



# Intelligent Wearable Elderly Service Platform Design Based on Big Data

Yuntong Zhong<sup>1</sup>(✉), Kehong Chen<sup>2</sup>, and Jiaqi Chen<sup>3</sup>

<sup>1</sup> Department of Accounting, Guangdong University of Technology, Guangzhou, Guangdong, China

zyt173649887@163.com

<sup>2</sup> Department of Computing, Guangdong University of Technology, Guangzhou, Guangdong, China

<sup>3</sup> Department of Business Administration, Guangdong University of Technology, Guangzhou, Guangdong, China

**Abstract.** China has now entered the stage of rapid aging and urgently needs to develop a new model of senior care. Smart wearable senior care platform not only can effectively solve the current aging problem in China, but also can make full use of big data and other technologies to innovate the mode of traditional senior care, which is the trend of future development. By analyzing the demand of smart senior care, this paper specifies the operation mode of the smart wearable senior care platform under big data, and provides a new development direction for the senior care industry under big data.

**Keywords:** Big Data · Smart Wearable Devices · Smart Aging · Aging · Aging Services

## 1 Introduction

According to the “Blue Book of Medical Devices” released by China Drug Administration and Management Research Association on October 15, 2021, wearable medical devices in China are gradually developing towards diagnostic remoteness. Compared with traditional medical devices, smart wearable devices can realize network transmission of data and play a crucial role in remote diagnosis in combination with the use of big data.

At present, the aging situation in my country is severe, and the number of empty-nest elderly people is increasing year by year. Through the combination of smart wearable devices, big data and pension platforms, doctors and children can understand the physical condition of the elderly through smart wearable devices, and combine the characteristics of the elderly. To meet their complex and individualized pension and medical needs, and at the same time stimulate new driving forces for the development of the industry and improve the quality of pension services, the smart wearable pension platform industry has become a hot development trend.

## 2 Demand Analysis

### 2.1 Current Status of Aging

According to international standards, a country or region with 10% of the total population over 60 years old or 7% of the total population over 65 years old is an aging society [1]. According to the results of the seventh census of China in 2020, the percentage of the elderly population over 65 years old is 13.50%. The aging situation in China is not optimistic.

### 2.2 Large Elderly Population

China is the most populous country and has a very large elderly population. According to the population composition data of 2010–2020 in Table 1, it can be seen that the population over 65 years old in China has reached 190.64 million in 2020, which is 60.28% more than the population over 65 years old in 2010, and the population over 60 years old has reached 264.02 million, which is 48.62% more than the population over 60 years old in 2010.

#### 2.2.1 The Percentage of Elderly Population is Growing Rapidly

According to the previous analysis, China's aging process has grown very rapidly in the last decade, with the proportion of the population over 60 years old growing by 5 percentage points, while the proportion of the world growth in the same period was only 2.1%, more than double [2]. 13.28% of the total population was over 60 years old in

**Table 1.** Population composition of China, 2010–2020

Year	Total National Population (10,000 people)	Population aged 60 and above (10,000 people)	Ratio (%)	Population aged 65 and above (10,000 people)	Ratio (%)
2010	133770	17765	13.28	11894	8.89
2011	134413	18415	13.7	12277	9.13
2012	135070	19315	14.3	12777	9.46
2013	135738	20243	14.91	13262	9.77
2014	136427	21242	15.57	13902	10.19
2015	137122	22200	16.19	14524	10.59
2016	137867	23086	16.75	15037	10.91
2017	138640	24090	17.38	15961	11.51
2018	139273	24949	17.91	16724	12.01
2019	139772	25388	18.16	17767	12.71
2020	140211	26402	18.83	19064	13.60

Data source: National Bureau of Statistics

2010, and has grown to 18.83% in 2020, which are very large increases, indicating that the proportion of the elderly population in China is growing rapidly.

### **2.3 Current Status of Senior Care Services**

There are many shortcomings in elderly services in China, which are mainly reflected in the following three aspects.

First of all, China's senior care service fails to provide "detailed service". They does not meet the real needs of the elderly in detail, resulting in a mismatch between the supply and demand of the social elderly service.

Secondly, senior care services are not diversified and personalized enough. The 13th Five-Year Plan formulated by the state clearly points out that "institutions and government should be combined to meet the diversified and personalized needs of elderly care services." [3]. At present, the elderly care system in China is mainly composed of two parts. The first is the family elderly care, which is the most traditional way. The second is the institutional elderly care. Because the institutional elderly care has many negative news about institutional elderly care, the elderly are less willing to choose this type of elderly care.

The coverage of senior care services is not complete. The level of elderly services in China varies widely among regions, and there is a serious lack of spiritual care and psychological comfort services for elderly groups, especially the problem of spiritual loneliness in rural elderly groups and senior elderly groups is more prominent [4].

### **2.4 The Needs of the Elderly for Retirement**

Different groups have different needs for senior care services, so groups need to be differentiated to provide more targeted and personalized senior care services.

#### **2.4.1 Self-care Elderly**

Self-care seniors usually need spiritual senior care services. They want not to be left behind by the times and want to learn novelties, keep up with the development of the times. However, current senior care services can rarely meet such needs of self-care elderly people.

#### **2.4.2 Disabled Elderly**

Disabled elderly often need to be accompanied and cared for by someone to help them eat, walk, etc. in their daily lives. Due to their limited mobility, these elderly people are prone to injuries in daily life, such as falls and collisions.

#### **2.4.3 Elderly People with Dementia**

Under the traditional elderly care method, many elderly people who have the ability to move around are confined to a fixed place, which is not only detrimental to their mental health, but the long-term lack of physical exercise will also lead to the decline of the physical function of the elderly, which will weaken their self-care ability and accelerate their becoming elderly people who need care [5].

**Table 2.** Differences in the demand for elderly services among the three types of elderly people

Classification	Self-care elderly	Disabled elderly	Elderly people with dementia
Physical condition	Good health condition, Able to take care of themselves	Unable to take care of themselves, Chronic diseases are common	Speech impairment, Memory loss
Differences in needs	Enrichment of senior living	Focus on care functions and safety and security	Balance of safety and freedom
Smart wearable senior care platform application	Health Monitoring, Emergency help devices, Entertainment Boards	Health monitoring, One-touch call for help, Fall monitoring alarm, Activity-aware monitoring	Health monitoring, Emergency help device, Activity-aware monitoring

#### 2.4.4 Variance Analysis

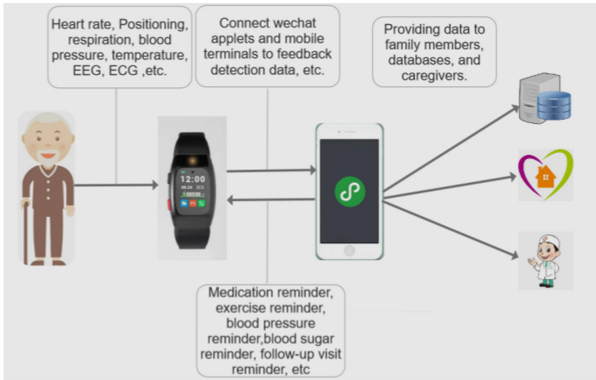
Table 2 proposes various functions of a big data-based smart wearable senior care service platform by analyzing the differences in senior care service needs of three groups.

### 3 Big Data Plus Wearable Device IoT Aging Service Platform

#### 3.1 Frame Design

The smart wearable elderly service platform based on big data analysis connects the elderly and their families together. The broad platform design can be divided into three parts. As shown in Fig. 1, the platform consists of three parts: wearable devices, mobile end platform, and back-end architecture.

The wearable and monitoring devices are various wearable devices that can be worn on the human body and monitoring devices based on IoT technology [6, 7]. The wearable devices are connected to the mobile terminal, which can reflect the location information, daily life and health information of the elderly to the cloud database and synchronize to the caregivers or family members in real time and accurately. The mobile platform is mainly responsible for providing visualization services for the elderly and uploading the obtained data to the cloud. The back-end database architecture is mainly used to store location data, health data and big data analysis for the elderly, and provide personalized services for the elderly.



**Fig. 1.** Intelligent wearable elderly service platform based on big data analysis

**Table 3.** Comparison of common wearable devices for the elderly

	Portable Blood Pressure Monitor	Wearable Medical Alarm Device	Smart bracelet
Functions	Measures blood pressure	Monitor hazards and alarm	Heart rate measurement, HD call, one-touch distress, etc.
Application of big data	Provide personalized health information tips	Guide the ambulance to the destination through GPS positioning	Collect data through sensors, analyze the wearer’s health status and provide certain guidance
Disadvantages	Single function, can only monitor the health condition	Single function, the wearer may not always be accurately identified when encountering danger	the function is complicated, and it is difficult for the elderly to learn how to use it.

### 3.2 Wearable Device Design

#### 3.2.1 Wearable Device Comparison

Wearable devices for the elderly can be broadly classified into the following categories (Table 3).

#### 3.2.2 Functional Design

Functionally, the smart bracelet has a number of functions, such as recording blood oxygen heart rate monitoring, blood pressure detection, monitoring sleep quality, service and alarm, anti-loss positioning system and other functions.

Heart rate monitoring uses the PPG photoelectric volumetric pulse wave tracing method, which converts pulsation changes in blood transmissibility into electrical signals, which are then converted into heart rate changes. Blood pressure is detected by sensors for pulse transmission velocity (PWV), and the corresponding PWV in the PPG is used to calculate diastolic and systolic blood pressure. Families can help their parents to set the time interval for heart rate, blood oxygen and blood pressure monitoring on the cell phone, and they can choose to measure the whole day or to measure at regular intervals.

The sleep monitoring system derives the user's sleep quality through the gravity sensor and the sensor to derive the frequency of body movement during sleep, combined with the change of heart rate. The temperature detection adopts high-precision thermal electric principle, and the error of temperature detection is reduced with the help of intelligent algorithm to achieve the effect of accurate detection.

The bracelet has two buttons: one-button alarm and emergency help. When the user needs to call the police or help, the bracelet will send the user's location, send an alarm message and call the child and the administrator at the same time. The upper end of the bracelet is equipped with a flashlight function, which is a tool that is convenient for users to see the road clearly in the dark.

Smart bracelet has a high-precision indoor positioning system, connected to the cloud server, the output and input of the cloud server are bi-directional signal connected to the link terminal. Bluetooth module using Bluetooth 5.0 technology to convert RSSI signal strength into distance data for transmission to the mobile terminal and link terminal, and automatically calculate the position coordinates of the smart bracelet through the trilateral method and display the position of the smart bracelet on the mobile terminal and link terminal.

The position alarm module adopts miniature sound and light vibration alarm, which enables the smart bracelet wearer to discover the distance beyond the distance set by the preset module in time and return to the initial set position, so that the relevant personnel can easily find the lost person wearing it.

### **3.3 Mobile Terminal Design**

The platform is based on Android and IOS multi-terminal compatible development, and also supports applet lightweight application environment, multiple users can interact with the system through App or applet.

#### **3.3.1 Mobile**

The main content of the mobile terminal is the UI interface design for interaction with users. Mixed development by week segment using uniApp technology and Axois module and other technologies, style implementation is mainly supported by ColorUI style components. UniApp supports the development of a set of code deployment compatible to different mobile platforms, while keeping the stability of both platforms.

### 3.3.2 Function Implementation

The system is designed with four sub-interfaces: “Home”, “Categories”, “Customer Service” and “My”.

The “Home” function is used to locate the nearest service points in the community and display the services they provide. The “Category” divides the services into “Housekeeping”, “Service”, “Maintenance” and “Consulting”. “Counseling Services” and “Training Services”. The “Customer Service” provides elderly people with voice inquiry services in different dialects. “My” is mainly for the management of personal information of the elderly in the platform.

### 3.4 Back-End Database Architecture

#### 3.4.1 Tencent Cloud Service Architecture

Tencent Cloud is Tencent’s public cloud platform open to enterprises, organizations and individuals. With Tencent Cloud servers as the backbone of data storage, the servers are better equipped to handle highly concurrent large data storage and requests, which can effectively solve the high cost problem caused by traditional high-device relational databases. At the same time, Tencent Cloud platform’s cloud storage platform data is very secure. It runs in a private network using sandbox isolation and effectively maintains the security performance of data resources through network control lists and security groups [8].

Tencent Cloud can detect the location and health of the elderly in real time based on user needs using big data demand analysis algorithms, combined with the physical signs data obtained by wearable devices.

#### 3.4.2 Build Hadoop Health Data Analysis System

Hadoop is the more popular open source software framework supporting data-intensive distributed applications, which can provide users with reliability and data mobility, and the Distributed File System (HDFS) is one of the core frameworks of the Hadoop system. HDFS consists of hundreds or thousands of servers each storing file data, which can support concurrent large influxes of data into the database and can well support the large amount of physical information updated in real time for the elderly (Fig. 2).

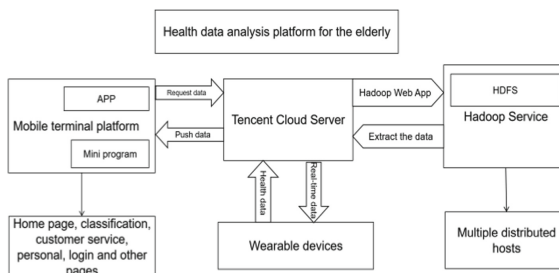


Fig. 2. Hadoop-based health data analysis platform for the elderly

Based on the scalability of Hadoop [9], it can be applied to applications for data analysis and storage. The large amount of physical signs information of the elderly can be directly assigned to each node of the Hadoop cluster to achieve high concurrency and make the user's personality typing more accurate.

The specific design idea is divided into the following two points: first, after the wearable device acquires the physical signs of the elderly, the system calculates the processed data according to the data analysis algorithm and how to store the data in the HDFS distributed system of Hadoop. The high fault tolerance of HDFS ensures the security of these data. Secondly, the data in HDFS is transferred to Tencent Cloud Platform, which filters the data asynchronously and pushes the data information to mobile terminals and wearable devices.

## 4 Conclusions

At present, the current situation of aging in China is very serious, and there are problems such as large stock of aging population and rapid growth of the proportion of aging population in the total population. However, the development of elderly service in China has not kept up with the speed of aging, the elderly service system is not refined enough, the demand for personalized elderly service has not been fully integrated into the current elderly service system [5], and the coverage of elderly service is not large enough. In addition, different elderly people have different needs for elderly care, so the elderly care service combined with the characteristics of the elderly to provide personalized services is the direction of future development.

Combined with big data, Internet of Things and other technologies, the intelligent wearable senior care service platform provides a more comprehensive, safer and more convenient senior care service mode for the elderly through the design of three parts: wearable devices, mobile end platform and back-end architecture, providing a new development direction for the senior care industry under big data.

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