The Design and Development Status of Service Robots in Human-Aid Activities

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Abstract. The breakthrough in artificial intelligence technology and the decreased cost of core robot components have accelerated the perception of service robots in various fields. The application scenarios of service robots are complex and diverse, including retail, logistics, medical care, education, security, etc., to achieve diversified and complex functions. Artificial intelligence technology is an important determinant for service robots to achieve substantial progress in the next stage of development. Thus, in this paper, three typical types of service robots, including domestic service robots, outdoor service robots, and the service robot for the elderly and relevant technology advancements are introduced and discussed. It could be concluded that the development of more compatible materials and the controller and sensor technology can effectively improve the sensitivity of the robot and the ability to adapt to complex environments, thus improving the diversity of functions, the convenience of use, and accelerating the commercial application of robots. The paper provides constructive suggestions for the development of service robots in the future and hopes to accelerate the large-scale popularization of service robots.

Keywords: Service Robot; Domestic Robot; Robot for Elderly.

1. Introduction

There are many demands for robots today, and this is one of the most important causes of the development of robot technology. The people who do not have enough time to do the housework because of the fast rhythm pay for most of their time at work and on the way to work. These need robots to help them deal with these problems. Also, robots can help people cook meals. Many young people today do not know how to make meals, which is very inconvenient for them in their daily lives. Robots can help them do this; they only need to give the robots the materials, which helps people a lot. The robots can even use to take care of older adults. In the present society, more and more older people stay at home alone without caring for their children because people nowadays are too busy and may not have time to take care of their elders. These robots can help take care of the eating problems of the elders and help them with walking [1]. So, robots are a good choice for these people to offset their absence. And robots can also make up for the lack of the labor force during COVID-19. This can be used in the medical region or in some factories. The robots used in these conditions can help to give the patients some tests on their health and do some simple work like turning the screw in the factory. These robots do much work to help keep the basic running of society. For the different needs of people, robots develop different uses which can be widely used in human society.

Nowadays, with the rapid development of modern technologies, many new electronic products appear, and robots are one of them. In this kind of environment, artificial intelligence is a very good direction to make some creative inventions and create benefits. So many people take this subject as work. So, in recent years, innovation in this area has been very significant. Since the invention of artificial in the 1950s, more people have accepted artificial intelligence and used it at home or work. During such a long period of time, artificial intelligence has developed a lot of advanced technologies. Robots with artificial intelligence have a lot of fantastic abilities like machine learning, which enables robots to learn about human behavior or other things they need. And natural language processing is a technology that enables artificial intelligence to distinguish human language and realize the efficient communication between humans and robots.

For the variable types of robots used by people in daily life, this passage talks about the function of three types of robots. They are domestic robots, outdoor robots and service robots for the elderly. This passage also introduces some technologies developed and the situations for these three types of robots. This passage supposes to give some advice for the future development of service robots and give some solutions to social problems like the lack of labor, the need for a high-quality life for people and the aging of the population.

2. Domestic servicing robots

This kind of robot appears in people's homes and is used to help people do the housework and take care of people. Domestic robots can help people a lot and release their pressure. Domestic robots also have several types; some robots help to do housework, robots that accompany children and help them learn, robots that can help disabled people and robots that can control electrical appliances [2]. Robots help people do housework, like robot mops, which are widely used worldwide. And many companies like iRobot and ECOVACS pay much attention to robot mops. A kind of typical domestic cleaning robot is shown in Figure 1.

Fig. 1 A kind of domestic robot for house cleaning purposes

The robot mops have an ultrasonic transducer and infrared sensor to detect the landscape and avoid making some damage. There are three types of interaction technologies used in this robot. They are obstacle sensors, cliff sensors and wall sensors. Obstacle sensors can analyze how the robot moves when it crushes obstacles like table legs or chairs. This ensures that the robots can continue working in a way without stopping by some barriers. The cliff sensor is used to ensure the safety of the robots. This sensor emits an infrared wave or ultrasonic wave to the ground in front of it to detect if there is any cliff on its way. When the robots move near the edge of the stairs or other cliffs, they will see the cliff and move away from it to avoid falling to the ground and causing some damage. And the wall sensor uses infrared light to detect the position of the wall in the room. This technology is used to keep the robot working away from the wall and avoid hurting the wall. Besides the three sensors, the robot mops also have a technology helping the robots to plan the way to pass through [3]. The robots use laser radar to measure the shape of the house and analyze how to move to sweep all the space in the room and successfully move without being stopped by some barriers. The brush of the robots will assemble the dust and other dirty things to the admission port and keep the floor clean. This robot is easy to manipulate and very efficient, so many people like this robot. And robots can help children learn [4]. This kind of robot is a kind of small robot. They can be putting on the table and singing songs to children or answering children's questions. This robot uses artificial intelligence to deal with the information received and satisfy people's requirements. They are very useful to help children study and have a happier childhood. Some domestic robots help disabled people to live more

conveniently. Some people cannot stand and walk because they have some leg problems or are too old to walk. This is very inconvenient in their daily life. However, robots can solve this question. The walking assistant robots receive the electrical signal of the human muscle and do the corresponding movement. This can help disabled people walk by themselves, which can let them avoid some illnesses brought by a long time of lying on the bed. Finally, the intelligent housing system. This system can allow the user easily controls their house. They can use the internet to open the air conditioner, television or other electric appliances when not at home.

3. Outdoor service robot

There is also a huge amount of demand for robots for outdoor work. People can use these robots to help them work and avoid wasting time on simple and easy work. When people play sports, robots can help them practice. For example, the pitching machine, when people need to practice their ping-pong, tennis or badminton skills, the pitching machine could serve the ball to the people. This let the practice more efficient and more convenient. There are even some robots that can play simple sports with humans. They can play simple football and basketball. This technology can be better in the future. And robots are also used to serve people in their lives. It could be seen that robots in many places play the servant role. They can listen to the order of people and give out some answers or some service. This kind of robot can more easily be seen in hotels and restaurants. And these robots all use artificial intelligence to work and analyze the data. AI uses hash rate, arithmetic and data to analyze the questions. Artificial intelligent use the data to learn, and through arithmetic, the artificial intelligence can get the output and do what it needs to do. And the hash rate is the basis for the calculation of the intelligence [5]. The amount of hash rate influence how fast the artificial intelligence will give the response. Besides satisfying people, outdoor robots can also do dangerous and difficult things that are very hard for people to do. Like outdoor security and inspection robot, these robots can finish some patrol work for people. This kind of robot has a camera on its top to record the facial data of people, and the thermal surveillance system will also measure the characteristic of people. This system will collect the heat difference between people and the environment and form a figure of people. These two systems can let the robots recognize the face of people less than 50 meters. The robots can also use for exploration. The robots can reach someplace people cannot reach because of too narrow or too dangerous. They can use their sensors to detect the landscape or other information about the place they detect. This will help people a lot in finding mineral projects, analyzing geography problems, detecting landscapes or even helping save people [6]. Outdoor robots can do many things and help people in different ways. These technologies will continue developing in the future and can be used in more complex situations. A kind of outdoor service robot is shown in Figure 2.

Fig. 2 A kind of outdoor service robot for excise purposes

4. Service robot for elderlies

When people become old, there will many problems appear in their bodies. They have difficulties in moving, eating and many other daily things. They need external forces to help them complete their basic need for living. According to these demands, service robots for the elderly have been born. As the United Nations defined, a country has over seven percent of people over sixty-five years old in an aging society and over fourteen percent in an aging society. It seems that most countries today belong to the range of aging societies. So, in this condition, the service for elders takes a more and more important role [7]. However, with the increasing number of elders who need to care about, it is difficult for people to fit all the need of these elder, for both do not have enough labors and cannot fit all the elders' demands. Thus, many companies have started focusing on artificial intelligence to bring innovations to the pension industry. The robots that help the elder can be coarsely divided into machines that help elders with their activities and robots that accompany them. These robots can solve the physical and mental problems of older adults.

For the machine that helps elders with their activities, scientists mainly focus on three-part: static systems that operate in a structured environment, wheelchair-mounted robotics systems for personal and care applications and mobile manipulator companions following the person. An example of robots designed under these three technologies is the MATS (flexible mechatronic assistive technology system robots) [8]. The purpose of this robot is to combine statistics and a mobile system to create a multiply use robot that can manage the housework of the users. This machine uses a Docking Station to connect to the wheelchair and enable it to move around. The MATS robots also use a modular design to let the robots move freely in the room.

The big range of the robot which can move is very meaningful to the old and disabled people. The structure and design of the robot itself are also very important causes of the freely moving of the robots. At the end of the robot, there is a connection point that is used to connect with the wheelchair, and the robot is divided into two parts: the arm of the robot and the electronic devices that deal with the images and data. As for the robots which enrich the elders' mental lives, there are also some outstanding robots like T-Rot, which can sensitively detect where it is and deal with the language information from the users [9]. This is also very useful for the elders to spend their time and have a better life. These robots all help the elders who have some disability in daily life to live easier. They can successfully finish their work. This robot will make the elders do what they want to do more efficiently. It helps to solve the question brought by the tendency of an aging society, releasing

pressure on people to take care of their elders. It is also security in elders' life if their children do not have time to take care of them [10]. The clamping robot arm for the elderly is shown in Figure 3.

Fig. 3 A kind of service robot for the elderlies

5. Conclusion

Artificial intelligence will have more developments in the future. The technologies of robots still have a lot of space to innovate. For the technologies in the future, I think there will still be many creations in the sensor to detect the surrounding environment. Not only for the landscape but also for the temperature or humidity and many other external effects. This can help the robots work in different environments and help people in more areas, which will further contribute to human society. Besides the detection of the environment, the development will also focus on communication with people because serving people is the main goal of the robots. Information from people and distinguishing and dealing with the language information is very important. It is related to whether artificial intelligence can give a reliable answer to the users. This may be a challenge to the scientists. The foreground of the robots maybe to give out the help of robots to people in more and more conditions like working in a complex mountain range or dealing with more complex data. In my opinion, the difficulties the artificial have to overcome is how to collect information about animals. The robots can also help people when they are studying animals, and how to infer what the animals mean is a challenge to the robots. For robots to serve humans, I think they should consider flexibility of robots since they can do more precise work and help people more. And the similarity of the robots also needs to be controlled because they are not human. The goal of the artificial is to serve humans, the above suggestions can make people more comfortable when they receive the service from the robots.

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