EasyChair Preprint

№ 1652

The Development of Smart Pension with Benefits and Challenges

Siqi Xin, Juan Li and Yueming Wang

October 13, 2019

The Development of Smart Pension with Benefits and Challenges

Siqi Xin
Software Department
Beijing University of Technology
Beijing,China

Juan Li
Software Department
Beijing University of Technology
Beijing,China

Yueming Wang
Software Department
Beijing University of Technology
Beijing,China

ABSTRACT

Nowadays, the aging of population is a problem faced by most countries in the world. With the continuous decline of fertility rate, the aging of population is becoming increasingly serious, and the number of empty elders is increasing day by day. The traditional pension mode can no longer meet the current diversified pension needs. With the rapid development of Internet technology, it has become a trend to rely on information technology to solve practical problems. Therefore, smart elderly care has become a key research direction at present. This paper analyzes the technology development status of smart pension, proposes the benefits and challenges brought by smart pension, and provides a reference for the development of smart pension industry.

KEYWORDS

Smart pension,Internet technology,Benefit challenge

1 INTRODUCTION

At present, many countries in the world are facing the problem of aging population. In China, with the rapid economic development, people's living standards have been significantly improved. With the improvement of living environment, equipment and facilities, and communication technology, the elderly have better conditions for old-age care. At the same time, the medical level is increasing day by day, medical equipment and conditions are constantly improved, and the average life expectancy of the elderly is extended, which causes the aging problem of China's population increasingly severe. According to China's national statistics, at the end of 2018, the total population in China was 1395.38 million, with 166.58 million people aged 65 or above, accounting for 11.9% of the total population and 16.8% of the elderly dependency ratio[1]. Similarly, most European countries, the United States and Japan have similar demographics. Overall, such trends suggest that by 2050 20% of the world's population will be over 60 years old[2]. With the rapid aging of the population, the problem of providing for the aged is particularly prominent, which not only aggravates the national economic burden, but also has an impact on social stability. Therefore, it is urgent to solve the problem of providing for the aged. However, the traditional pension model can no longer support the current pension problem. Every country is actively carrying out the smart pension model, combining the Internet with pension, and changing the traditional single pension model.

Wisdom endowment concept first put forward by the British trust life, Chinese scholars Zuo Meiyun. define smart pension refers to the use of information technology and other modern technology, such as the Internet, social networks, Internet, mobile computing, etc., around the old man's life daily life, safety, health, entertainment, leisure, health, learning, sharing and so on various aspects the life of the aged support services and management, to the old information automatic monitoring and early warning and disposal actively, implement the technology and the elderly friendly, autonomous, personalized intelligent interactive[3], smart pension and combined with the existing resources in the communities, families, To provide safe, convenient and effective new old-age services for the elderly. The United States, Japan, Germany and other countries have developed early in the field of smart old-age care, with relatively mature technologies. They can provide more professional old-age care services for the elderly through remote monitoring, medical assistance, Internet of things, sensors and other technologies, which can be used as a reference for research in the field of smart old-age care.

This paper aims to propose potential problems and Suggestions in the field of smart pension by analyzing the mode and technology development status of typical countries, and finally make a summary to provide references for scholars in the field of smart pension.

2 RESEARCH METHDOLOGY

2.1 Database Selection and Search Strategy

In this study, involving in the field of computer Science and engineering, social Science and health, so we have a wide range of related database search, in Scopus, Web of Science, CNKI, ScienceDirect as data source, to the theme "" smart care" AND "elderly" or the theme of "" smart home" AND "elderly" for retrieving conditions, retrieval nearly five years of the article, through reading and screening, finally get to 88 references.

2.2 Data Filtering

Firstly, the articles searched were screened by category, and only academic articles related to smart pension and smart home were retained, while interview records, newspaper and magazine articles were excluded. Secondly, the second selection is conducted on the titles and abstracts of selected articles one by one, according to the criteria of whether they are related to the wise elderly care and whether the technology is applied, so as to directly read high-quality articles that are closely related to the topic of the paper when reading the literature later. In the end, the whole article was read after two rounds of screening. According to whether the technology used in the article is of reference value in the field of smart elderly care, the article related to the application of smart elderly care and technology was screened for the third time, so as to facilitate subsequent research and analysis.

2.3 Literature Analysis

Through the final screening, the obtained papers are analyzed in the following aspects. The analysis for the year shows the results in Figure 1. In 2016-2018, the number of papers published in the field of smart pension is the largest, and the number of papers published in 2014 is the smallest. It can be seen that in the past two years, with the rapid development of artificial intelligence, the

application of smart pension in technology Increasingly.

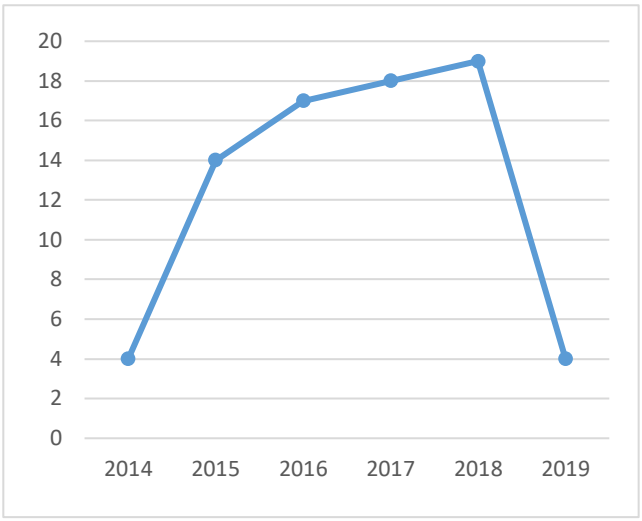

Figure 1：Distribution of literature by year published

The results of the analysis in Figure 2 show that countries are vigorously developing the pension industry. Among them, the United States, South Korea, India, and Australia have published a large number of documents, and the research results are rich.

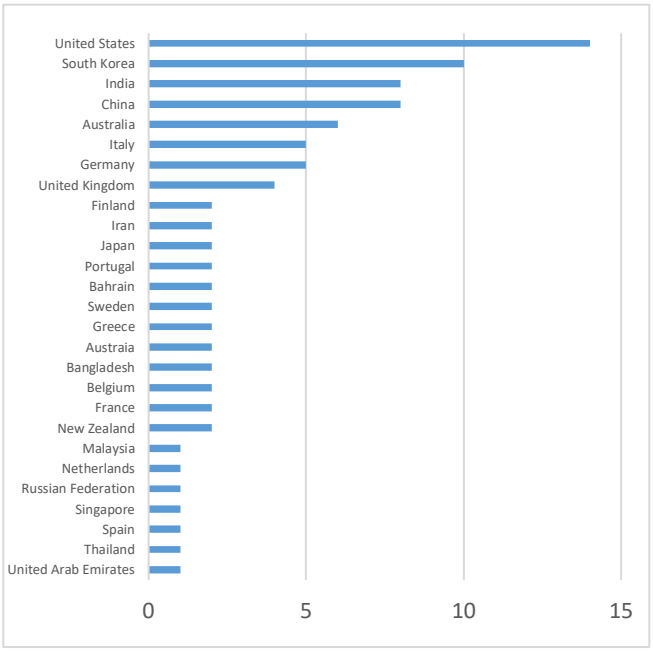

Figure 2：Documents by country

Most of the articles in the field of smart pension are related to the fields of computer science, engineering, medicine, etc. The analysis results in Figure 3 show the subject areas of the paper.

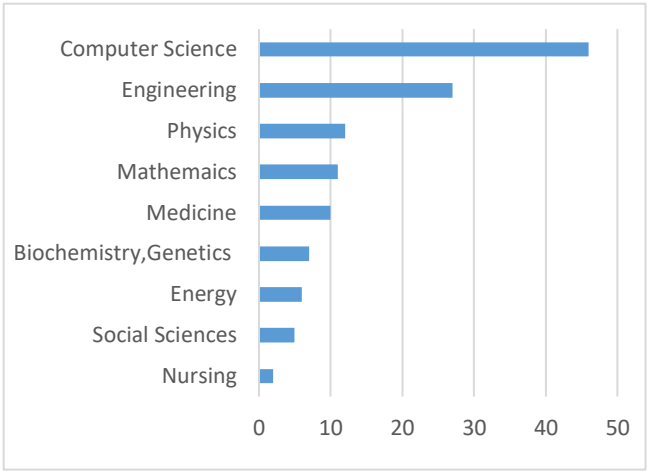

Figure 3：Documents by subject area

In smart elderly care, information technology is mainly used to provide intelligent services. In terms of technology application, the Internet of things and sensors are mainly used for technical support in smart home. Wearable devices are small in size and easy to operate, which can be used in intelligent elderly care. The analysis results in table Figure 4 show the application types of smart pension technology.

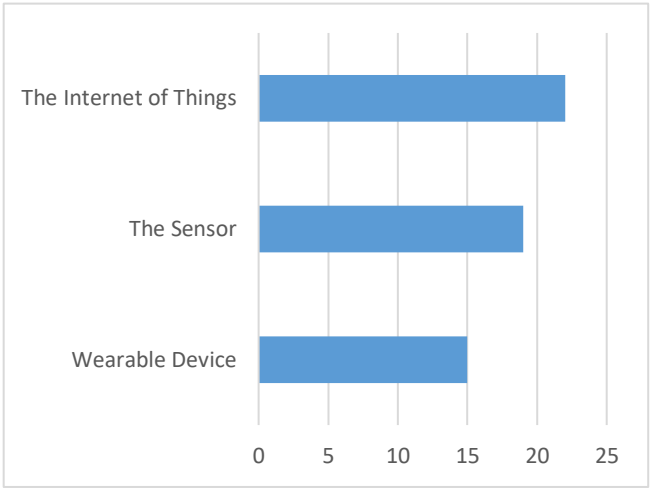

Figure 4：Documents by technology type

3 CURRENT PENSION MODEL

The aging of the population is a serious problem faced by many countries. The choice of the pension model is one of the important ways to solve the problem of aging. China is a typical populous country in developing countries, and the problem of aging in recent years is particularly serious. Due to past traditional ideas and closed production methods, family pension has become the main way of providing for the elderly. With the rapid development of the national economy, a single way of providing for the elderly can not meet the current problems of old-age care. Therefore, the addition of the socialized pension model has become one of the main ways to solve the problem of old-age care [4]. The state has also strengthened the construction of various civil welfare and

welfare homes, providing social care services for urban and rural elderly care, such as life care, culture, nursing, and fitness [5]. The United States is a representative country in the West and has also entered an aging society. In the United States, older people live in apartments after retirement, and community pensions and institutional pensions have become the main form of old-age care in the United States [6]. The community aged care service is quite large, and it is designed to be a one-of-a-kind pension. There are various clubs and courses to provide more elderly care for the elderly. There are three types of institutional pensions in the United States: technical care and care for the aged care institutions, intermediate care and care for the elderly, and general care for the elderly, to cater for the needs of the elderly, to meet the multi-level service needs of the elderly [7]. At the same time, the United States has also established a relatively complete and continuous database of health information science engineering, which can quantify service objectives and quality standards to objectively evaluate the quality of service of various aged institutions [8]. As one of the countries with the highest proportion of the elderly, Japan provides the corresponding nursing services for the elderly, so that a large number of elderly people who cannot take care of themselves can enjoy their old age. Japan's pension model is mainly for institutional pensions. The government provides a large number of pension facilities within the welfare range. It also encourages women to go out to work, and the government helps to take responsibility for aged care[9]. In this way, the pressure on children is reduced and the fertility rate is increased. .

By analyzing several typical countries, it can be seen that home pension, community pension and institutional pension are the ways of pension that different countries choose according to their national conditions. Under the problem that the elderly population is numerous and many countries are entering an aging society, how to apply these three old-age models to the national pension is the most important. Nowadays, science and technology are developing rapidly. In the context of smart cities, the use of scientific and technological means to solve the problem of old-age care will help the development of the old-age field. Therefore, each country is committed to the development of smart and old-age care, and provides better and safer services to the elderly in a better way.

4 DEVELOPMENT STATUS OF SMART PENSION TECHNOLOGY

With the aging of the population, a single pension model can no longer solve the problem of aging, and the rise of smart pensions has brought a new pension model for the aged care industry. Wisdom pension mainly uses information technology to assist in old-age care, and can monitor the elderly 24 hours a day, and timely warning to prevent the harm caused by unexpected events to the elderly. Wisdom care provides services for the elderly through the following technologies.

4.1 The Internet of Things

The application of Internet of things in the smart home can help the elderly. Intelligent home technology allows users to automatically control household equipment through the Internet, communicate with various digital devices based on the Internet of things, and effectively provide services for users[10]. The Internet of things is a network of physical devices connected by sensors, software and network in the home. Systems in the smart home, such as lighting and switches, are managed by the Internet of things[11].

Ghasemi, F. et al. propose a framework-based approach based on the Architecture Trade-Off Analysis (ATAM) approach—a health-care architecture smart home system that analyzes and evaluates software system architectures to quickly and timely diagnose environmental incidents and Health risks, meeting quality attributes such as safety and interoperability, providing a better health care system for the elderly[12][13]. An intelligent mat based on the Internet of things, connected with multiple sensors, is used for remote monitoring of elderly people living alone or medical care users, which is used to collect sleep time and sleep quality data, and send the data to guardians for remote monitoring [14][15]. Saraubon, k. et al. proposed an intelligent system for elderly care developed by the Internet and mobile technologies, which is based on the fall detection of accelerometer, and realizes remote video monitoring, voice commands and heart rate monitoring on mobile devices [16]. Liu,Z. Et al. proposed an application based on the Internet of things and connected to the community monitoring center, which can monitor the health status of the elderly in the community, provide reasonable health plans for the elderly and improve the medical quality of the elderly[17][18][19][20].

Aiming at the application of Internet of things technology in the field of intelligent pension, Chinese scholar Qu wei et al. proposed to build an intelligent pension system based on the Internet of things by using the Internet plus Internet of things technology to solve the problems faced by the elderly in China. This system also includes intelligent pension medical subsystem, intelligent pension entertainment subsystem, intelligent pension shopping subsystem and intelligent pension restaurant subsystem[21]. All four subsystems obtain data through Internet of things technology and store them in the community cloud center. After the cloud center analyzes the data, it returns to each subsystem to complete the pension service. Yu-qiong zhang put forward constructing disability elderly intelligence service platform, platform mainly relates to the terminal layer, network layer, platform layer and service layer, including smart home, intelligent rehabilitation facilities, remote visit system, perimeter alarm equipment, recreational equipment, etc., to realize online, convenient and timely understanding of the elderly health and lifestyle information, at the same time, it can meet the personalized needs of old people[22]. In addition, the internet-based smart home access system can send photos of visitors to family members via the Internet through hardware deployment, where image processing technology is applied to connect with the Internet to ensure the safety of the family[23].

The Internet of things technology used in smart home relies on point-to-point connection for most communication protocols. Therefore, network connection between various devices and applications in home automation system is the key[24][25]. The application of the Internet of things module in the social network platform can collect environmental and physical user data, so that medical and nursing personnel can supervise the living conditions of the elderly[26]. The Internet of things can also be combined with the medical system, and can be based on better care for the elderly in medical aspects[27][28]. A health care system based on the Internet of things can monitor and register important information of patients and provide a mechanism to trigger alarms in an emergency[29][30][31].

4.2 The Sensor

The application of sensors can greatly improve the technical level in the field of intelligent pension, and provide more accurate and comprehensive technical support. In the field of sensor application, some scholars have done a lot of research.

Ma, x. et al., by deploying EMCS containing sensors in the homes of the elderly, collected data from the sensors and established a binary classification model based on random forest, analyzed the sleep quality of the elderly, and then analyzed the physical conditions of the elderly[32]. Takahashi, Y. et al. proposed an Internet of things sensor shaped like handrail as a new sensing system, which can monitor behavioral changes for a long time to determine whether the behavior of the elderly is abnormal and monitor the daily life of the elderly[33]. Gochoo, m. et al. proposed a deep learning classification method using binary sensors to monitor the daily activities of the elderly, and converted the data of the binary sensors into binary active images for training and testing of DCNN classifier, so as to analyze the activities of the elderly and realize the task of elderly care[34]. Hernandez - Penaloza, g. et al. proposed a complete system based on multi-sensor scheme to support the daily activities of the elderly, which includes a set of algorithms for data collection and processing to detect abnormal events and meet the needs of patients with health monitoring and cognitive impairment[35].

The application of sensors in the medical monitoring system can assist the elderly, and various data such as heart rate, temperature, blood pressure and electrocardiogram can be acquired through sensor devices and transmitted to the hands of medical staff and guardians through the Internet[36]. The application of wireless sensor network in intelligent elderly care can better assist guardians and caregivers to take care of the elderly[37]. The wireless sensor network can monitor the target area, and identify the activities of the elderly through a large number of deployed sensor nodes. The innovation and energy saving system based on RFID tags can monitor the daily activities of the elderly, so as to determine the physical conditions of the elderly[38][39]. Wireless sensor network can be used in smart homes to provide care for the elderly. Through sensor devices, their health status can be monitored continuously and medical assistance can be provided in time in case of emergency[40].

In smart home, using the intelligent bed pressure sensor devices can monitoring the pressure of the patients occurred on a regular basis, to prevent a fall from the bed, especially in Alzheimer's patients, most of them can be moved, with such devices can inform nurses whether the old man on the bed, help nurses care for the elderly[41][42]. Deep video sensor can be used to monitor the life of the elderly in an intelligent environment and assist the elderly care in an indoor environment[43]. A new home monitoring system based on cognitive sensor network can also be used in elderly care. The system includes optimum number of cognitive sensors that can be used to detect water flow, electrical equipment and emergency buttons. Cognitive sensors can monitor the information of the elderly by detecting their daily activities in the house[44]. A new packet transmission model based on LoRaWAN intelligent wireless paging sensor network (WPSN) supports real-time elderly care application[45]. The expert system for real-time monitoring of elderly medical monitoring by wireless sensor network can meet the actual health needs of different elderly people[46]. In the smart home applications, a new human body recognition sensor can effectively distinguish multiple residents in the home environment and detect its height as a unique biological feature[47]. Intelligent home assistance system based on streaming media sensor data can assist in the care of the elderly[48].

In terms of fall prevention in the elderly, Bhati, N introduced the design of fall detection prototype based on accelerometer for the elderly, including accelerometer, gyroscope, temperature sensor, pressure sensor and heartbeat sensor, to monitor whether the elderly fall and quickly generate alarm to inform medical staff or relatives[49]. The wireless sensor network can also be used to detect falls of the elderly and send alerts to mobile devices[50].

4.3 Wearable Devices

The application of wearable devices can help community caregivers or guardians look after the elderly 24 hours a day and keep abreast of the elderly. These devices are not only used for monitoring, but can also affect important functions and provide treatment to prevent disease while maintaining comfort. Meanwhile, wearable devices can send the acquired physical information data of the elderly to the central processing unit or medical center, providing timely information of the elderly to guardians and caregivers. Wearable devices are small, easy to operate, unobtrusive, and waterproof, providing reliable and confidential data. According to the statistical results, the attitude of the elderly towards wearable devices has significantly changed, and wearable devices that can be simply worn on the wrist are the most acceptable position for the elderly[51].

Development of wearable sheath, the purpose is by imitating human arm movements and actions to control the robot arm, through the manipulation of the system can provide remote nurse daily, at home or nursing home, for example, can be wearable jacket with sensors to detect and track the wearer's arm movements and actions to obtain information[52]. The SMARTA project develops and tests integrated standard sensors and innovative wearable and environmental sensor systems to remotely monitor the home and detect whether the elderly have abnormal behaviors, so as to provide nursing solutions[53]. Wearable devices can be combined with telemedicine to ensure continued medical care and geriatric care. Elderly people can obtain body data by wearing smart sensor insoles to monitor physical activity and prevent falls[54].

Smart clothes can integrate technology into existing clothes, embed more sensors and realize more functions than smart watches and mobile phones[55]. A health-related smart shirt that measures heart and breathing rates, as well as the wearer's exercise intensity, and can monitor the wearer's state of various physical characteristics[56]. HAR, based on wearable sensors, is increasingly suitable for environmental assisted living, especially for applications involving remote and continuous monitoring of the elderly[57]. HAR accelerometer can be used to identify normal and abnormal activities, such as walking, standing and responding to body pain, so as to better monitor the physical conditions of the elderly[58]. Wearable sensors can objectively evaluate the wearer's body through such activities as changes in gait or position[59]. The frequency of falls and incidence of physical diseases in the elderly are relatively high. Some studies can use wearable devices to quantify limb movements and compare these indicators with the outcome data to judge the situation of the elderly[60]. At the same time, wearable devices can also capture other physiological data, such as vital signs, posture, movement and sleep patterns, and collect a large amount of daily information of the wearer for evaluation to detect early diseases[61]. The gait of the elderly is evaluated by smart bracelet, and the physical condition of the elderly can be obtained by analyzing the data returned from the status of the elderly[62].

The home care system for the elderly based on wearable sensors can be used as a monitoring system through a personal computer. Sensors are used for data transmission, and web services are used for communication between monitoring systems to obtain the physical information of the elderly in real time[63][64].

The wearable intelligent system based on the Internet of things imitates the concept of personal care focusing on health and safety services[65], which can provide better care for the elderly in the field of smart care.

5 THE BENEFITS OF WISDOM AND PENSION

In an age of severe aging, smart retirement can bring long-term impacts, including life and environment, to users. By using smart devices in the daily life of the elderly, it is helpful to pay attention to the health, safety and psychology of the elderly. The benefits brought by wisdom and pension are as follows.

5.1 Health and Safety

In the wisdom of the elderly, through the use of smart home technology to help solve the problem of population aging, help elderly patients with chronic diseases inside and outside to live independently[66]. By using monitoring technology to assist the elderly, the status of the elderly can be provided in real time, and the user can be reminded in time when problems occur[67]. At the same time, the monitoring staff can also remotely monitor the health status of the elderly, identify dangerous situations at an early stage, and provide telemedicine care in times of crisis[68]. When monitoring the physical information of the elderly, nursing staff can remotely manage electronic prescriptions by using electronic cases to help maintain registration and reduce medical errors[69]. In virtual medical technology, remote medical treatment or counseling can be used to replace elderly people with reduced mobility to go to the hospital for treatment, so as to bring benefits to the elderly[67].Using robots at home can also help older people live healthily[70][71]. Adult children can't always take care of their elderly parents. Mobile smart homes can help the elderly, take care of their lives and help the elderly [72].

5.2 Environmental Benefits

Energy efficiency is considered important in home automation. Smart homes have become an advanced technology for reducing and monitoring energy use in residential environments. While using smart devices, advanced equipment is used to control intelligent systems to reduce energy waste, which is more acceptable to users[73]. For example, the automatic lighting control system can not only help the elderly with the same action to turn on or off the lighting, but also reduce energy consumption and increase the convenience and efficiency of the daily activities of the elderly[74]. The implementation of wind, solar, bio-intelligence and geothermal energy[75] in smart home energy systems can save energy and reduce energy costs for consumers. Using wireless network technology instead of wired systems in smart homes can increase flexibility and mobility, reducing costs and energy[76]. Studies have shown that using the Internet of Things in smart homes can significantly reduce costs[77].

5.3 Mental Health

Nowadays, the number of elderly people living alone is increasing day by day, and often the elderly will have loneliness and affect mental health. Using smart devices, the intelligent automation system can provide users with comfort, so that users can be safe and have a better experience. Smart devices can always run without affecting life[78][79]. By using smart devices, the elderly can have a comfortable experience, which is also very helpful for the mental health of the elderly. Studies have shown that smart homes can improve social interaction and help users to feel isolated[80]. With the development of technology, smart-age-related smart devices are expected to become more affordable and comfortable to use over time[81], reducing the loneliness of the elderly and providing a better experience for the elderly.

6 THE CHALLENGE OF SMART PENSION

Although smart pensions bring great benefits in health, environment and safety, they also have certain challenges. In the process of using technology, a large amount of user data will be acquired. In this process, data security issues and privacy issues will occur, and in severe cases, users will be threatened. The main challenges facing smart pensions are the following.

6.1 Security and Privacy

Smart devices used in smart retirement can cause security and privacy leaks. Surveillance equipment used in the community, when abnormal conditions are detected, such as smoke, fuel, personnel trapped, etc., will send an alarm to residents via telephone or the Internet, but at this time will also open the camera of all vulnerable areas. Generate security and privacy issues[82][83]. In smart devices that use the Internet of Things, there is sometimes a risk of attack or access by strangers and malicious unauthorised persons[84]. A large amount of private data is collected and stored during the use of smart devices, which raises privacy and security issues[82]. The risk of privacy violations is a major obstacle in the process of using smart devices to support the elderly[85], which many users cannot accept, which will be the biggest challenge for the development of smart pension.

6.2 Data Management

In smart device applications, data flow between heterogeneous devices and electronic hardware in smart homes can create a risk of failure, which can result in the loss of large amounts of data[86]. In smart homes, many devices can share data, and devices controlled via the Internet may be attacked by hackers to obtain a large amount of confidential data[87]. At the same time, when there is a large amount of private data flowing in the device, the data may be lost during the connection process, resulting in the risk of data leakage[88]. There is a large amount of data circulation between smart home devices. The process of transferring information between the terminal host and the gateway will lose data or be stolen. Therefore, data management is a major challenge in the development of technology in the field of smart care, and more technical talents are needed. Better data management methods.

CONCLUSION

In this paper, we introduce the pension model of typical countries, analyze the technology development status of smart pension in detail, and finally analyze the benefits and challenges of smart pension in the future. Although the development of smart old-age care technology is relatively rich, it can help the safety, physical and mental health of the elderly, save energy and bring environmental benefits. However, smart pension is still facing risks of privacy security and data management, which needs to be improved by technicians in future research. In order to solve the aging problem, smart pension is the future development trend and a breakthrough in the pension service industry, which conforms to the requirements of the new pension model in the information age. By analyzing the current situation of technology and the benefits and challenges in the future, this paper provides ideas for the future development of smart pension industry and promotes the future development of this field towards the direction of scale and intelligence.

REFERENCE

[1] National bureau of statistics of the People's Republic of China.Population age structure and dependency ratio[EB/OL].

[2] (2008, Dec. 1). [Online]. Available: http://www.un.org/News/Press/docs//2007/pop952.doc.htm 2012.

[3] Zuo Meiyun.The connotation, mode and opportunity of intelligent pension[J].Public safety in China.2014,10:48-50.

[4] M U Guangzong. Reform and Prospect of Traditional Pension Plan for the Aged in China[J]. Journal of Renmin University of China, 2000, 14(5):39-44.

[5] Zhang Mingsheng. The Transformation and Innovation of the Pattern of Caring for the Aged under the Aging Tendency[J]. Journal of Shanxi University (Philosophy & Social Science), 2008, 31(3):117-122.

[6] Wan Jiang,Yu Han,Wu Yin. A Comparative Study of Foreign Pension Models - Taking USA，Denmark and Japan as Examples[J].South Architecture,2013(2): 77-81.

[7] Gao Yan.International comparison of institutional pension services.Labor security world,2011(8):48.

[8] Pei Xiaomei. Introduction to long-term care for the elderly[M]. Social sciences academic press, 2010.

[9] UNRISD. The changing shape of the care diamond: The case of child and elderly care in Japan[M]// Understanding the Navstar :.

[10] Gaikwad, P.P., Gabhane, J.P., Golait S.S., 2015. A survey based on Smart Homes system using Internet-of-Things. In: Proceedings of International Conference on Computation of Power, Energy Information and Commuincation (ICCPEIC), 2015.

[11] O. Galinina, et al.Smart home gateway system over Bluetooth low energy with wireless energy transfer capability EURASIP J. Wirel. Commun. Netw., 2015 (1) (2015), pp. 1-18

[12] Ghasemi, F., Rezaee, A., Rahmani, A.M.Structural and behavioral reference model for IoT-based elderly health-care systems in smart home (2019) International Journal of Communication Systems, 32 (12), art. no. e4002, .

[13] Chen W L, Chen L B, Chang W J, et al. An IoT-based elderly behavioral difference warning system[C]//2018 IEEE International Conference on Applied System Invention (ICASI). IEEE, 2018: 308-309.

[14] Jeong, J.H., Kim, J.-S.IoT-based smart mat system for remote monitoring systm of user (2019) Proceedings - 2018 Joint 10th International Conference on Soft Computing and Intelligent Systems and 19th International Symposium on Advanced Intelligent Systems, SCIS-ISIS 2018, art. no. 8716244, pp. 536-538.

[15] Ben W, ZHOU W, LI Z. Research on Distributed Intelligent Mattress on the Internet of Things[J]. DEStech Transactions on Computer Science and Engineering, 2018 (cmsam).

[16] Saraubon, K., Anurugsa, K., Kongsakpaibul, A.A smart system for elderly care using IoT and mobile technologies (2018) ACM International Conference Proceeding Series, pp. 59-63.

[17] Ferreira G, Penicheiro P, Bernardo R, et al. Security Monitoring in a Low Cost Smart Home for the Elderly[C]//International Conference on Universal Access in Human-Computer Interaction. Springer, Cham, 2018: 262-273.

[18] Park S J, Subramaniyam M, Kim S E, et al. Development of the elderly healthcare monitoring system with IoT[M]//Advances in Human Factors and Ergonomics in Healthcare. Springer, Cham, 2017: 309-315.

[19] Guan K, Shao M, Wu S. A remote health monitoring system for the elderly based on smart home gateway[J]. Journal of healthcare engineering, 2017, 2017.

[20] Liu, Z.-J., Tseng, S.-P.Design and Implementation of the Health Monitor for Aged People (2019) Advances in Intelligent Systems and Computing, 834, pp. 139-143.

[21] Qu Wei,Jiao Peiyan,Li Hui.Research of the wisdom community endowment system based on internet of things[J].Journal of Shenyang Normal University (Natural Science Edition),2017,35(01):93-97.

[22] Zhang Yuqiong.Building the Disabled Elders' Service Platform of Wisdom Pension —— From the Perspective of Social Network[J].Scientific Research on Aging,2015,3(06):48-57.

[23] P. Rajiv, R. Raj, M. Chandra.Email based remote access and surveillance system for smart home infrastructure Perspect. Sci. (2016)

[24] Mainetti L, Patrono L, Secco A, et al. An IoT-aware AAL system for elderly people[C]//2016 International Multidisciplinary Conference on Computer and Energy Science (SpliTech). IEEE, 2016: 1-6.

[25] Waltari, O., Kangasharju, J., 2016. Content-centric networking in the internet of things. In: Proceedings of the 13th IEEE Annual Consumer Communications&Networking Conference (CCNC), IEEE.

[26] Miori V, Russo D. Improving life quality for the elderly through the Social Internet of Things (SIoT)[C]//2017 Global Internet of Things Summit (GIoTS). IEEE, 2017: 1-6.

[27] Lee C Y. Smart Wearable Apparatus for Elderly Care[J]. Impact, 2018, 2018(2): 32-34.

[28] Firouzi F, Rahmani A M, Mankodiya K, et al. Internet-of-Things and big data for smarter healthcare: from device to architecture, applications and analytics[J]. 2018.

[29] Pinto S, Cabral J, Gomes T. We-care: An IoT-based health care system for elderly people[C]//2017 IEEE International Conference on Industrial Technology (ICIT). IEEE, 2017: 1378-1383.

[30] Alansari Z, Anuar N B, Kamsin A, et al. The Internet of Things adoption in healthcare applications[C]//2017 IEEE 3rd International Conference on Engineering Technologies and Social Sciences (ICETSS). IEEE, 2017: 1-5.

[31] Lee N E, Lee T H, Seo D H, et al. A smart water bottle for new seniors: Internet of Things (IoT) and health care services[J]. International Journal of Bio-Science and Bio-Technology, 2015, 7(4): 305-314.

[32] Ma, X., Goonawardene, N., Tan, H.P.Identifying elderly with poor sleep quality using unobtrusive in-home sensors for early intervention (2018) ACM International Conference Proceeding Series, pp. 94-99.

[33]]Takahashi, Y., Nishida, Y., Kitamura, K., Mizoguchi, H.Handrail IoT sensor for precision healthcare of elderly people in smart homes(2018) Proceedings - 2017 IEEE 5th International Symposium on Robotics and Intelligent Sensors, IRIS 2017, 2018-January, pp. 364-368.

[34] Gochoo, M., Tan, T.-H., Huang, S.-C., Liu, S.-H., Alnajjar, F.S. DCNN-based elderly activity recognition using binary sensors (2018) 2017 International Conference on Electrical and Computing Technologies and Applications, ICECTA 2017, 2018-January, pp. 1-5.

[35] Hernandez-Penaloza, G., Belmonte-Hernandez, A., Quintana, M., Alvarez, F.A Multi-Sensor Fusion Scheme to Increase Life Autonomy of Elderly People with Cognitive Problems (2017) IEEE Access, 6, pp. 12775-12789.

[36] Chauhan, J., Bojewar, S.Sensor networks based healthcare monitoring system (2017) Proceedings of the International Conference on Inventive Computation Technologies, ICICT 2016, 2, art. no. 7824814, .

[37] Islam T, Mukhopadhyay S C, Suryadevara N K. Smart sensors and internet of things: a postgraduate paper[J]. IEEE Sensors Journal, 2016, 17(3): 577-584.

[38] Xiao, F., Miao, Q., Xie, X., Sun, L., Wang, R.SHMO: A seniors health monitoring system based on energy-free sensing.(2018) Computer Networks, 132, pp.108-117.

[39] Alsinglawi B S, Nguyen Q V, Gunawardana U, et al. Passive RFID Localization in the Internet of Things[M]//Recent Trends and Advances in Wireless and IoT-enabled Networks. Springer, Cham, 2019: 73-81.

[40] Udupa, P., Yellampalli, S.S.Smart home for elder care using wireless sensor (2018) Circuit World, 44 (2), pp. 69-77.

[41] Hong, Y.-S., Kim, D.-Y.A deployment of fsr sensors and its sensing algorithm for implementing a smart bed to prevent pressure ulcers (2018) Journal of Theoretical and Applied Information Technology, 96 (2), pp. 392-399.

[42] Hong Y S. Smart Care Beds for Elderly Patients with Impaired Mobility[J]. Wireless Communications and Mobile Computing, 2018, 2018.

[43] Jalal A, Kamal S, Kim D. A depth video sensor-based life-logging human activity recognition system for elderly care in smart indoor environments[J]. Sensors, 2014, 14(7): 11735-11759.

[44] Gaddam A, Mukhopadhyay S C, Gupta G S. Elder care based on cognitive sensor network[J]. IEEE Sensors Journal, 2010, 11(3): 574-581.

[45] Yang G, Liang H. A Smart Wireless Paging Sensor Network for Elderly Care Application Using LoRaWAN[J]. IEEE Sensors Journal, 2018, 18(22): 9441-9448.

[46] Almarashdeh I, Alsmadi M, Hanafy T, et al. Real-time elderly healthcare monitoring expert system using wireless sensor network[J]. International Journal of Applied Engineering Research ISSN, 2018: 0973-4562.

[47] Mokhtari G, Zhang Q, Nourbakhsh G, et al. BLUESOUND: A new resident identification sensor—Using ultrasound array and BLE technology for smart home platform[J]. IEEE Sensors Journal, 2017, 17(5): 1503-1512.

[48] Chen B, Fan Z, Cao F. Activity recognition based on streaming sensor data for assisted living in smart homes[C]//2015 International Conference on Intelligent Environments. IEEE, 2015: 124-127.

[49] Bhati, N.M.Health based ubiquitous fall detection for elderly people (2017) 8th International Conference on Computing, Communications and Networking Technologies, ICCCNT 2017, art. no. 8204033, .

[50] Chavan S C, Chavan A. Smart wearable system for fall detection in elderly people using internet of things platform[C]//2017 International Conference on Intelligent Computing and Control Systems (ICICCS). IEEE, 2017: 1135-1140.

[51] Y.-M. Fang, C.-C. Chang.Users' psychological perception and perceived readability of wearable devices for elderly people.Behav. Inf. Technol. (2016), pp. 1-8,

[52] Ishac, K., Suzuki, K.Gesture based robotic arm control for meal time care using a wearable sensory jacket (2017) IRIS 2016 - 2016 IEEE 4th International Symposium on Robotics and Intelligent Sensors: Empowering Robots with Smart Sensors, pp. 122-127.

[53] Pigini, L., Bovi, G., Panzarino, C., Gower, V., Ferratini, M., Andreoni, G., Sassi, R., Rivolta, M.W., Ferrarin, M.Pilot Test of a New Personal Health System Integrating Environmental and Wearable Sensors for Telemonitoring and Care of Elderly People at Home (SMARTA Project) (2017) Gerontology, 63 (3), pp. 281-286.

[54] Hubl M, Pohl O, Noack V, et al. Embedding of wearable electronics into smart sensor insole[C]//2016 IEEE 18th Electronics Packaging Technology Conference (EPTC). IEEE, 2016: 597-601.

[55] Priya, A.; Kumar, A.; Chauhan, B. A Review of Textile and Cloth Fabric Wearable Antennas. Int. J. Comput. Appl. 2015, 17.

[56] Hexoskin Wearable Body Metrics. Available online: http://www.hexoskin.com/ (accessed on 12 July 2016).

[57] Attal, F.; Mohammed, S.; Dedabrishvili, M. Physical Human Activity Recognition Using Wearable Sensors. Sensors 2015, 15.

[58] Wu, W.; Dasgupta, S.; Ramirez, E.E.; Peterson, C.; Norman, G.J. Classification Accuracies of Physical Activities Using Smartphone Motion Sensors. J. Med. Internet Res. 2012, 14.

[59] B. Grimm, S. Bolink.Evaluating physical function and activity in the elderly patient using wearable motion sensors.EFORT Open Rev, 1 (5) (2016), pp. 112-120.

[60] M. Marschollek, A. Rehwald, K.H. Wolf, M. Gietzelt, G. Nemitz, H.M. Zu Schwabedissen, et al.Sensors vs. experts - a performance comparison of sensor-based fall risk assessment vs. conventional assessment in a sample of geriatric patients.BMC Med Inform Decis Mak, 11 (2011), p. 48.

[61] X. Li, J. Dunn, D. Salins, G. Zhou, W. Zhou, S.M. Schussler-Fiorenza Rose, et al.Digital health: tracking Physiomes and activity using wearable biosensors

reveals useful health-related information.PLoS Biol, 15 (1) (2017), Article e2001402.
[62] Zhong, R., Rau, P.-L.P., Yan, X.Application of smart bracelet to monitor frailty-related gait parameters of older Chinese adults: A preliminary study.(2018) Geriatrics and Gerontology International, 18 (9), pp. 1366-1371.
[63] Al Hossain M N, Pal A, Hossain S K A. A wearable sensor based elderly home care system in a smart environment[C]//2015 18th International Conference on Computer and Information Technology (ICCIT). IEEE, 2015: 329-334.
[64] Lo B P L, Ip H, Yang G Z. Transforming health care: body sensor networks, wearables, and the Internet of things[J]. 2016.
[65] Karthicraja V M, Prasad V L K, Kruthika U, et al. Smart Wearable Systems for Personal Care with Internet of Things[C]//2018 Fourth International Conference on Biosignals, Images and Instrumentation (ICBSII). IEEE, 2018: 206-212.
[66] B. Reeder, et al.Framing the evidence for health smart homes and home-based consumer health technologies as a public health intervention for independent aging: a systematic review.Int. J. Med. Inform., 82 (7) (2013), pp. 565-579.
[67] S.J. Czaja.Long-term care services and support systems for older adults: the role of technology.Am. Psychol., 71 (4) (2016), pp. 294-301.
[68] M. Khan, et al.Context-aware low power intelligent SmartHome based on the Internet of things.Comput. Electr. Eng.(2016)
[69] C. Cavicchi, E. Vagnoni.Does intellectual capital promote the shift of healthcare organizations towards sustainable development? Evidence from Italy.J. Clean. Prod., 153 (2017), pp. 275-286.
[70] Schwiegelshohn, F., et al., 2015. A Holistic Approach for Advancing Robots in Ambient Assisted Living Environments. in Embedded and Ubiquitous Computing (EUC), In: Proceedings of the 13th IEEE International Conference on, IEEE.
[71] Kan, C., et al., 2015. Mobile sensing and network analytics for realizing smart automated systems towards health Internet of Things. In: Proceedings of IEEE International Conference on Automation Science and Engineering (CASE), IEEE.
[72] L.Y. Mano, et al.Exploiting IoT technologies for enhancing Health Smart Homes through patient identification and emotion recognition.Comput. Commun.(2016)
[73] Lima, W.S., et al. 2015. User activity recognition for energy saving in smart home environment. In: Proceedings of IEEE Symposium on Computers and Communication (ISCC).
[74] Schweizer, D., et al., 2015. Using Consumer Behavior Data to Reduce Energy Consumption in Smart Homes: Applying Machine Learning to Save Energy without Lowering Comfort of Inhabitants. In: Proceedings of the 14th International Conference on Machine Learning and Applications (ICMLA), IEEE.
[75] B. Zhou, et al.Smart home energy management systems: concept, configurations, and scheduling strategies.Renew. Sust. Energ. Rev., 61 (2016), pp. 30-40.
[76] T. Jiang, M. Yang, Y. Zhang.Research and implementation of M2M smart home and security system.Secur. Commun. Networks, 8 (16) (2015), pp. 2704-2711.
[77] P. Rajiv, R. Raj, M. Chandra.Email based remote access and surveillance system for smart home infrastructure.Perspect. Sci. (2016)
[78] Mehrabani, M., Bangalore, S., Stern, B., 2015. Personalized speech recognition for Internet of Things. In: Proceedings of IEEE 2nd World Forum on Internet of Things (WF-IoT), IEEE.
[79] S.T.M. Bourobou, Y. Yoo.User activity recognition in smart homes using pattern clustering applied to temporal ann algorithm.Sensors, 15 (5) (2015), pp. 11953-11971.
[80] M. Chan, et al.A review of smart homes—present state and future challenges. Comput. Methods Prog. Biomed., 91 (1) (2008), pp. 55-81.
[81] D.C. Khedekar, et al.Home automation—a fast - expanding market.Thunderbird International Business Review, 59(1) (2017), pp. 79-91.
[82] A. Jacobsson, M. Boldt, B. Carlsson.A risk analysis of a smart home automation system.Future Gener. Comput. Syst., 56 (2016), pp. 719-733.
[83] Jacobsson, A., Boldt, M., Carlsson, B., 2014. On the risk exposure of smart home automation systems. In: Proceedings of International Conference on International Conference on Future Internet of Things and Cloud (FiCloud), IEEE.
[84] Matharu, G.S., Upadhyay, P., Chaudhary, L., 2014. The Internet of Things: Challenges&security issues. in Emerging Technologies (ICET), International Conference on, IEEE.
[85] H. Yang, H. Lee, H. Zo.User acceptance of smart home services: an extension of the theory of planned behavior.Ind. Manag. Data Syst., 117 (1) (2017), pp. 68-89.
[86] E.I. Konstantinidis, et al.A lightweight framework for transparent cross platform communication of controller data in ambient assisted living environments. Inform.Sci., 300 (2015), pp. 124-139.
[87] A. Arabo.Cyber security challenges within the connected home ecosystem futures.Procedia Comput. Sci., 61 (2015), pp. 227-232.
[88] Waltari, O., Kangasharju, J., 2016. Content-centric networking in the internet of things. In: Proceedings of the 13th IEEE Annual Consumer Communications & Networking Conference (CCNC), IEEE.