

# Current Status and Future Trends of Robotics: Literature Review

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## Abstract

**On the basis of querying and reading a lot of information about robots, according to the different application fields, the robots are classified, and the application status of various types of robots are analyzed respectively. After in-depth understanding and thinking, the possible development of robots is proposed. in future.**

## Keywords

**Industrial robots; Service robots; Special robots; Future trend.**

## 1. Introduction

With the continuous development of science and technology, robots and related industries have sprung up rapidly, and social productivity has also developed rapidly. The application of robots in industry, agriculture, medical care, education and other fields has brought earth-shaking changes to human production and life.

There are many ways to classify robots, which can be divided into industrial robots, service robots and special robots according to their uses. The application field of the robot determines the shape, volume, control method and other factors of the robot, and these factors determine the degree of difficulty of the required science and technology, so the application status and future development trends of various robots are not the same.

## 2. The development status of robots

### 2.1. Development status of industrial robots

Industrial robots are multi-joint manipulators or multi-degree-of-freedom robots used in industrial production. They can help people complete simple and repetitive tasks such as welding, handling, spraying, assembly, and welding. The reason why industrial robots are widely used in logistics and transportation, automobile manufacturing, electronic assembly, metal processing, chemical engineering and other fields is because compared with traditional human labor, it not only improves labor productivity, but also improves the safety of the production process. Improve the stability of quality and reduce the input of natural resources and human resources. With the widespread use of industrial robots, some people are also worried about the loss of labor jobs, fearing that it will cause large-scale unemployment. But time after time technological reforms have proved that this kind of unemployment caused by technological innovations will not happen. We can see that, while industrial robots replace laborers, they also create a large number of new jobs, such as robot operation posts, automation integrator, robot research and development posts, and these posts require people to undergo short-term training or It is long-term learning to be competent. Therefore, in this regard, robots not only improve production efficiency and improve the working environment, but also improve the overall quality of the people, which is conducive to the development of human society.

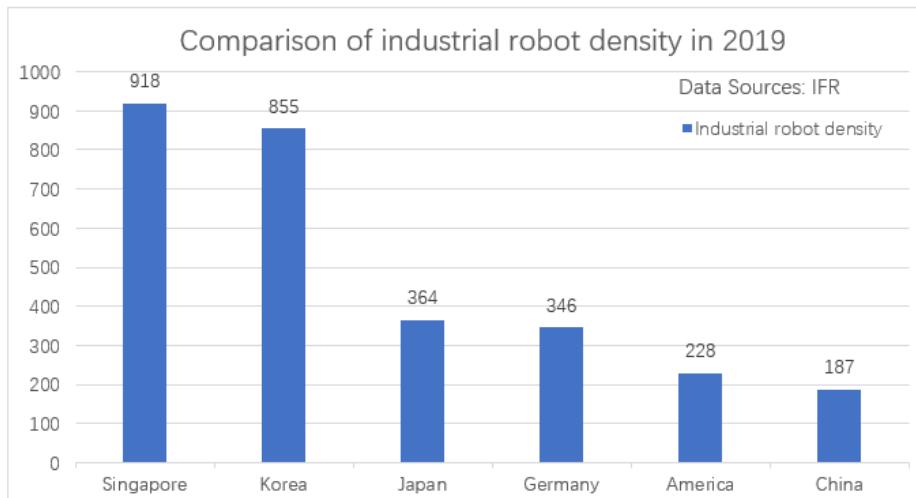


Figure 1: Comparison of industrial robot density in some countries in 2019

The report on industrial robots issued by the International Federation of Robotics (IFR) on September 24 shows that there are more than 2.7 million industrial robots in use in factories around the world. It is used to measure the manufacturing level of a country). Singapore has the highest robot density in the world, which has reached 918 units per 10,000 people, followed by South Korea's 855 units per 10,000 people and Japan's 364 units per 10,000 people, as shown in Figure 1. The number of industrial robots owned by China per 10,000 workers is 187, ranking 15th. Compared with developed countries in the world, the density of industrial robots in my country is relatively low. As a result, my country is a major manufacturing country in the world in applying industrial robots. There is still huge room for development, and humans will still be the main market for robot sales in the next few years. From the perspective of the sales of industrial robots, Japan occupies more than 50% of the world's market share, among which FANUC and Yaskawa Electric, the four major families of industrial robots, account for 30.2%. ABB of Switzerland and KUKA of Germany together occupy about 20% of the market share. About 70% of newly installed robots in China come from foreign suppliers, and local brands only occupy a small part. However, with the rapid development of my country's robotics industry, the gap between my country's independent brands and foreign industrial robot brands is getting smaller and smaller. The market share has gradually increased in recent years, so we are full of confidence in the future of domestic industrial robots.

## 2.2. Development status of service robots

Service robot is a kind of semi-autonomous or fully autonomous robot. The service work it is engaged in can make humans survive better and make equipment outside the manufacturing industry work better<sup>[1]</sup>. Service robots are mainly used for services, covering a wide range, including medical rescue, logistics handling, housekeeping services, maintenance and other aspects. High service efficiency and low labor costs are the two major advantages of service robots over traditional service industries.

As a young member of the robot family, service robots have a late start, but due to advanced science and technology and complete prior knowledge, various countries have made some achievements in research in this area. Among them, developed countries such as the United States, Japan, South Korea, Germany, and France have been particularly successful. Prominent, for example, the personal partner robot PaPeRo launched by Japan's NEC company is only 38 cm high, but it is equipped with a high-speed computer processor, high-definition camera, microphone array, ultrasonic sensor, etc., which can recognize natural language and communicate with humans. Conversation can move safely in an unfamiliar environment without collision. At the same time, it can also form different "characters" through learning from

the surrounding environment. In addition to the partner robots in Japan, there are also the remote monitoring robot ConnectR from iRobot in the United States, the home robot Care-O-Bot developed by Fraunhofer IPA in Germany, and the security robot Mostitech robot launched by the Korean mobile operator SK Telecom.

Compared with developed countries in the United States and Japan, my country's research on service robots started late. However, with the implementation of the national 863 plan and the national key research and development plan, my country's research in the field of service robots has also made some achievements. At present, the service robots developed and sold in my country mainly include security robots, nursing robots, cleaning robots, educational robots, and medical robots. Siasun Robot Automation Co., Ltd., affiliated to the Chinese Academy of Sciences, has developed an intelligent inventory robot, which uses laser SLAM fusion visual navigation technology, combined with cloud big data platform, RFID inventory system, etc., which can realize the construction of environmental maps of more than 10,000 square meters. Autonomous walking, autonomous obstacle avoidance, autonomous charging, can be used for cargo location guidance, cargo inquiry and cargo inventory in warehouses, shopping malls and other scenarios. This year, the new crown epidemic has spread across the world, and service robots have been on the stage of fighting the epidemic with their unique advantages and played a huge role. During the epidemic, service robots were widely used for spraying disinfectants, propaganda of epidemic prevention knowledge, epidemic data analysis, body temperature monitoring, and instrument operation. 'Xiao' robot performed outstandingly in the fight against the "epidemic", and therefore won the service robot "Outstanding Contribution Award for Anti-epidemic Pioneer". This is not only a recognition of 'Xiao' robot's digital war against the "epidemic", but also artificial intelligence in the epidemic. The strength of prevention and control is reflected.

### 2.3. Development status of special robots

Special robots refer to robots that are used in professional fields to complete special tasks. They are generally operated by professionally trained personnel and can assist or replace humans in performing tasks. Special robots are professional service robots other than industrial robots, public service robots and personal service robots. They mainly include: pipeline robots, underwater robots, agricultural robots, electric robots, nuclear industrial robots, fire-fighting robots, military robots, etc.

Special robots have a special application field and can help people complete some tasks that humans cannot complete or have high risk factors, such as working in a pipeline environment. Military robots, such as unmanned submarines and military drones, are of great strategic significance to the country. Therefore, the research of special robots has a profound impact on personal safety, economic development, and national security.

my country has also achieved certain results in the research of special robots. Sinsong Robot Automation Co., Ltd. developed an underground detection and rescue robot with life detection function in 2009, which can be used for disaster rescue work. In addition, Siasun Robotics has also developed a serpentine arm robot with (24+1) degrees of freedom, which is mainly used in small spaces and harsh environments. It can also be used with different tools to complete the cooling of nuclear power plant reactors. Pipeline maintenance operations, search and rescue operations for people trapped at the earthquake site, and reconnaissance of military targets over obstacles in the field of vision, etc. RXR-M40D-GT02 fire-fighting robot is a kind of fire-fighting robot developed by Shandong Guotai Technology Co., Ltd. that integrates the functions of fire detection, fire fighting, cooling and chemical pollution decontamination. It can be used in petrochemicals, large warehouses and other high-temperature , Strong radiation, easily collapsed places. In 2017, the Institute of Optoelectronics Technology of the Chinese Academy of Sciences, the Chinese Academy of Engineering Physics and Southwest University of Science

and Technology jointly independently developed a nuclear radiation-resistant robot. Generally, the robot will fail immediately in a strong radiation environment, the material will age, the camera will have a black screen, and the control chip will be destroyed. The robot can resist up to ten thousand sieverts of nuclear radiation and can work normally in a high temperature environment. Equipped with complex crawler and wheel axle device, it has flexible movement ability and can shuttle freely in special terrain. The special anti-radiation robot can not only be used for the rescue work of nuclear explosion accidents, but also can be used in the inspection and maintenance of nuclear power plant facilities by installing different mechanical tools to avoid the dangers caused by manual inspection and repair. In terms of military robots, my country already has ammunition destruction robots known as "security guards in the depths of the grasslands", the mountain four-legged bionic mobile platform "Big Dog", small combat robots, and EOD robots "Hexi", which are used for warship maintenance. Underwater flaw detection robots, large-scale strategic UAV "Xianglong" and other military-purpose robots.

### 3. The future trend of robots

#### 3.1. Intelligent robot

From automation to intelligence is the development direction of robots. How to make robots more intelligent has always been a problem that people are studying. In recent years, the development of artificial intelligence technology is booming, combining AI technology with robots, allowing robots to imitate human learning and understanding capabilities, so that robots have certain judgment and decision-making capabilities and realize intelligent development.

#### 3.2. Human-machine integration

Wang Tianran, an academician of the Chinese Academy of Engineering, said that "human-machine integration" means that humans and robots can work in the same natural space, can work closely together, can improve their skills autonomously, interact naturally, and ensure safety at the same time. Human-machine integration is still a trend in the development of robots. After the realization of human-machine integration, the relationship between robots and humans will change, that is, from a slave relationship to a partnership.

#### 3.3. 5G technology

As a wireless transmission technology with low latency and high reliability, 5G technology has a positive effect on the development of robots. The high transmission rate of 5G can realize the delay-free transmission between sensors and robots, between robots and robots, and between robots and engineers, so that robots can react faster and truly realize human-machine integration. 5G technology can also realize remote control and monitoring of robots, making it possible to remotely control robots in real time.

#### 3.4. Application of new materials

The application of new materials can enhance the strength of the robot, reduce the weight of the fuselage, and even change the way of energy transmission of the robot, thereby expanding the scope of application of the robot. As for the current rapid development of autonomous driving, the use of new materials can improve its endurance. With the continuous birth of new materials, the development of robots will enter a higher stage.

### 4. Summary

In summary, the robot has high operating efficiency, low labor cost, wide application range, and broad development prospects. With the improvement of science and technology, robots will

inevitably develop towards comprehensive, intelligent, and market-oriented development, and the era of human-machine integration is bound to come. We admit that compared with developed countries, my country's robots are relatively late in development and weaker in intelligence, especially in industrial robots. However, with the continuous growth of my country's hard power and the unremitting efforts of scientific researchers, in the near future, my country's Robotics will catch up with developed countries.

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