Smart Elderly Care System and Health Management Empowered by Big Data: A Case Study of the Innovation of the Intelligent Wheelchair Application

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Abstract: Under the context of big data, the relevant departments of the state have launched an in-depth design of the elderly problem and called on social forces to play a leading role in the elderly care industry. Some people in the elderly care industry predict that 2020 will be the pioneering year of elderly care in China. The improvement of the smart elderly care system and health management is the general momentum. The Chinese people are committed to reuniting their families and returning to their homelands eventually, so the development of smart elderly care in China is an impending trend.

1 INTRODUCTION

1.1 The Living Conditions and Psychological Characteristics of the Elderly in China

1.1.1 Living Conditions

Today the world is facing a common problem - population aging. Especially in China, the population aging falls into a large demographic imbalance between rich and poor countries in terms of the economic development gap, and following the retirement of the elderly, their welfare and entitlements are below the world standard. The majority of the elderly in China currently have low-income levels and China is confronting an unprecedented aging process. According to the data released by the National Bureau of Statistics, from 2014 to 2020, the population of the elderly over 60 years old in China increased from 210 million to 264 million, with a compound annual growth rate of 3.72%. In 2020, the total population of the elderly increased by 3.99% year-on-year, accounting for 18.7% of the total population. According to the international classification standard of the elderly population, the proportion of the population over 60 years old in the total population is greater than 10%, which is considered to have entered an aging society.

1.1.2 Psychological Characteristics

As the elderly age, their psychology also undergoes significant changes, with the most significant characteristic being their increasing dependence on their children. They yearn for the company of their children. Their mood will fluctuate considerably if their children are not around or when they are subjected to an unfamiliar environment. This will be detrimental to the physical and psychological health of the elderly (Salter 2015).

After retirement, the elderly will no longer regularly participate in cumbersome daily affairs and will find it difficult to keep abreast of the development and progress of society. Therefore, in a subjective sense, they need more opportunities to communicate with the outside world and seek psychological rewards from it.

1.2 Explanation of Basic Concepts

1.2.1 Smart Elderly Care

Smart elderly care is a new concept emerging with the development of the times, which can be simply

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understood as "Internet + elderly care". Smart elderly care is a sensor network system and information platform, which mainly serves the elderly who age alone at home, in the community, and the elderly care institutions, providing fast, prompt, efficient, low-cost, and intelligent elderly care services for these objects.

1.2.2 Smart Elderly Care Ecosystem

The smart elderly care ecosystem is similar to a ring model, with the central point for the sake of the well-being of the elderly. It uses technology, information, and other advanced means to improve the life quality of the elderly by combining the Chinese concept of elderly care with the organic deployment of various factors in the elderly care system among the elderly, society, and government agencies (Robert, Matjaz 2016).

1.3 Drawbacks of the Traditional Elderly Care Model

In China, the traditional concept of "caring for the elderly" is advocated. From these concepts, it is clear that the elderly in China still largely rely on their children, especially their sons, for their old age. But in today's view, this concept does generate some undesirable social effects.

1.3.1 Expensive Charges

In rural areas, the problem of old-age care for the elderly has become a burden for many children. According to the survey, the charges of elderly care institutions in rural areas are generally around 2,000 yuan per month, which is a considerable expenditure in combination with the local price level and wage level. In this regard, the elderly people generally choose to age at home, taking turns to live in the homes of their children, which not only makes the elderly feel displaced but also causes strife among siblings.

1.3.2 Unfamiliar Environment

According to a study conducted by the Canadian Institute of Health Information, they conducted a follow-up survey of 5,000 elderly people over 65 years old who lived in nursing homes for a long time and found that 26% of these elderly people suffered from depression and were mentally and physically distressed, and 18% experienced extreme emotional instability. According to the study, these elderly

people living in nursing homes have poor physical and mental health (Ni 2016).

1.3.3 Isolation of Family Affection

In the traditional Chinese concept, "elders relocate to the birthplace in their later years", China is a country that attaches great importance to family affection. Placing parents in a nursing home as they age is tantamount to isolating precious family affection and causing a certain psychological burden to the elderly. Moreover, nursing homes generally lack vitality and have a lot of negative energy.

1.3.4 Elder Abuse

In the past few years, the news of elder abuse by nursing home caregivers was saddening, which is largely related to the quality of old-age caregivers. Generally speaking, old-age nannies are mainly middle-aged and elderly women in rural areas and laid-off women workers in cities, who are not highly educated as well as older, which is simply a model of the elderly taking care of the elderly. Taking care of the elderly is very heavy work, which can easily cause physical and mental pressure to the elderly caregivers, and the continued accumulation of negative emotions can easily cause harm to the elderly being cared for.

1.3.5 Enhanced Loneliness

First, with the advancement of China's aging process, the elderly population is growing; second, with the development of science and information technology, many elderly groups cannot keep pace with the trend of the times and are unable to use the Internet, failing to understand the world of young groups, thus gradually generating a sense of loneliness of not being understood or even neglected; third, influenced by the physical and psychological characteristics of the elderly themselves, they are emotionally unstable and can easily lose control of their emotions when encountering some unsatisfactory situations (Tong, Huang 2015).

2 METHOD

2.1 Development Trend of Smart Elderly Care Management Service System

2.1.1 Elderly Care Is the Core Work of the Government's Civil Affairs, and Governments at All Levels Quickly Start to Implement It

Compared with other countries, China's elderly care model is relatively simple, mainly divided into two forms: home-based elderly care and social elderly care. The traditional home-based care model has an unshakable position in the context of Chinese culture and thought, but due to the family planning policy implemented by the state since 1982, many families have only one child in response to this policy, which has led to many only-children occupying the mainstream in the 1980s. Elderly care serves as the core work of the government's civil affairs. (Li, Li 2018) Governments at all levels should quickly start to implement it, and a large amount of capital investment and nursing staff assistance policies have been fully implemented.

2.1.2 The Elderly Care Method: Model Is Upgraded and the Proportion of Institutional and Community Old-age Care Increases

Although countries such as Japan and Singapore are relatively close to China in terms of cultural and living habits, the difference from my country is that the elderly in countries such as Japan and Singapore are mainly borne by the state. This is mainly due to their small population, the country's developed economy, and the state's ability to provide various old-age welfare for the elderly.

2.1.3 The Old-age Care Method: Tool Is Upgraded and More Intelligent Methods Will Be Added

With the advancement of information technology and the strong demand for social elderly care, some high-tech products for the elderly have gradually appeared in the market. (Zhou 2018) These high-tech products not only improve the quality of life in old age, but also provide emotional comfort to the empty nesters to a certain extent, and new changes have taken place in the form of Chinese-style old-age care. The smart elderly care service model of "system + service + elderly + terminal" covers a variety of elderly care forms such as institutional elderly care, home elderly care, and community daycare. The construction of the smart elderly care ecosystem has brought new vitality to the elderly care industry and produced a series of effects that are beneficial to social progress. To this end, this ecosystem has been recognized and concerned by the government, enterprises, and the public. The elderly group can also enjoy the convenience brought by the development of science and technology.

2.1.4 Research on Elderly Care Products: Innovative Research on Intelligent Wheelchairs

The control structure of the intelligent wheelchair mainly consists of three parts: the detection system, the control system, and the execution system. The detection system is mainly composed of various sensors, which can detect the environmental information of the outside world and the health of the human body. The control system comprises STM32F103ZET6 MCU as the main control chip, ESP8266 module for the Internet of Things (IoT) information transmission, and GPRS module for users' information positioning. The execution system mainly has the functions of a special structure of wheelchair, users' information transmission, and intelligent obstacle avoidance.

(1) Service functions of the detection system

The detection system mainly includes the perception of the external environment (such as intelligent obstacle avoidance, etc.), blood pressure, and heart rate detection sensors. Through the detection of human heart rate, the IoT big data is analyzed to detect users' physical condition and the ESP8266 low-power intelligent WIFI chip is used to connect the data to the cell phone users and users' relatives, thus, users' health condition can be viewed through the cell phone. The detection system also comprises a voice detection module, and users can control the moving direction of the wheelchair by voice, which greatly simplifies users' tedious operation steps.

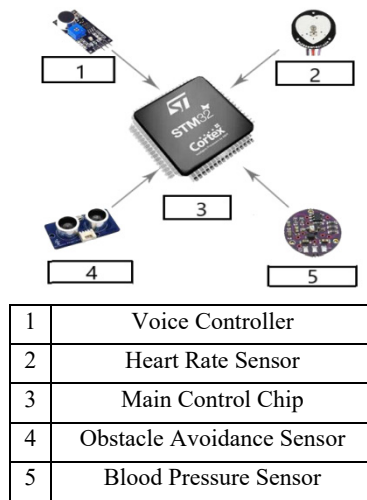| 1	Voice Controller
2	Heart Rate Sensor
3	Main Control Chip
4	Obstacle Avoidance Sensor
5	Blood Pressure Sensor

Figure 1: The detection system of the intelligent wheelchair (self-made).

(2) Control system

The control chip used in this digital intelligent wheelchair is STM32F103ZET6 MCU as the main control chip, with ARM as the core, which includes 64KB of SRAM and 512KB of Flash inside, serving as a MCU with powerful function configuration.

(3) Information transmission system

Since wheelchairs are used by disabled and elderly people, most of them are in poor physical condition. In order to keep users and their relatives informed of their physical health, we collect information about the user's physical condition through sensors and then transmit the information to the user's relatives' cell phones via the Internet using the ESP8266 chip, so that their families can be informed of the user's physical condition in a timely manner.

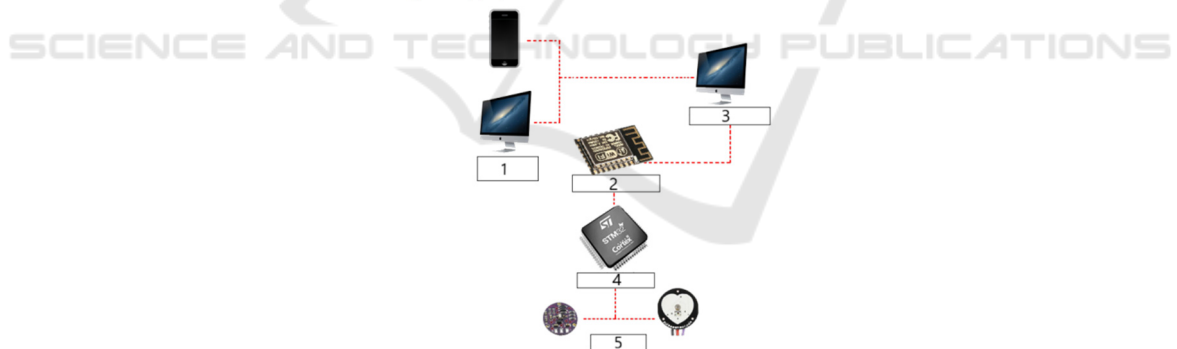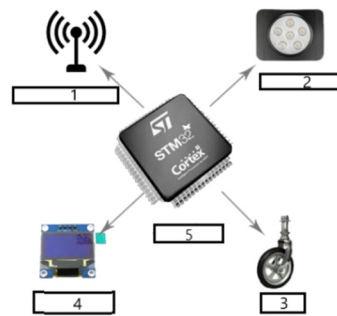| 1	User Mobile Terminal
2	Master Server of the Corporate
3	Information Transmission Module
4	Main Control Chip
5	Detection System

Figure 2: The control system of the intelligent wheelchair (self-made).

(4) Execution system

The executive system of the digital intelligent wheelchair includes automatic alarms, night lights, and numerous motors.

1	Alarm Signal Sending Device
2	Wheelchair Lighting
3	Wheel
4	LCD Display Module
5	Main Control Chip

Figure 3: The execution system of the intelligent wheelchair (self-made).

Figure 4: Appearance of the wheelchair (self-made).

3 RESULTS

3.1 Smart Elderly Care Ecosystem and Health Management

3.1.1 Strengthening Top-level Design and Overall Planning

(1) Formulating relevant laws and regulations. At present, there is not a complete set of laws and regulations on smart elderly care at the national level in China. Only If the top-level design can be improved and sound laws and regulations can be formulated, can we provide strong support for the implementation of smart elderly care. With clear legal provisions, government departments will have a complete set of implementation policies, and it is easier to form scale effects.

3.1.2 Accelerating the Construction of Hardware and Soft Environment

(1) Construction of the basic hardware. In the previous concept, smart elderly care can be simply understood as "Internet + elderly care". Smart elderly care is a sensor network system and information platform, which mainly serves the

elderly who age alone at home, in the community, and the elderly care institutions, providing fast, prompt, efficient, low-cost, and intelligent elderly care services for these objects. Government departments should continuously improve the quality and level of network communications to provide favorable conditions for the implementation of smart elderly care. For some impoverished and remote areas, government departments should allocate some financial funds for the construction of network facilities.

(2) Construction of cultural environment. For many elderly people, the concept of smart elderly care is still relatively vague. This has a lot to do with their usual living environment and their acceptance of new knowledge. Therefore, it is necessary to carry out cultural environment construction. Administrators can promote smart elderly care by pulling banners in the community to provide a basic impression of it and then conduct in-depth door-to-door publicity to introduce the ecological system of smart elderly care in detail. In addition to cultural dissemination for the elderly, it is also possible to create a certain atmosphere of public opinion in society.

3.1.3 Enhancing the Construction of Talent Team

Smart elderly care is inseparable from the Internet, and young people are the main users of the Internet. To strengthen the talent team, efforts are required from the following aspects. The first is to strengthen ideological construction. It is needed to mobilize young people to join the smart elderly care from the ideological aspect. In the view of many young people, the elderly care industry means frequent dealings with the elderly, who are more stubborn and difficult to get along with. It is necessary to break this concept of young people ideologically. The second is to improve the quality of the team and provide them with relevant knowledge of the elderly care service industry in the process of training. The third is to boost the retention and training of newcomers and make them more closely connected with the company by raising their remuneration and industry status, thereby improving the level of the team and enhancing the capacity building of the team.

4 DISCUSSION

4.1 Sound Modernized Smart Elderly Care Service System

(1) Introducing PPP mode. In order to provide better services for the elderly, it is necessary to break the existing elderly care service model, explore the market-oriented operation mode, and promote the transformation of the main body of elderly care services from unity to diversification. First, on account of the comprehensive research results, the program design of the APP is completed based on the comprehensive consideration of the actual situation, needs, and complete information of the elderly, so as to ensure the effect after implementation. Second, in-depth training of the talent team enables them to proficiently apply and master the basic functions of the APP, so that the promotion of the APP can be carried out more smoothly. Third, in the process of developing the APP business, effort should be made to strengthen team management, guarantee the rationality of the creation plan, and ensure the smooth implementation of the creation plan.

(2) Improving the return visit system. In order to make the implementation of smart elderly care smoother, relevant departments should improve the return visit system. It is believed that smart elderly care and old-age health management are also services in the final analysis. The satisfaction of the elderly is extremely important to the development of the smart elderly care industry(Wei 2019).

5 CONCLUSIONS

According to relevant statistics, China officially entered an aging society in 1999. China's demographic structure is gradually shifting from growth to stability. It is estimated that the number of elderly people in China will hit a peak around 2050, with the proportion of people aged 60 and above reaching more than 30%. Asian countries such as China, Japan, and Korea are entering the aging society at a slower pace than European and American countries, but the aging process is much faster than that in other countries. Smart elderly care has become an inevitable trend in China, and the integration of smart elderly ecosystems and smart products in health management has provided sufficient impetus for the development of elderly care. Under the new situation, the smart elderly care

ecosystem presents different new characteristics. Relevant social and government administrators should carefully analyze these characteristics and formulate corresponding management countermeasures, which is a long process and needs to be explored step by step.Smart elderly care contributes to the stable development of China's society.

REFERENCES

Li G, Li H X. An Analysis of the Development of Continuing Education for the Elderly in my country from the Perspective of Active Aging [D]. Taiyuan: College of Continuing Education, Shanxi University, 2018: 4-5

Ni Y C. Research on the Construction of Home-based Elderly Care Service System in Urban Communities under the Background of Population Aging [D]. Nanjing: Nanjing University of Traditional Chinese Medicine, 2016: 33-54

Robert Dukaric, Matjaz B. Juric: Towards a Unified Taxonomy and Architecture of Cloud Frameworks[J]. Future Generation Computer Systems, 2016, 8: 48-59

Salter. Standby Reverse Mortgages. A Risk Management Tool for John Retirement Distributions[J]. Journal of Financial Planning, 2015,8:40-48

Tong H J, Huang C Y. Changes in Contemporary Chinese Family Structure and its Social Impact [J]. Northwest Population, 2015(6): 81-84

Wei H M. Analysis of the Intervention of Social Work in Community Home Care Services [J]. Industry and Technology Forum, 2019, 4(8): 65-7

Zhou Y M. Detailed Explanation of Architectural Design of Elderly Care Facilities [M]. Beijing: China Construction Industry Press, 2018.4: 12-20