The Application of Robotics in the Field of Service from the Investment Perspective

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Abstract. Just as the industrial revolution, which brings significant change and boom to the development of productivity, the robots in the service industry are highly possible to adjust and regenerate the current business. However, many technological workers are still experimenting with applying artificial intelligence to the services, lowering the cost of the service robots. The paper aims to determine the investment opportunity by exploring the role of service robots will play in the future. This paper uses PEST to offer the general situation of the current service robotics industry. It finds out the specific problems that existed in the immature industry and market. Finally, the paper sheds light on a few solutions and analyzes venture capital and optimal funding for technological startups. For the other researchers, it is better to investigate the overall potential value given by the service robots and people's expectations of service robots. In this way, the view toward the investment opportunity will be more comprehensive and incisive.

Keywords: Service robots · Investment opportunity · PEST · General situation

1 Introduction

1.1 Background

A service robot is an ancient concept. As early as 1985, the first service robot product of TRC company founded by Engelberg was the "nurse assistant" robot used in hospitals, which began to be sold in 1990. In these three decades, with the development of the times and the progress of science and technology, human beings have made a qualitative breakthrough in service robots. The popularity of robots is also slowly increasing. They often appear in many public places, such as hotel meals, hospital surgery, etc. They reduce the operating costs of some enterprises and replace part of the labor force.

Service robots are mainly divided into five categories: household service robots, consultation and explanation service robots, logistics distribution robots, unique field service robots, and humanoid giant flexible robots. Our research will analyze the small

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F. Balli et al. (Eds.): ESFCT 2022, AEBMR 226, pp. 545–556, 2022.
https://doi.org/10.2991/978-94-6463-052-7_64

bracelet and manufacturing chain of previous and current service robots, find the fatal problems that service robots face, and try to give practical solutions. Our analysis will give people who invest in service robots a better understanding of this industry. Our research results will be indispensable to the field of service robots. If service robot companies want to make a qualitative leap, they need to understand my research and partially adapt our solutions [1].

1.2 Related Research

Li et al. mainly explained the impact of robotics on the hotel industry. The emergence of machines driven by artificial intelligence and robot technology has dramatically impacted the hotel industry. It will replace some people's jobs, thereby raising the unemployment rate. Bowles' 2014 forecast shows that 54% of European occupations can be computerized through rapid automation. A 2015 study by Chui et al. found that AI and robotics could directly replace 45 percent of American jobs in the future [2]. Sanchez et al. conducted in-depth research on robots and divided robots into four types: medicine, video processing, manufacturing, and housework. The author mentions the history of robotics and shows the latest robotics and their models. In addition, the author discusses the prospects of current robotics [3]. Bush et al. described the benefits of using robots for surgery, including reducing pain, shortening hospital stay, and faster recovery to the body quality and level of losing money. Compared with humans, the surgical robot has higher flexibility and can move without shaking. In addition, robots can use optics and surgical visualization to improve the accuracy of surgery without the traditional direct vision of the naked eye or television microscope. It reviews the history and development of these operations and the current situation and future direction of robotic heart surgery [4].

Abitbol et al. showed people's investment in robotic surgery and its use in recent years. It introduces the patients and events using robotic surgery and clinical results between 2003 and 2016. Finally, it is concluded that robots in gynecological tumors can reduce the cost in time [5]. Blöcher and Alt described that with the development of the catering industry, the catering industry and the hotel industry have gradually changed under the influence of artificial intelligence. It analyzes the current situation and application of artificial intelligence in the catering industry and puts forward a systematic process innovation potential identification method. It makes a detailed analysis of the catering market in Europe [6]. Allan et al. showed that the global population is proliferating, and the need for robots that provide the elder capability to live independently is increasing rapidly. It reports the latest technology for this kind of robot, the problems and challenges of the robotic devices, and the investment prospect in this area [7].

Schraft has researched and concluded that the robotics application in the service industry is not mature enough. Making peripheral changes to existing industrial robotics seems impossible to put service robotics into use; instead, new structure and technical approaches will be necessary. Schraft predicts that the number of service robots will increase as a consequence of the increase of people in the service industry [8]. Ivanov illustrates the popularity of the current robots in the service industry through the applications in hotels, restaurants, theme and amusement parks, meetings and events, airports, car rental, travel agencies and tourist information centers, and museums and galleries.

Automation in tourism is adopted now, but not all service processes can be automated. The primary drivers for the adoption are productivity, accessibility, and service augmentation [9]. Berezina lists quite a few examples of robotics in restaurants, such as biometric identification, robots at the back of the house, and the service robots in the front. Berezina concludes that any form of automation will decrease the cost and increase efficiency, no matter whether the company is big or small. However, if establishments can adopt some technologies that make sense, it will improve the whole service [10]. Mourtzisa et al. research that the Maintenance of manufactured products is widespread in 2017. Modern manufacturing enterprise is shifting their focus from products to PSS. The main goal of this project is to develop a service system. Through collaboration between site technical personnel and manufacturer, AR technique remote maintenance is implemented. Many manufacturers have developed and tested augmented reality remote maintenance platforms that provide PSS maintenance services [11].

Berezina et al. research that robots are more widely used in various industries. The research will introduce the application of RAISA in the catering industry and analyze this application the advantages and challenges. AI and robotics significantly impact the restaurant industry, both for good and evil. Further research and review of robots in the catering industry are needed. Finally, achieve full automation [12]. Doelling et al. research is about home service robots. However, robots are not commercially available on a large scale. There are some research challenges and deficiencies. Research supports an initiative to build advanced intelligent homes for disabled military personnel and their families. Finally, home automation is realized [13].

1.3 Objective

This paper describes the PEST analysis of the robot market and finds out the four major problems that service robots are facing now, including the particular requirement of service robotics on the environment, difficulties of R & D results' commercializing, high cost caused by technology bottlenecks and low penalty, as well as the natural causes of the problems [1]. The following article describes two methods to solve the previous four problems and how to implement them.

2 Pest Analysis

2.1 Political

In recent years, the technology and demand for service robots have grown year by year. Our country also put forward a series of relevant government policies to promote the development of service robots that hope to realize the commercialization of service robots. Services robots have included home service robots and professional service robots. So we need a wide range of service robots. The Chinese government also pays attention to the progress and development of artificial intelligence technology. Artificial intelligence technology has become a national strategy, leading to the future of artificial intelligence technology having extensive prospects.

Artificial intelligence's scale is close to 50 billion yuan in 2020, resulting in the robotics market ushering in a new opportunity. Chinese steady economic growth and

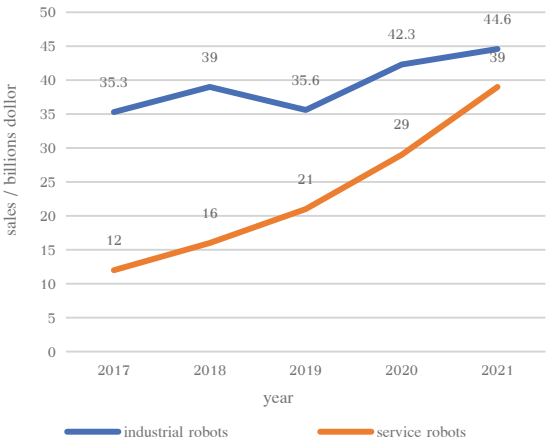

Fig. 1. The sales of robots in the Chinese market

favorable policy support also benefit the market development of service robots. For the development of robots, our country promulgated "the 13th Five-Year Plan" in March 2016 to thrive industrial robots, service robots, surgical robots, and military robots, promoting the commercialization of artificial intelligence technology in various fields. Our country promulgated "The 13th Five-Year Plan for National Science and Technology Innovation" in July 2016, conquering the core component association technology, industrial robots realize industrialization, and service robots realize productization. Our country promulgated the "Intelligence Manufacturing Development Plan (2016–2020)" in September 2016 to promote service robots research and development and industrialization. Moreover, other relevant policies are all to promote the development of service robots [14].

2.2 Economic

As with the more development the countries are, the distribution of funding in the tertiary industry keeps increasing these years, bringing a potential market for the service robots. Just as the industrial revolution started in the 18th century, which brought tremendous benefits and saved a massive labor force, so too it is predicted that the robots in the service industry nowadays will benefit the society. Today, our economies appear to be approaching a tipping point in the service sector, akin to the industrial revolution, because technologies are fast becoming more intelligent, more powerful, and less expensive (Fig. 1).

Indeed, The global scale of economies of the service robots is approaching that of industrial robots from 2015 to 2019 at a rapid rate. This indicates the adoption growth of service robots. The impact of service robots on the economy on a global scale is hard to investigate now. However, we can conclude and predict it from countries with high adoption of service robots, investigating the change in their economy. In the case of Japan, a country with extensive robot use. Because robots increase productivity and

expand demand in all industries, resulting in higher product and labor demand in the industry, the macroeconomic general equilibrium effect is always highly positive.

To be more specific, service robots have economies of scale. Because most of the expenditures are incurred in their creation, robots and AI-delivered services provide significant economies of scale and breadth. For example, physical robots are a fraction of the cost of hiring more people, while virtual robots may be deployed for pennies on the dollar. Virtual service robots (such as chatbots and virtual agents) may be scaled at almost no cost. Not just virtual service robots like chatbots, but even 'visual' ones like holograms, have such remarkable scalability [15].

2.3 Social

In 2020, the global workforce first declined in decades from 3.456 billion to 3.388 billion for many reasons, including the decisive factor, Covid-19. According to the data from International Labor Organization, ILOSTAT database retrieved on February 8, 2022, the global population ascended from 7.683 billion to 7.762 billion in 2020, which means the global workforce has a share of the global population declined significantly during these three years [16]. Among these, the most notable is that since 2012, the number and proportion of China's workforce population have dropped for seven consecutive years. According to the International Labor Organization, China's population is aging, and the labor supply is constantly decreasing [17].

At the same time, the average world wage is climbing since the education level of the global population is growing, which means the general labor costs are rising.It is worth noting that the absolute index of the average wage of Chinese employees has been higher than 100 in the past ten years. According to the Fig. 3, it has been overall climbing, indicating that the average wage of employees has been on the rise; that is, the labor cost is constantly rising [18].

The trend of population aging, the continuous reduction of labor supply, and the increase in labor costs bring severe challenges to social development and enterprise employment. These factors jointly promote the acceleration of the demand for machines to replace the workforce and serve human beings.

2.4 Technological

The vast majority of military robots have two characteristics: artificial intelligence's image recognition and positioning ability.

Image recognition technology is significant to the service robot. Image recognition technology allows the robot to have a pair of sensitive eyes. Through the camera installed on the robot body, the image data is transmitted to the image recognition server through real-time video streaming transmission. The server analyzes and processes the data through the core machine vision algorithm and finally feeds the results. The front end of the robot responds according to the feedback results. At present, image recognition will be affected by the lighting environment, video jitter, decorations, etc. If the image processing server is placed in the cloud, the requirements for network broadband and response speed are very high. If the server is placed inner the robot, performance, cost, and energy consumption also need to be considered.

Positioning is one of the essential abilities that service robotics need to have—the majority of positioning and navigating use the technic of Simultaneous Location And Mapping (SLAM). Usually, the robot sensor may create a map structure at any time. However, using a single sensor is hard to detect complicated circumstances, so using multi-sensor fusion is the future [19].

3 Challenges

3.1 The Special Requirement of Service Robotics in the Environment

Recently, service robotics have specific requirements for the environment where they can be used. Firstly, most service robotics cannot face harsh weather. Their parts can easily be damaged by wind, sun, or rain, so it is impractical to use robots outdoors according to current technology. The service robot needs to move on the flat ground in a relatively closed environment. Moving on uneven ground may affect the judgment of the sensor and make wrong instructions. Service robots can be seen everywhere in the Beijing Winter Olympic Games, including inspection and epidemic prevention robots, guidance robots, and meal delivery robots from the Winter Olympic village to various competition venues. However, these robots execute instructions in a closed environment [20].

Secondly, service-type robot intelligence can only complete the standardized process. For example, in this epidemic, Chinese hospitals used service-type robots to deliver drugs to patients, which significantly reduced the contact between doctors and patients, thus reducing the risk of the epidemic.

Thirdly, the human influence on the outside world is immeasurable and preventable. For robots, humans may be one of the reasons that prevent them from completing their tasks. This is because people are curious about new things. For example, when people see service robots in hotels, they always want to touch them, leading to unclear instructions [21].

3.2 Difficulties of R&D Results' Commercializing

On the one hand, the subject of the market and the holder of core technology are different. Technology research and development in service robotics mainly relies on universities and research institutes currently. However, because they are not market subjects, their research and development results are often unable to be transformed into products quickly. At the same time, as market subjects, enterprises often have weak technology research and development capabilities. They have not cooperated closely with research institutes and universities, so they are challenging to industrialize. Therefore, service robotics cannot exert its market value of technological achievements well.

On the other hand, the transformation of technological achievements of service robotics is slow. There are three main reasons for it: First, most of the technological research and development results in this field are theoretical and less practical. Second, the achievements have low scientific and technological content, which means they can be substituted easily, and the transformation effect is poor. Third, the industry still lacks

unified standards for products. Due to this, many service robot enterprises only stay in the sense of conceptual products, using the support of relevant policy to realize their capital operations. Some of them are unable to provide suitable products or even copy the achievements of others directly, which seriously affects the industry level of the entire global market [22].

3.3 High Cost Caused by Technology Bottlenecks

High cost is also one of the service robotics industry's bottlenecks. Service robotics encounter more complex application scenarios than industrial robotics, which determines that it inevitably needs to interact with people frequently. To make the interaction between robots and people in the best state, high-precision sensors, AI algorithms, chips with high computing power, and stable network transmission are indispensable [21].

However, the supply chain of service robotics exposes many shortboards leading to the high cost in these four aspects. First, the cost of high-precision sensors is high because there are only a few automatic lidars in the world. If enterprises want to import components into China, it will cost tens of thousands of dollars [23]. Second, chips with high computing power for service robotics are always in short supply. Since 2020, the growth of sweeping robots has far exceeded the quota given by raw material suppliers of chips. The main reason is that microcontroller chips (MCU), which are very important in raw materials, cannot support shipments. In China, the price of highly scarce chips in the market has risen nearly ten times. Some scarce ones used to be 6 yuan apiece now it is more than 50 yuan [24].

3.4 Low Penetration

One of the biggest problems that service robotics companies face is the low popularizing rate because civilians lack the knowledge of service robotics. On one side, companies can hardly advertise their product in an enormous scope, owing to the broad subdivision. On the other side, software technology, hardware technology, development, and Maintenance of robots need money to maintain. In addition, this is a comprehensive product integrating several key technologies, so its own production cost determines its high price.

However, most robots that can be used in the family are relatively low-cost floor-sweeping robots. The expensive nursing robots and companion robots are still rarely used by people. The actual food delivery robot can only be used in large enterprises or hotels. Therefore, the popularity of robots has become a big problem. Due to the low popularize, people's concept of service robots has changed. Initially, people invented service robots to serve humanity and simplify people's lives. However, service robots have become mascots in many places due to the low penetration rate and are even very easy to be ignored. For example, the guiding robots are most often seen in shopping malls and other places; although people can see them, few people will use them, and more people will use them as decorations [22].

4 Solutions and Advice

4.1 Penetration of Service Robots

All the time everyone hopes service robots can more quickly and better to development. It can truly become a part of our life. Then it can make our life more convenient and fast. In recent years, the aging of the population and the severe shortage of labor force are the problems we are facing. Moreover, this has also led to increased demand for service robots. Government and capital also start more research and development in artificial intelligence robots. Moreover, it makes the intelligence robots industry that is more fully recognized and understood by the public.

4.2 Technological Innovation of Service Robot

The innovation of service robots has two main impacts on the environment. The first is laser navigation technology. Such as the application of laser navigation technology in floor mopping robots. This technology has greatly improved the floor mopping robots. The old robots swept everything insight, and the robot itself does not know what it is scanning. However, since we have this technology, the robot can come into the room and scan the whole room to build a map of the room. In this way, the robot can clean regularly and know where needs to clean, and take the steps to clean the floor. The new technology compared to the previous floor mopping will be a lot of advances. The main problem with environmental factors is that they can only be used in a closed environment, not a wide range of use. With laser navigation technology to better identify obstacles, it can also be identified and applied in an unsealed environment [25].

The second is machine vision. The advantage of machine vision is that it has great flexibility and a degree of automation. Machine vision has a significant advantage over the human eye, it can instead human eye location, recognition, measure, and detection. And more accuracy, objectivity, adaptation, reliability, and efficiency than the human eye. Machine vision covers much ground, such as optics, mechanical engineering, computer, science, etc., the applied range is very wide. Currently, machine vision is mainly used application in the field of automation. In the detection of the object, it can be more quickly and accurately to complete the detection. Relative to the human eye work efficiency has obvious improvement. Machine vision can also be part of the solution to the needs of a particular environment. Because it can more accurately measure the nearby environment, to find some advantages and disadvantages. This technological innovation and expansion have effectively convenience given us life to some extent, also it is going where we want to go [26].

4.3 Promising Areas in Service Robotics

At first, to make enough profit, the investment companies can focus on the logistical companies, which require highly standardized processes and are filled with repeated work with heavy loads [27]. The robots such as the AGVs (automated guided vehicles) in the logistics industry could significantly reduce labor force costs and improve efficiency. The following will explain these two benefits in detail. If the service robots operate 24 h

a day, the investment in deploying them is amortized significantly faster. The investment in logistics service robots is returned in about 23 years, and such a system lasts around 15 years. Operating expenses are about 24 percent of the yearly investment; operation availability is about 98.5 percent, high productivity, optimized costs, and processing time. Furthermore, the robotics with exceptional environment adaptability food appears to have more advantages in the service robotics markets. The food-delivery robots and dish-cleaning robots are good examples of these. The food-delivery robots mainly in the hospitality mainly depend on their function of detecting roads, moving on flat grounds, and connection with the Internet of the hotel, which is relatively easy compared to other sophisticated robots. The dish-cleaning robots mainly have the function of maneuvering the brushes and controlling the water flow in different designed ways. These examples illustrate that robotics catering to the customer's real needs can bring success to the business. Therefore, it is better to focus on and invest in logistical robotics that can adapt to particular circumstances.

Some people argue that robots specializing in a closed environment with standardized working conditions can have their full effect. They use the example of the supermarkets in the Chinese market: There are only a few robots, such as guiding robots and food delivery robots, because people tend to the personalized services with added emotional values provided by the real people. However, scholars have found that the acceptance of the customers is mainly based on how well the robots can deliver the functional needs and the social-emotional and relational needs to achieve the role congruency [28]. This illustrates that robots instead have a promising future in the frontline services such as restaurants and airports if companies can produce high-quality robots with the ability to finish different work.

4.4 The Entrepreneurial and Administrative Management After Financing

Because the development of service robotics is a slow and gradual process, venture capital, which focuses on the high reward in 3 to 10 years, is an optimal choice for the robotics companies. After the robotics companies succeed in gathering the funding from the financial companies, the management of the financial organizations toward the technology companies is essential and significant because it reduces the risks by tracking and abandoning the failed projects. There are different views about the effects of financial leverages on the entrepreneur's management practices. Some view it as unnecessary, and others consider it a practical tool to improve a company's efficiency as it is reported that in the Chinese capital market, most private equity or venture capital companies lack a professional consultant team for startup companies. However, as the capital market becomes more and more competitive, the consultant team is turning into a powerful tool for venture capital to attract startup companies. For example, private equity companies may provide better choices for employees of the companies or help convert technological innovation into business products. In general, most PE-backed buy-outs increase both entrepreneurial and administrative management practices, illustrated in research mainly based on the cases in the Netherlands [29]. Therefore, service robotics companies would better find a venture capital with profound plans and advice for development and management to sustain and improve their efficiency.

5 Conclusion

This paper uses PEST to analyze the service robot industry. Then we also analyzed the service robot industry, which has four challenges. The first one is The Special Requirement of Service Robotics on Environment. The second was Difficulties of R&D Results' Commercializing. The third is High Cost Caused by Technology Bottlenecks. The fourth is Low Penetration. Moreover, to their four problems are explained, write the reasons. We also provide two solutions to the above problems. One is to solve some problems that cannot be applied due to the special environment and the low penetration rate of service robots from the aspect of technological innovation. The other is from Promising Areas in Service Robotics and Entrepreneurial and Administrative Management after Financing. To make the service robot known to everyone, we need to increase the research and development of technology and innovation and strive to achieve commercialization as soon as possible. Let the service robot come into our lives and become a part of our lives.

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