New Development of Service Robots in Japan

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Abstract: The development of service robots in Japan is introduced in this paper. Through the analysis of professional service robots and personal / family service robots with various structures, the future development direction of service robots is clarified. It is shown that the development route of service robots in Japan is instructive to enhance China's national core competitiveness.

Keywords: Japanese robot; service robot; home service robot

1. Introduction

Service robot is an important branch of robot [1]. It is a strategic high-tech product integrating machinery, electronics, control, materials, biomedicine and other disciplines. It plays an important supporting and leading role in the development of related technologies and industries. Service robots can be divided into two categories: professional service robots and personal and family service robots, with a variety of structural forms, including humanoid (foot type, wheel type), pet type, wheelchair type, wearable type, etc.

On the one hand, with the intensification of the aging trend and the acceleration of the pace of life in various countries, home service robots have begun to enter thousands of households. On the other hand, service robots will be more widely engaged in various production operations instead of people, so as to liberate human beings from heavy, repetitive and monotonous production operations that are harmful to health and dangerous. Therefore, in recent years service robots in the global professional field mainly meet the needs of aging society and services for the disabled, youth education, daily life entertainment and new lifestyles, and the market is huge. At present, the countries leading the global research and development of robot technology mainly include the United States, Japan, Germany, South Korea and China. The suppliers include not only international well-known companies such as Honda and NEC, but also many small or medium-sized high-tech enterprises with characteristics such as iRobot, Cyberdyne studio and JLM [2].

2. Japanese Service Robots

From a practical point of view, Japan places robots serving human life in an important position. In 2001, Japan established key application fields of robots, including social life, medical welfare, public utilities, biological industry and manufacturing industry. It is predicted that the potential market scale will reach 9.7 trillion yen by 2035, and the share of nursing, auxiliary and medical products in service robots will expand rapidly [3].

Figure 1. A robot exactly like Professor Ishiguro in the Institute of intelligent robots, Osaka University, Japan.

Japan's service robots are in full bloom and have expanded to all aspects of social life. The guiding concept for the development of service robots in Japan is to "establish a symbiotic society in which people interact with robots". To promote the research on the symbiosis between human and robot, the goal is to realize the social autonomous robot. For the developed robot, a comprehensive Turing Test will be carried out to evaluate its human characteristics, which can be used for dialogue assistance in elderly nursing, communication training and learning assistance with healthy people as objects, etc.

In terms of humanoid robots, Professor Ishiguro in the Institute of intelligent robots, Osaka University, Japan developed a robot exactly like himself in 2006 (Figure 1) and was listed in the "best invention of 2006" of Times magazine in the same year. The robot is driven by compressed air and small driver, and all kinds of actions and expressions are vivid. Actroid, a humanoid reception robot developed by Kokoro company in Japan in 2005 (Figure 2), has artificial muscles and can make human like expressions of joy, anger and sorrow according to dialogue. The psychotherapy seal robot Paro developed by Japan Institute of industrial technology (Figure 3) is a pet robot with advanced intelligent system. It is very sensitive to sound, light, temperature and body contact, and can understand simple sentences. At present, Paro has been introduced into medical treatment in more than 10 countries, which can accompany patients with Alzheimer's disease and children with autism and

congenital stupid diseases. The robot PaPeRo Petit developed by NEC (Figure 4) focuses on Humanized Interface and achieves the purpose of caring for the elderly or children [4].

Figure 2. Actroid, a humanoid reception robot developed by Kokoro company in Japan.

Figure 3. Paro, a psychotherapy seal robot developed by Japan Institute of industrial technology.

Figure 4. PaPeRo Petit, a robot caring for people developed by NEC in Japan.

The Yurina CareRobot developed by JLM (Figure 5) can not only help people get up, but also drive automatically as a wheelchair to serve the elderly and the disabled. Toyota has launched a robot "walking practice assistant" and "balance practice assistant" (Figure 6) to provide assistance for walking and other rehabilitation training, as well as a "life assistance robot" to help the owner complete life chores such as picking up falling objects in family life.

Figure 5. Yurina CareRobot developed by JLM to serve the disabled people in Japan.

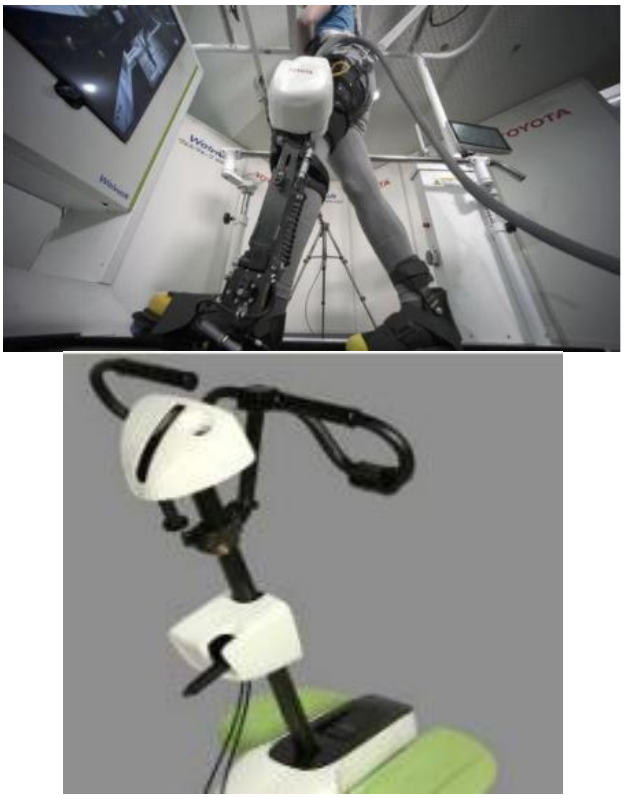

Figure 6. Walking practice assistant (upper) and balance practice assistant (lower) robots developed by Toyota, Japan.

Figure 7. Walking assistant robot developed by Panasonic, Japan.

Figure 8. HAL-5, an exoskeleton robot developed by Cyberdyne company, Japan.

Figure 9. Archelis, a "walking chair" robot developed by Nitto, Japan.

In 2016, Panasonic developed a "self-supporting stand-up walking assistant robot" (Figure 7) to help patients get up, get out of bed and walk, and a "care system" to detect the actions of the elderly. HAL-5 exoskeleton robot developed by Cyberdyne company (Figure 8) can assist the wearer to complete daily movement, heavy object handling and other work. It has been successfully applied to patients with muscle weakness, stroke and spinal cord injury. Nitto has developed the medical "walking chair" Archelis (Figure 9), which can reduce the muscle fatigue of doctors during surgery. The intelligent wheelchair robot while is very different from the traditional wheelchair, like a friendly toy. The shape is small, with a width of only 60 cm, a length of about 80 cm and a turning radius of 70 cm. The two front wheels are respectively composed of 24 independent small wheels. This structure ensures that the front wheels can move laterally and greatly reduces the turning radius [5].

Figure 10. A pneumatic manipulator with five fingers developed by Squse Company of Japan.

Figure 11. 3D printing bionic EMG artificial limb Hackberry developed by Exii Company of Japan.

In terms of service robot manipulator, Squse Company of Japan has developed a pneumatic manipulator with five fingers (Figure 10), which can take soft objects such as food without breaking. Exii Company of Japan has launched 3D printing bionic EMG artificial limb Hackberry (Figure 11). Its 3D data and circuit board data are all open source, which can be downloaded from anywhere in the world and produced by 3D printer. Japan Electric Equipment Company has launched the automatic tracking support arm iArmS (Figure 12). This product can firmly support the doctor's wrist at rest and track the movement of the wrist quickly during movement, so as to reduce the vibration and fatigue of the doctor's wrist [3].

Figure 12. iArmS, an automatic tracking support arm launched by Japan Electric Equipment Company.

In addition, there are: Laundroid, a laundry robot with folding skills; Lightbot, a blind guide robot that can avoid obstacles; Swing Lift Cocoro, a wall storage care robot; a "robot toilet" equipped with an automatic wiping arm;

Raku Vest, an auxiliary mechanical arm that makes agricultural work easier, etc. More service robots are under development [6].

3. Conclusion

Japan takes service robot as a strategic industry and gives strong support. Due to the increasingly serious aging of the population, the inward driving force for the development of service robots in Japan is strong. Service robot is an integral part of modern manufacturing and service industry. Learning from the development route of service robot in Japan is also of great significance to enhance China's national core competitiveness.

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