Million)	Market share	Self- developed ASIC
1	The Company	~433	~1.7%	√
2	Company A	~400	~1.5%	√
3	Company B	~345	~1.3%	×
4	Company C	~300	~1.2%	×
5	Company D	~175	~0.7%	√

Source: Companies' annual reports; CIC Report

Notes:

- Company A is a privately owned company, founded in 1946 and headquartered in Germany. The company specializes in sensors and automation solutions for industrial applications, providing a wide range of sensor products for intelligent robot companies. In 2024, the company's intelligent robot spatial sensing solutions revenue reached about RMB400 million.
- Company B is a privately owned company, founded in 2017 and headquartered in China. The company focuses on visual perception technology for intelligent robots, mainly supplying LiDAR and algorithm modules. In 2024, it's intelligent robot spatial sensing solutions revenue was around RMB345 million.
- Company C is a privately owned company, founded in 2016 and headquartered in China. The company provides LiDAR to companies in the intelligent robot and automotive industry. In 2024, the company's intelligent robot spatial sensing solutions revenue was around RMB300 million.
- Company D is a Hong Kong Stock Exchange listed company, founded in 2014 and headquartered in China. The company provides LiDAR and cameras to companies in the intelligent robot and automotive industry. In 2024, it's intelligent robot spatial sensing solutions revenue reached about RMB175 million.

The Company ranked first by revenue in the spatial sensing solutions market for robot vacuums in 2024. Currently, approximately 70% of robot vacuums utilize LiDAR technology as their primary spatial sensing solution. Within the LiDAR segment, the Company has established itself by capturing over 50% market share by shipment volume in 2024.

Entry Barriers

The global intelligent robot spatial sensing solutions market is characterized by significant entry barriers that shape competitive dynamics:

- Core Algorithm Barriers:** The development of spatial sensing solutions involves highly complex algorithms, including object recognition, 3D mapping, and SLAM, representing a high technical threshold. Market leaders differentiate through capabilities in deep vision, semantic understanding, multi-sensor fusion, and continuous optimization across platforms. The required R&D investment and accumulated expertise create significant barriers to entry.
- Scenario Complexity and Implementation Know-How:** Spatial sensing systems must operate reliably across diverse environments with varying requirements for precision, latency, and form factor. This requires strong engineering and algorithm optimization capabilities to ensure efficient deployment across platforms. Leading companies leverage cross-scenario experience to deliver integrated hardware-software solutions that balance performance and cost.

INDUSTRY OVERVIEW

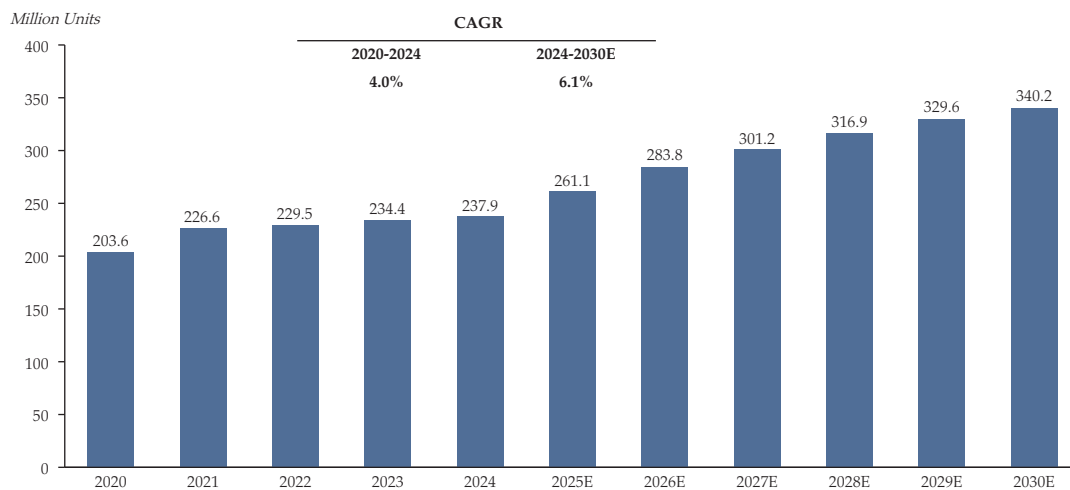
- Product Validation and Customer Trust:** Spatial sensing systems integrate multiple critical components, and stable supply chain, quality control, and cost management capabilities are essential prerequisites for entering customer validation processes. Given the critical role of these solutions in system performance, validation cycles are typically long, resulting in high switching costs. Established players benefit from scale, supply relationships, and proven track records, strengthening customer trust and long-term engagement.

THE GLOBAL INTELLIGENT DEVICE MARKET

The global intelligent device industry has entered a phase of steady expansion, supported by continuous advancements in sensing, connectivity, AI, and human-machine interaction technologies, as well as the diversification of digital-lifestyle and professional application scenarios. Intelligent devices integrate hardware and software capabilities, including sensing, processing, connectivity and application-level algorithms, into compact platforms, enabling richer functional experiences and more seamless user interaction. This category covers a broad range of products, such as XR devices, smart wrist-worn devices, spatial-audio-enabled TWS earbuds, intelligent scanning and mapping equipment, and consumer and professional drones. Together, these devices reflect the broader industry trend toward higher intelligence, enhanced autonomy, and strengthened sensing capabilities.

The global intelligent device shipment volume increased from 203.6 million units in 2020 to 237.9 million units in 2024, representing a CAGR of 4.0%, and is expected to reach 340.2 million units by 2030, with a CAGR of 6.1% from 2024 to 2030.

Global Intelligent Device Market Size, in Terms of Shipment Volume, 2020-2030E



Source: IDC, Wellsenn XR, CIC Report

Note: This market only includes devices with spatial sensing capabilities, and excludes automobiles

SPATIAL SENSING SOLUTIONS FOR INTELLIGENT DEVICES

Overview

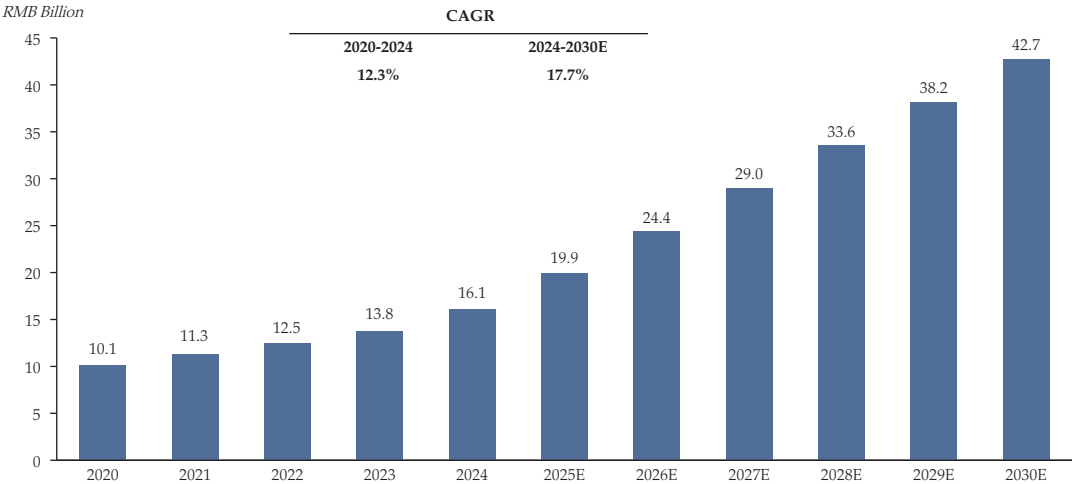
Spatial sensing technology extends beyond its foundational role in robotic applications, driving both the emergence of new product categories and enabling intelligent upgrades to existing devices. As the technology continues to mature, we are witnessing a proliferation of intelligent devices that leverage spatial sensing capabilities to execute increasingly complex tasks. These range from MR/AR/VR devices that require precise environmental mapping for immersive experiences, to sophisticated pet companion robots that must accurately perceive and interact with their surroundings. This expansion reflects a broader trend where spatial sensing is becoming a fundamental enabling technology for the next generation of intelligent devices, enhancing their ability to understand and interact with the physical world in more sophisticated ways.

INDUSTRY OVERVIEW

Market Size

The global spatial sensing solutions market for intelligent devices in terms of sales revenue grew from RMB10.1 billion in 2020 to RMB16.1 billion in 2024, representing a CAGR of 12.3%. From 2024 to 2030, the market is expected to grow rapidly at a CAGR of 17.7%, reaching RMB42.7 billion by 2030.

Global Intelligent Device Spatial Sensing Solutions Market Size, in Terms of Sales Revenue, 2020-2030E



Source: IDC, CIC Report

Note: This market only includes devices with spatial sensing capabilities, and excludes automobiles

Market Drivers and Future Trends

The key market drivers in spatial sensing solutions for intelligent devices include the following:

- **Enhanced User Experience Requirements:** Smart devices are evolving toward more natural and immersive interaction, with spatial sensing supporting capabilities like gesture control and mixed reality integration, becoming a key differentiator.
- **Edge AI Computing Advancement:** Advancements in terminal computing power and lightweight AI models enable real-time scene understanding and 3D reconstruction, accelerating application innovation and large-scale adoption, while driving the shift from cloud-based to device-side computing.
- **Industry Standards and Ecosystem Development:** Industry standardization and ecosystem development are accelerating adoption, while spatial sensing expands from premium devices to broader consumer applications, increasing overall market penetration.

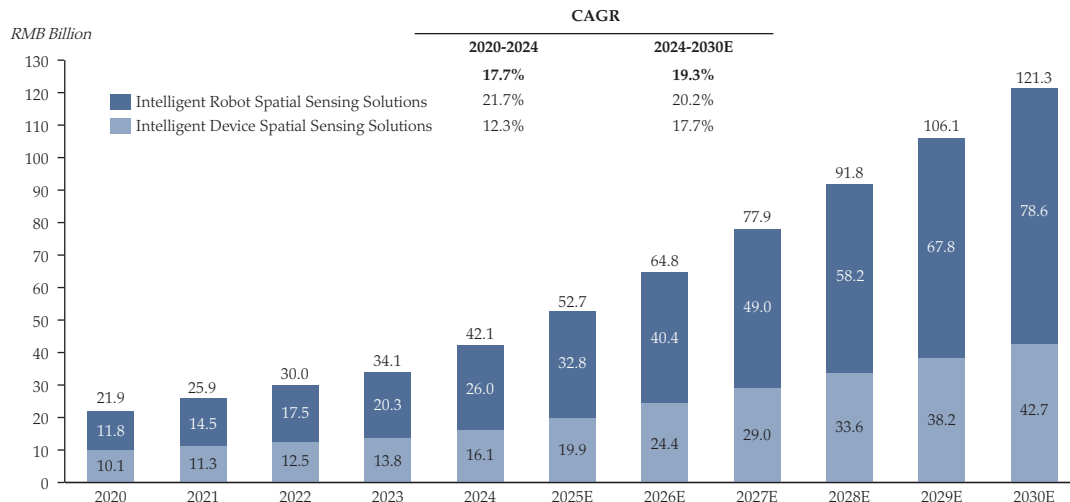
THE GLOBAL SPATIAL SENSING SOLUTIONS MARKET

Spatial sensing technology serves as a core capability that enables environmental perception, precise positioning, and autonomous interaction, increasingly forming the foundation for advanced functionalities in both intelligent robots and intelligent devices. With continuous advancements in AI, multi-sensor fusion, and edge computing technologies, spatial sensing solutions are playing an increasingly vital role in applications such as navigation, obstacle avoidance, and task execution for intelligent robots, as well as environmental understanding and immersive interaction for intelligent devices, collectively driving technological iteration and market expansion. The global spatial sensing solutions market are typically categorised into two main sectors by application scenarios, intelligent robot spatial sensing solutions and intelligent device spatial sensing solutions.

INDUSTRY OVERVIEW

The global spatial sensing solutions market size increased from RMB21.9 billion in 2020 to RMB42.1 billion in 2024, representing a CAGR of 17.7%. The market is expected to maintain positive growth momentum, with a projected CAGR of 19.3% from 2024 to 2030, and is anticipated to reach RMB121.3 billion by 2030. The Company held a market share of approximately 1.0% in the global spatial sensing solutions market by revenue in 2024.

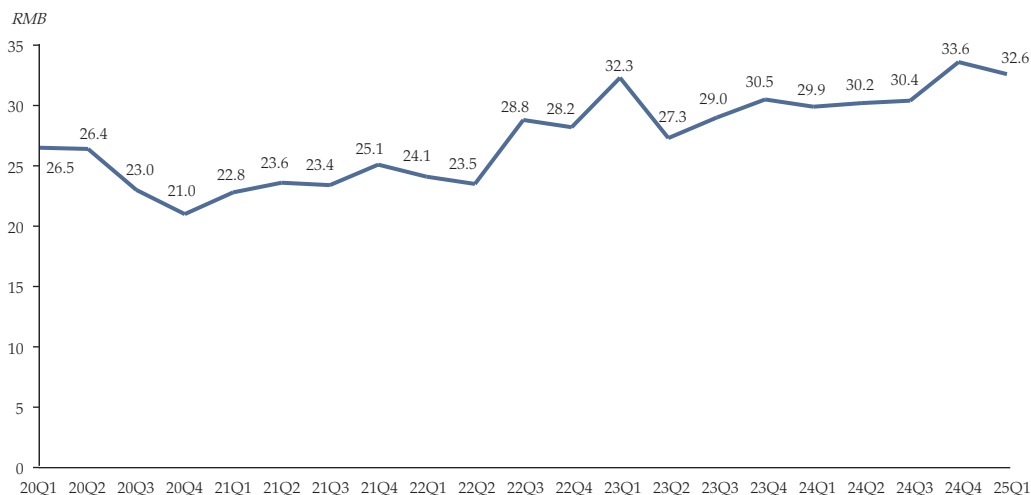
Global Spatial Sensing Solutions Market Size, in Terms of Sales Revenue, 2020-2030E



Source: International Federation of Robotics, IDC, CIC Report

COST ANALYSIS OF CORE COMPONENTS

CMOS Image Sensors (CIS) are important raw materials for the Company. The following chart shows the historical price trends of global CIS chips from Q1 2020 to Q1 2025:



Source: WSTS, CIC Report

From 2020 to early 2022, global CIS average selling prices declined due to pandemic-driven demand contraction and a higher mix of mid-to-low-end products, before gradually recovering with work-from-home demand and rising automotive penetration. From mid-2022 to early 2023, CIS prices rose sharply on higher wafer costs, supply constraints, and structural demand from automotive, security and premium smartphones. Since the second half of 2023, as inventories normalized and demand from automotive, industrial vision and high-end smartphones remained stable, CIS prices showed moderate recovery, followed by a sequential decline in Q1 2025 amid increased supply and softer demand. CIS chips are widely used across consumer electronics, automotive, industrial vision and other sectors, with the Company primarily purchasing and utilizing consumer-grade CIS chips.

INDUSTRY OVERVIEW

SOURCE OF INFORMATION

CIC was commissioned to conduct research, analyze and prepare the CIC Report on the global market for intelligent robot spatial sensing solutions, along with other related economic data. The commissioned report has been independently prepared by CIC without influence from us and other interested parties. We have agreed to pay a fee of RMB500,000 to CIC in connection with the preparation of the CIC Report.

During the preparation of the CIC Report, CIC conducted both primary and secondary research through a variety of resources to obtain in-depth knowledge, statistical data and industry insights regarding market trends in the target sector. Primary research involved interviews with key industry experts and leading market participants, while secondary research collected publicly available sources such as publications issued by the Chinese government, annual reports released by relevant industry players, information from industry associations and CIC’s proprietary database.

The findings and projections presented in the CIC Report are based on the following key assumptions: (i) the overall global social, economic and political environment is expected to remain stable over the next decade; (ii) major industry drivers will continue to support the growth of global intelligent robot spatial sensing solutions market throughout the forecast period; and (iii) there will be no force majeure event or regulatory transition that could significantly disrupt or fundamentally alter current market dynamics.

Directors’ Confirmation

Our Directors confirm that, to their best knowledge after making reasonable enquiries, there has been no adverse change in the market information presented in the CIC Report since the date of the report which may qualify, contradict or have an impact on the information in the Industry Overview section.