Research on the Design of Elderly Fall Prevention Monitoring Crutches based on NB-IOT

Wenjuan Zhang[1, *], Jiarui Li[2], Shiyu Wang[3], Jin Xing and Mingyu Du[4]

[1]School of Accounting, Anhui University of Finance and Economics, Bengbu 233000, Anhui, China;

[2]School of Finance, Anhui University of Finance and Economics, Bengbu 233000, Anhui, China;

[3]School of Economic, Anhui University of Finance and Economics, Bengbu 233000, Anhui, China;

[4]School of International Economics and Trade, Anhui University of Finance and Economics, Bengbu 233000, Anhui, China.

[*] Corresponding Author

Abstract

Falls of the elderly are common in daily life. Falls of the elderly will cause serious consequences such as psychological damage, fracture and soft tissue damage, endanger the physical and psychological safety of the elderly, and increase the survival pressure of the elderly in their families and communities. In order to improve the safety of the elderly going out, we have developed an intelligent travel system for the elderly using NB-IoT technology, which can detect the fall of the elderly and make an immediate warning.

Keywords

Old people; Fall prevention monitoring; NB-IOT; Smart travel.

1. Introduction

According to the research of the World Health Organization, falls are the second leading cause of death in accidental injuries around the world, and the death rate is second only to road traffic injuries. Nearly 684000 people worldwide die from direct or indirect causes of falls every year, especially for the elderly over 60 years old. Even if the injuries are not fatal, there are still about 37.3 million cases of falls that are serious enough to need to go to hospital for treatment. Falls and fall-related injuries are a serious public health problem in the world and are becoming increasingly serious. The number of years of life loss caused by falls every year in the world exceeds the total number of traffic injuries, drowning, burns and poisoning. Due to the different age, gender and health status of individuals, the types and severity of injuries suffered by each fall patient will vary, and the fall prevention monitoring crutches for the elderly are targeted at such situations, With the goal of safe, convenient, accurate and reliable intelligent travel behavior, a new intelligent travel monitoring system based on NB-IOT is proposed, which links individuals, families and intelligent travel monitoring. It uses a variety of sensor devices to form the Internet of Things to collect data in real time, transmit it to the system server through the Internet, and use big data and cloud computing to process data, effectively continuously monitor and intelligently manage it, Send the danger message in time so that the guardian can get the information of the guardian in time.

2. Development status of intelligent fall prevention monitoring products for the elderly

2.1. Overview of the research status of intelligent monitoring products for the elderly to prevent falling

In China, more than 1/3 of the elderly over the age of 65 have experienced falls every year, and 2/3 of the accidental casualties are also caused by falls. The proportion of the elderly over the age of 75 is more than 70%. According to the conservative prediction of the National Bureau of Statistics, the domestic potential market population is at least 640 million. The number of elderly people is increasing year by year, making the elderly care industry have more and more broad development space.

Due to the rapid development of new technologies such as IoT, the real life will become more and more digital, and the impact on human life will also be greater and greater. Now, the Internet of Things technology has become an important strategic industry in the world. NB-IoT is a low-power wide-area network communication technology that works in authorized spectrum. It can realize large connection in a wide area through low cost and low power consumption. Narrow-band Internet of Things technology is widely used in intelligent transportation, intelligent travel and other aspects.

China's population base is too large, and the problem of social aging is serious. By the end of 2017, the number of elderly people over the age of 60 has reached 240 million, accounting for 17.3% of the country's total population. As NB-IoT technology is a new communication mode, the total bandwidth of the Internet of Things will be strictly limited to a range recognized by international standards. The maximum operating power of NB-IoT technology can reach 180KHz. Compared with traditional communication forms, the Internet of Things communication at this frequency can transmit information with lower consumption.

NB-IoT narrowband IoT technology can realize long-distance, low-cost and low-cost information transportation in the process of organizational structure, and has great advantages in technology and performance. Therefore, many anti-fall products have applied NB-IoT narrowband IoT technology. NB-IoT narrowband Internet of Things can process and optimize the system interface. The system end outputs the signal and connects it with the network layer through the air port. The base station transmits the signal through the intelligent communication equipment. Through the use and improvement of information and communication technology, relevant staff summarized and collated data, constantly developed and improved the Internet of Things communication technology, and made great contributions to the future pension industry.

2.2. The purpose and significance of developing intelligent fall prevention monitoring products for the elderly

In our products, the ADXL345 accelerometer system in the chip can measure the acceleration of the elderly in three directions in time. The collection and management of acceleration information is completed by its main control module (single chip computer). The GPS module can complete the real-time positioning system for the elderly, and the NB-IoT module can continuously submit the information to the system server, The system can send an alarm message to the guardian's mobile APP and the applet client in WeChat in time after the old man has an accident, so as to provide more effective assistance to the old man and thus ensure the safety of the old man's travel.

The high and new technologies such as sensors, microelectronics products and communications currently used in this system have been widely used in production, business and other fields, but the utilization rate in improving the quality of life of the elderly is not high. According to relevant data, nearly 500000 people in the world are injured, incapacitated or

even lost their lives due to falls every year. However, falls are not the direct cause of death in most cases, but because the injured cannot be found and treated in time. Every year, the medical expenses caused by accidental falls are as high as 5 billion yuan, and the indirect social costs are huge.

With the rapid development of the Internet of Things, the real-time detection of the intelligent travel monitoring system provides a good feedback, which overcomes the disadvantage of losing the ability to move or even lose consciousness after the monitored person falls. In view of the increasing aging and the poor quality of life of the elderly, this system will greatly reduce the indirect social costs caused by the elderly who fail to get assistance due to accidental falls.

3. Design process of NB-IOT application of intelligent monitoring crutches for the elderly

As shown in Figure 1, the system first uses the three-axis accelerator sensor module to collect the acceleration signal generated by human activities, and then proposes to divide the data analysis into two parts: the preprocessing of the user terminal signal and the background processing.

Among them, the interaction unit mainly includes function keys, LED indicators and buzzers. The function keys provide the user with the function of canceling false alarms. The LED indicators are mainly used to display the connectivity status of the communication network. The buzzer can get a feedback alarm signal when the system detects a fall. The whole system is composed of acceleration acquisition unit, microprocessor unit, wireless communication unit, and remote fall monitoring background. The whole module adopts 5V voltage. The system collects the acceleration by the acceleration unit, and the microprocessor unit preprocesses the signal. The suspicious signal data in advance after the pretreatment is transmitted to the server through the wireless communication unit, and then the user's remote fall monitoring background carries out the final analysis, processing and early warning. When the fall is detected, the system can automatically trigger the alarm item.
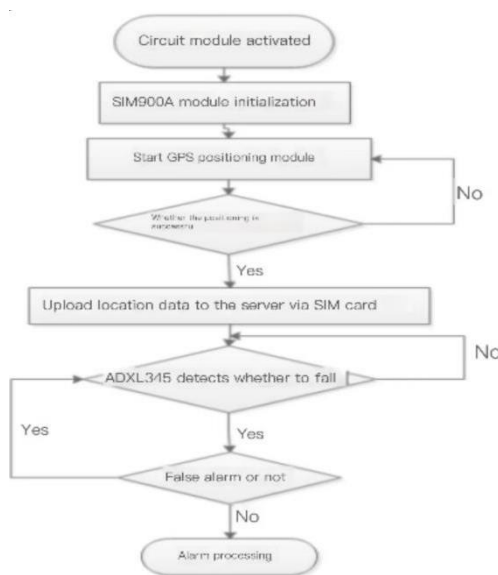

Figure 1. Design flow chart

4. The development prospect of intelligent fall prevention monitoring products for the elderly in China

In China, accidental falls are the main cause of fatal and non-fatal injuries for people aged 65 and above. With the growth of age, people's body and perception are aging, and the risk of serious consequences caused by falls is also increasing. The death rate of falls in China will also increase with the increase of age. The death rate from 60 to 69 years old will account for 9.8%, while the death rate from 70 to 79 years old will reach 12.5%, while the death rate over 80 years old will increase significantly, even reaching 22.5%. At present, the life expectancy of most people in China has reached more than 60 years old. According to the national statistics, the life expectancy will reach 77 years old in 2020. The increase of average life expectancy is closely related to the aging of the population.
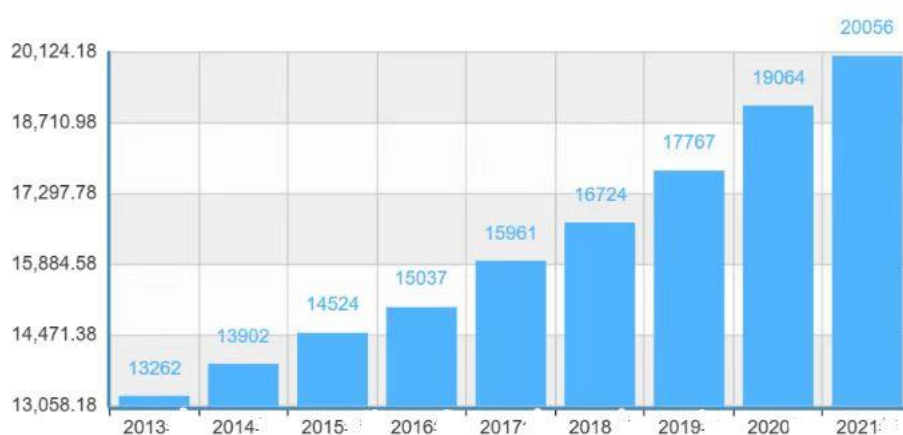

Figure 2. Population aged 65 and above

The data shows that the number and proportion of the elderly in China are on the rise, however. According to the WHO report, in the past 2020, the number of people over 60 years of age in the world has exceeded the number of children under 5 years of age, which means that the population aging process is intensifying. It is expected that by 2030, the number of people over 60 years of age in the world will account for 1/6 of the total population. From 2020 to 2030, the population aged over 60 will increase by 40%, from 1 billion to 1.4 billion. It is expected that the world's population over 60 will double to 2.1 billion in 2050. From 2020 to 2050, the number of the world's elderly aged over 80 will triple to 426 million.

As shown in Figure 2, 71.5% of the elderly have different degrees of injuries after falls. Hip fracture accounts for 7.3%, hand or arm fracture accounts for 12.5%, and head injury accounts for 8%. More than half of the elderly will have bruises or bruises. At the same time, according to the survey, about half of the elderly will have psychological fear after falling, fear of falling again, which will greatly reduce the amount of exercise, further deepen physical weakness or muscle atrophy, which will further increase the risk of falling, Form a vicious circle. The elderly who are disabled due to falls are likely to need long-term care in the future, resulting in certain expenses.

In addition, according to research, there are great geographical differences in the fall mortality of the elderly. The higher mortality rate is mainly concentrated in Yunnan, Guizhou, Fujian, Hubei, Zhejiang and Jiangsu. The lower mortality rate is Jilin, Heilongjiang, Hebei, Tibet, Inner Mongolia, Liaoning and Shandong. That is to say, the rate of elderly people falling to death is higher in the southeast and central regions, and the mortality rate is lower in the northeast and Tibet.

The economic cost of fall-related injuries is huge. In Australia, the average health system cost per fall injury for people aged 65 and over is US $1049, while in Finland, the figure reaches US $3611. Canadian research evidence shows that implementing effective prevention strategies can reduce the incidence of falls by 20% and save more than 120 million dollars annually. In China, at least 26 million elderly people over 60 years of age fall no less than 32 million times each year, and the vast majority of them are injured or killed. The medical expenses directly incurred for this reason exceed 6.5 billion yuan, which also imposes a certain burden on the national financial expenditure. The annual cost to the country and society due to falls of the elderly is estimated to be 20 billion to 100 billion yuan. The fall burden of the elderly is so heavy that it is necessary to reasonably predict the fall and fall prevention, which means that more attention should be paid to this imminent health crisis, especially to achieve the sustainable development goal of healthy aging.

5. Suggestions for the improvement of intelligent monitoring products for the elderly to prevent falling

5.1. Learn in practice and grow under professional guidance

As undergraduate students, our team knowledge is not deep enough to grasp and apply, and we lack social experience, industry cultivation and weak in enterprise management, which leads to the weak foundation of our technology company and can not quickly form its own distinctive corporate culture. In view of this, members of our team should continue to learn and practice, and properly experience enterprise management, project planning and other activities to learn from experience. After obtaining certain profits, all staff of the company can visit and investigate well-known companies or companies with excellent management systems; In addition, we can hire management experts as consultants at the early stage of the company's establishment, slowly consolidate the enterprise foundation under the appropriate professional guidance, and absorb more excellent management talents after the company grows.

5.2. Ensure that employees are qualified and product quality is up to standard

Our scientific and technological products are applied to a large number of precision mechanical parts, and the operating principles such as installation and operation are complex, and the practical experience of safety structure design is insufficient, the theoretical scheme is lack of sufficient demonstration, and the technical level of operators is different, and the product quality cannot be unified. If the quality is not up to standard, first, accidents will occur frequently, threatening the life and health of elderly users; The second is to change the design again to increase the budget cost, which will result in waste of human, material and financial resources. In view of this, the countermeasure is to carry out multiple debugging of the product before it is officially put into the market, simulate the real life scene experiment, implement the system of working with certificates for technical workers, conduct professional training and review, and regularly organize learning and training and technical review after entering the job.

5.3. Implement financial budget to ensure fund security

As a start-up company and in the high-tech industry, our company has a great demand for funds, which leads to a high probability that we will overspend due to insufficient funds or poor control of project costs during the development of new products. If the funds cannot be repaid in time, once there is a problem in the capital chain, it will not only delay the time of product launch and promotion, affect product innovation, but also cause huge risks to the company's finance and reputation. To solve this problem, we need to broaden financing channels, constantly improve the company's "hematopoietic" mechanism, implement the financial

budget and final accounting system, use funds in a planned way, and set up a special department or appoint a special person to monitor the company's capital flow.

5.4. Accelerate secondary research and development to meet market demand

In terms of product research and development, we should first ensure that the quality of the first generation of products that have been put into the market meets the standard, and carry out investigation and analysis of market demand, increase cooperation with the government and businesses, improve the sense of society, and constantly improve and optimize the use experience according to various user feedback suggestions. In addition, we should increase the investment in research and development after obtaining a certain profit, hire more high-end scientific and technological talents, further improve the product quality, and upgrade, Expand functions, develop multiple series and multi-level product categories, enrich product structure, and carry out large-scale production to adapt to market changes and gain more profits.

5.5. Create corporate culture and expand the company brand

After the market positioning is gradually clear, the company will be committed to creating a unique corporate culture, strengthening the sense of belonging and identity of its employees. At the same time, we will also design our own unique advertising, and launch advertisements through various short videos, blogs and other sharing platforms. Offline, we can carry out Zhixing technology product experience activities in communities, nursing homes and other places, find more potential customers, and increase publicity, Continuously expand the influence of the company.

5.6. Expand industrial chain and increase market share

After the first-generation products get a certain degree of good feedback from the market, the company will be committed to research and develop relevant upstream and downstream industrial chain products, explore different fields, extend the industrial chain, strengthen intra-chain division and cooperation, cover most of the industrial chain segments at a certain speed of development, strengthen the company's development engine, in order to obtain higher product added value and obtain higher benefits.

5.7. Invent more patents and acquire more independent intellectual property rights

When the company has reached a fairly strong level of development, the company has both financial, material and human resources, and also has a complete set of enterprise management system. The enterprise culture is widely penetrated, and all employees are active and enterprising. At this time, the company will formulate a patent plan, for example, to obtain a certain number of invention patents within a certain period of time. Only with a large number of independent intellectual property rights can it have a foothold in the industry market.

6. Conclusion

At present, China's population growth rate is low or even negative, the advantage of population dividend is greatly weakened, and the problem of population aging is increasingly prominent. How to better serve the elderly and let them enjoy their old age has become the focus of the whole society. The intelligent travel monitoring system based on NB-IOT developed by our smart travel technology company has effectively catered to the travel needs of the elderly at present, and has a large development space. However, since this entrepreneurial team is a student team, there are still many deficiencies. Therefore, we will continue to learn and grow in practice, down-to-earth, and develop the company.

Acknowledgement

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