

Research and Design of One-stop Intelligent Elderly Care Comprehensive Service Platform Based on Event-driven Architecture

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Abstract. In the context of an aging population, innovative development of smart elderly care as a pension model not only offers a novel solution to address the increasing aging issue but also provides an alternative choice to cater to the expanding requirements of elderly care services. This study accomplished system design by conducting research and analysis on China's existing smart pension market while leveraging available information technology. Furthermore, Java Eclipse and MySQL were employed for system construction along with intelligent health monitoring devices to enable real-time health monitoring, collection of vital signs data, and artificial intelligence-based disease prediction within home environments for older adults. Consequently, this approach can fulfill the demands of elderly care services while facilitating intelligent, convenient, and humanized homecare experiences that allow seniors to enjoy their golden years while alleviating burdens on their children.

Keywords: Elderly Care Services, Health Monitoring, MySQL, Java Eclipse.

1. Introduction

1.1. Background

In 2020, the total number of elderly people aged 60 and above in mainland China was 264 million, accounting for 18.7% of the total population. In the 20 years since China entered an ageing society in 2000, the proportion of the elderly population has increased by 8.4%. The proportion of elderly individuals witnessed a 5.4% increase over the span of ten years, from the sixth National census in 2010 to the seventh national census in 2020 [1]. The phenomenon of population ageing presents a challenging scenario.

With the advancement of science and technology, coupled with the enhancement of living standards, the paradigm of elderly care in contemporary society has undergone fundamental transformations. The demands for elderly care have gradually shifted from mere survival to encompassing enjoyment, thereby exhibiting characteristics such as high quality, efficiency, diversification, and personalization. In recent years, the intelligent platform system for elderly care has been continuously upgraded through iterative advancements in big data analytics, cloud computing infrastructure, and 5G mobile Internet technology. According to statistical data, there were 920 companies operating within China's smart elderly care industry in 2021, this number increased to 618 during January-August 2022. As of 2021, the market size of China's smart elderly care industry exceeded ¥600 million yuan—an impressive year-on-year growth rate of 62.23% compared to that observed in 2020 [2].

1.2. Literature review

In China, the development of smart elderly care is still in its nascent stage, characterized by inadequate application of key technologies, limited variety of smart elderly care products, lack of standardization and normalization in the regulatory system, insufficient implementation of supportive policies, and low cognitive levels among the elderly and their caregivers. Moreover, traditional pension concepts impose constraints on innovation. However, an analysis of overall trends indicates

that significant progress can be expected in future research prospects and development needs for smart elderly care [3].

According to the current research status, foreign scholars predominantly concentrate on the application and functional investigation of fundamental and technical aspects. These include intelligent sensing technology and equipment research and design, smart home design, research on quality of life in later years within the internet of things environment, as well as environmental design assistance for the elderly and related pathological studies [4].

Based on the current developmental landscape, developed nations have taken the lead in flexibly implementing intelligent elderly care practices tailored to diverse levels of needs and service scenarios, yielding notable outcomes. In Canada, private nursing homes will leverage advanced telemedicine technology to offer multi-party consultations and round-the-clock nursing services. Japan leans towards employing cutting-edge smart products like multifunctional beds and robots to better cater to the physical and emotional requirements of older adults. The United Kingdom will fully harness smart monitoring equipment to attentively monitor the living conditions of seniors residing in intelligent retirement apartments [5].

Since 2010, the implementation of smart home care practices in various regions of China has been gradually progressing. However, in comparison to other countries, there exists a relatively lower level of demand protection, narrower coverage group, and limited utilization rate of smart devices. Hangzhou Smart Elderly Care caters to the needs of elderly individuals, disabled individuals, and those suffering from dementia by providing emergency callers for their safety requirements [6]. Qingdao City relies on information platforms to offer free or affordable services that safeguard the basic physiological needs of economically disadvantaged individuals and senior citizens receiving minimum living allowances [7]. In Nan'an District, Chongqing a self-service hotline has been established where elderly individuals are automatically directed to appropriate service providers based on voice prompts for purchasing elderly care services [8]. Beijing has developed a virtual nursing home and a smart senior care demonstration base. Through telephone terminal products, websites, and apps, seniors can avail meal assistance as well as cleaning and walking support services [9]. Overall, the smart elderly care industry continues to be an emerging strategic sector in my country with vast development prospects and strong momentum for growth [10].

In order to address the comprehensive health management needs of elderly individuals at home, this study encompasses systematic research and design by combining health data from seniors with other relevant information while considering their susceptibility to chronic diseases. Consequently, we have developed the one-stop intelligent elderly care comprehensive service platform that enables elderly individuals to using it at home effortlessly. This platform incorporates AI-based disease prediction capabilities along with abnormal vital sign alerts, facilitating health consultations and doctor-patient communication. Given the current societal trend towards aging populations, this system holds significant application value.

2. The Market Analysis

2.1. Policy analysis

The policies in the field of smart elderly care in China have undergone the changes depicted in Figure 1.

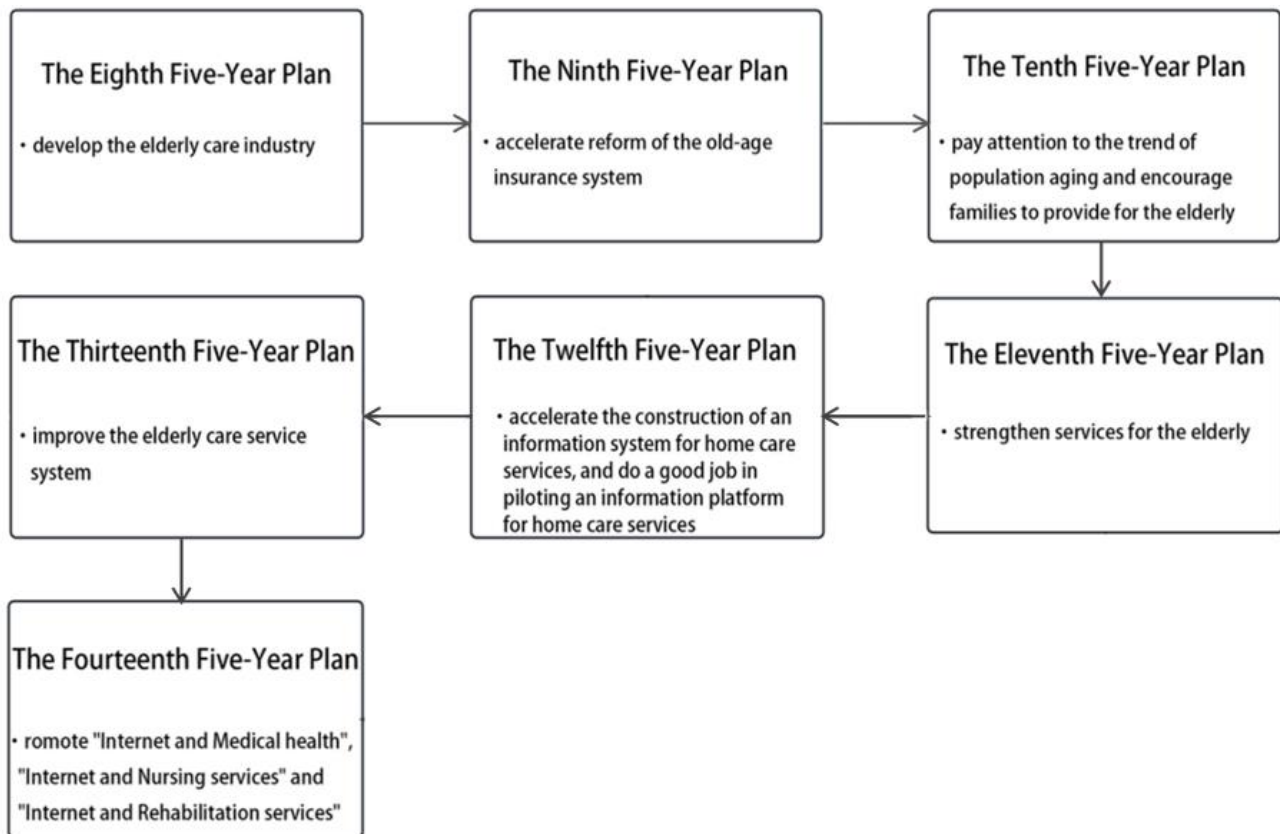


Figure 1. China's national economic planning, the evolution of intelligent pension policy

In response to the escalating aging population and in alignment with the national strategy, the 14th Five-Year Plan for Aging Undertakings and Elderly Service System Development, issued by The State Council of China on December 30, 2021, aims to establish a comprehensive institutional framework. This framework will facilitate effective coordination and high-quality development of aging undertakings and industries, enhance integration between community-based institutions, promote the convergence of medical care and health services with support systems, ultimately directing towards achieving the goals set for the elderly service market beyond 2025 [11]. The elderly care industry remains a pressing social concern that necessitates resolution; thus harnessing technology in addressing these challenges within the Internet era becomes imperative.

2.2. Target market size analysis

Firstly, based on the data forecast, there has been a consistent increase in the proportion of individuals aged 65 and above within the global population over time, indicating a worldwide trend towards an aging society.

Figure 2 presents a projected chart illustrating the distribution of age groups in Europe, clearly demonstrating a progressive rise in the percentage of individuals aged over 65 [12].

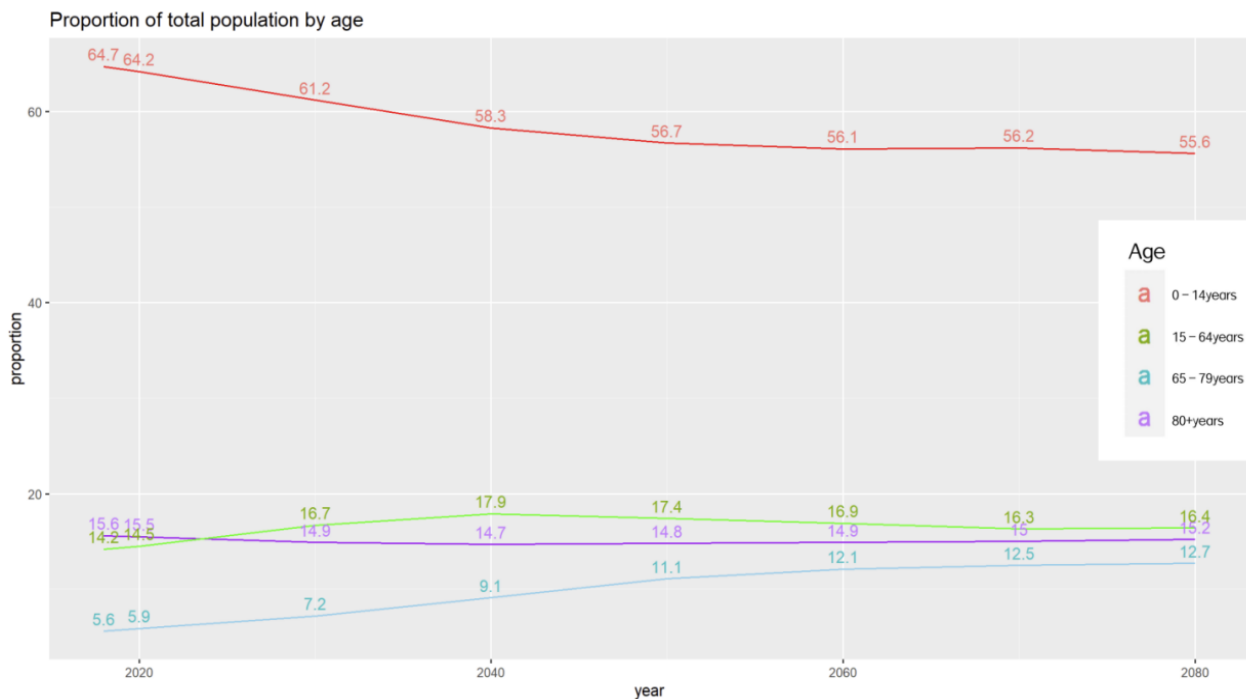


Figure 2. Population structure by major age groups (EU-28) 2018 and projections to 2080

Conversely, the growing prevalence of smart devices has provided elderly individuals with increasingly abundant opportunities to engage with electronic devices and access the Internet. Figure 3 illustrates the percentage of individuals aged 65-74 who utilize the Internet at least once a week in numerous countries, with most exceeding 50% [13].

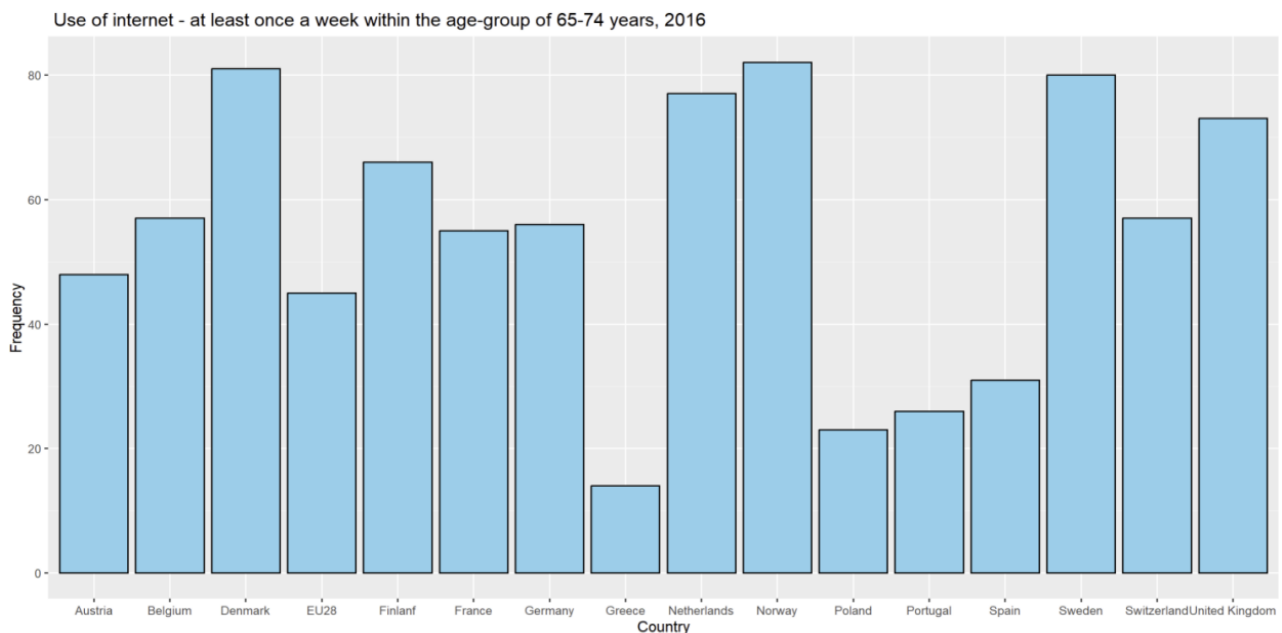


Figure 3. Population structure by major age groups (EU-28) 2018 and projections to 2080

This implies that there exists a greater potential for market expansion in the domain of smart facility services catering to the elderly population.

3. System Design and Implementation

The one-stop intelligent elderly care comprehensive service platform includes elderly care system management, elderly care system configuration, nursing service data analysis, health monitoring problem record, elderly care content setting and other functions. This system supports multiple users,

and each user sets the corresponding permissions according to their permissions. With a powerful user rights management function, each user can carry out detailed permission operation restrictions for multiple users to ensure system security. The foreground interface is reversible, and its actions can be a single operation or a sequence of operations.

3.1. System Structure Design

The platform employs an event-driven architecture (EDA), ensuring a high degree of decoupling among event processors [14]. The asynchronous nature of events enhances the software's resilience against congestion. Within this system, events can be seamlessly transferred between loosely coupled components and services. The entire system is divided into three main entities: the user (the elderly or their children), the One-stop Intelligent Elderly Care Comprehensive Service Platform, and the medical workers or alliance members. Figure 4 illustrates the system architecture.

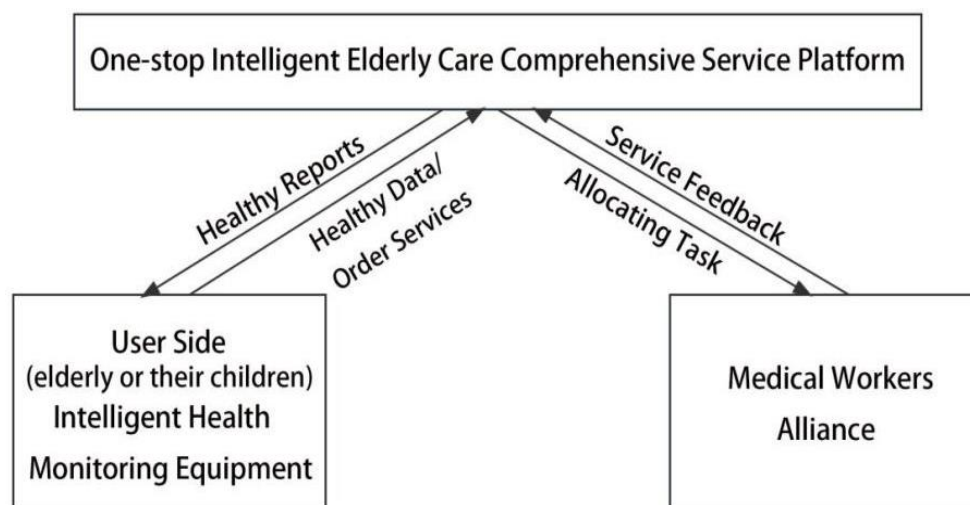


Figure 4. System architecture

3.1.1 Client (the elderly or their children)

The elderly and their children can order elderly care services from the system, collect health data through smart wearable devices and upload it to the system. Through the data analysis of the platform, the current health status and health recommendations can be viewed, and potential health risks can be known.

3.1.2 One-stop Intelligent Elderly Care Comprehensive Service Platform

As a data terminal, the user's service request is assigned to medical staff for completion. Health data collected by the monitoring system is analyzed and emergency rescue services are provided if necessary.

3.1.3 Medical workers and alliance

Complete the tasks assigned by the administrator and report back to the system. Medical workers primarily undertake medical tasks, including emergency response, health assessments, and other related duties. Meanwhile, franchisees are responsible for receiving orders within the medical services category.

3.2. Main technologies of the system

3.2.1 System Interface Design

The system interface adheres to the principles of simplicity and user comfort, while also taking into full consideration the specific needs of elderly users as depicted in Figure 5. Through the UI control interface, users are able to input data, execute various actions, and receive feedback from the application. Its development primarily relies on interface designer tools and the programming languages Java Eclipse for implementation.

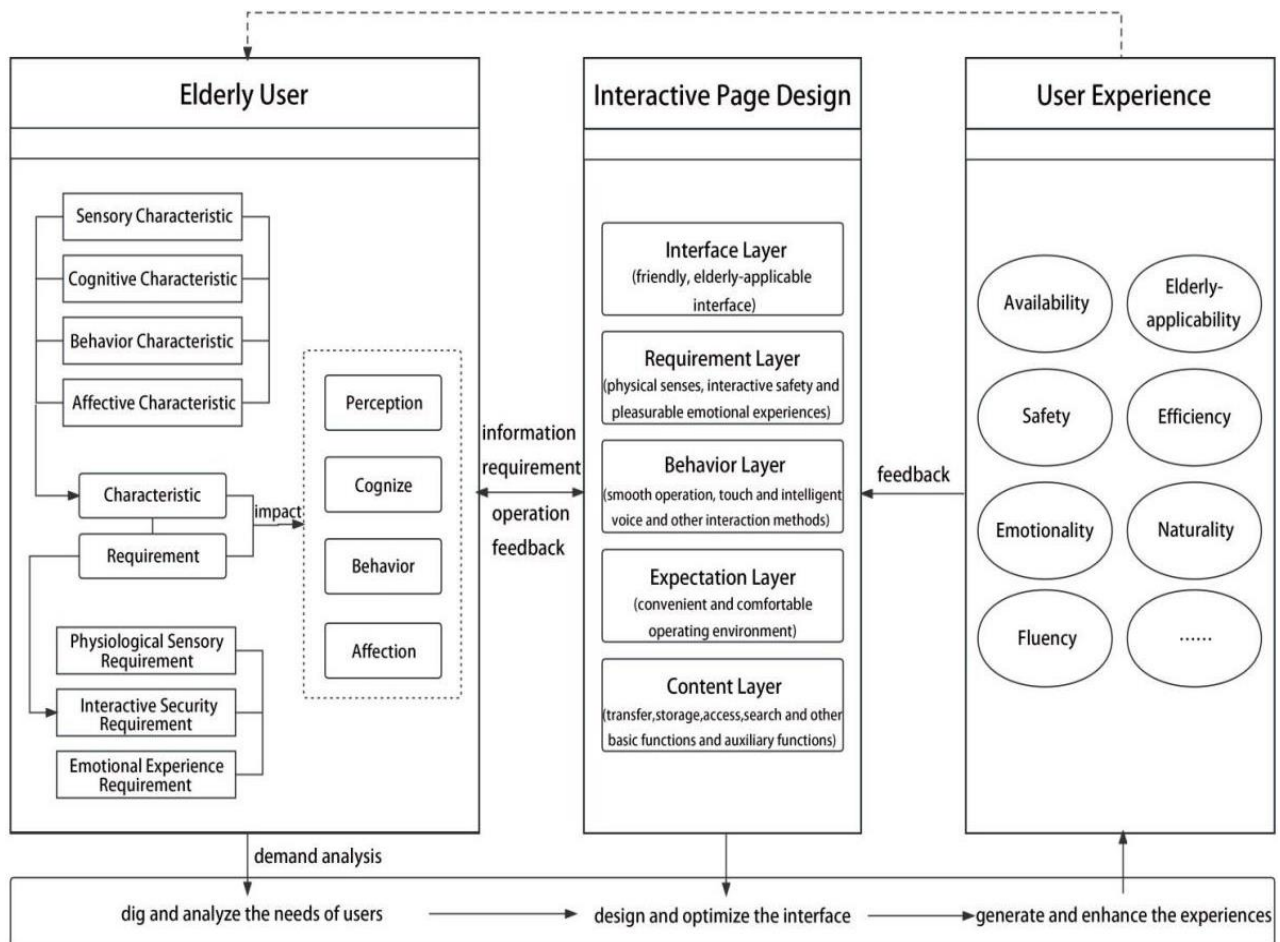


Figure 5. Interface design principles

3.2.2 Data base

The system utilizes a MySQL database [15] for data storage and employs modelling to transform the entity model of the real world into the conceptual model of the information world, represented by an E-R model as depicted in Figure 6. Following this model transformation, a relational data model is obtained, which corresponds to the relational database design paradigm used by the database. Subsequently, through further normalization based on established database design principles, a structured representation of the database is achieved.

The user data within the system encompasses attributes such as username, password, gender, date of birth, phone number, and address. A detailed depiction of the user data structure can be found in Table 1.

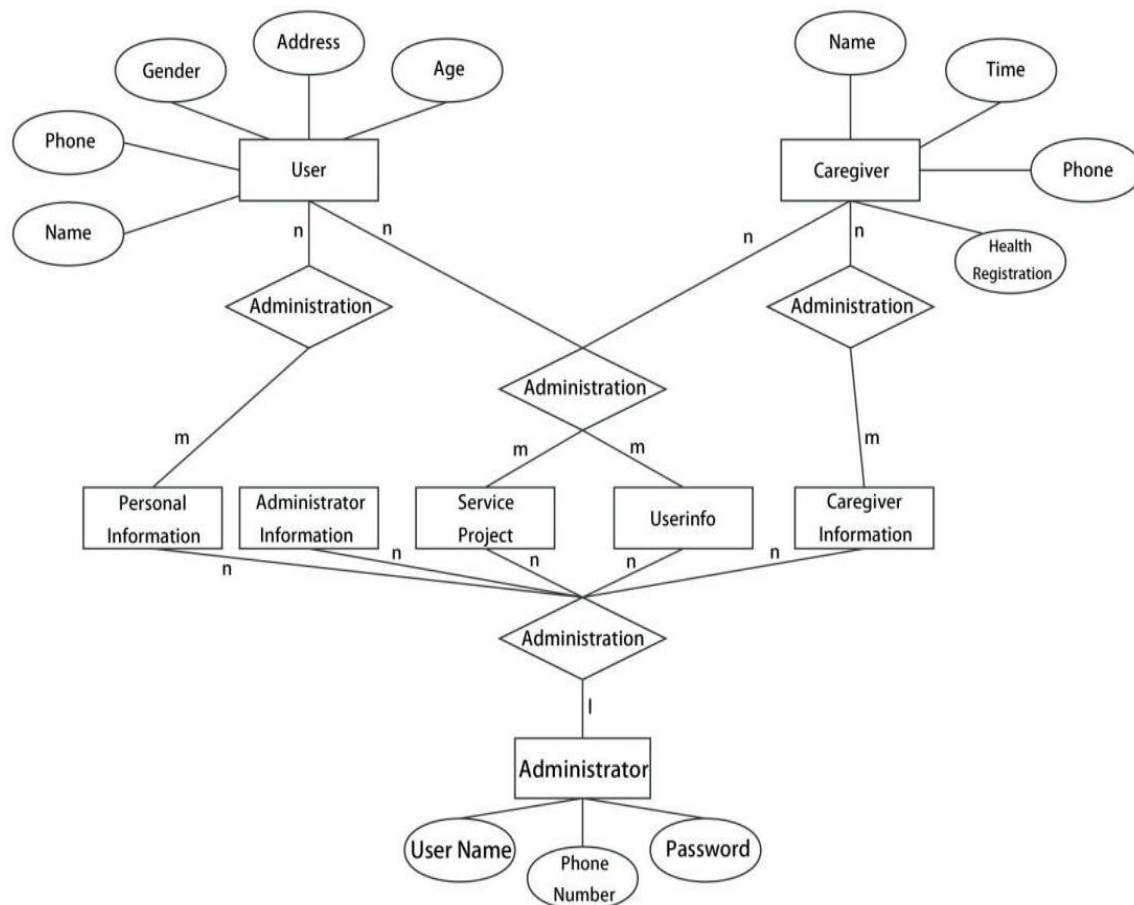


Figure 6. E-R figure

Table 1. User data structure in MySQL

Data name	Code	Datatype	Null allowed
Username	username	varchar	no
Password	password	varchar	no
Sex	sex	varchar	no
Birth Date	birth	datetime	no
Telephone number	tel	varchar	no
Address	add	varchar	no

3.2.3 Home care health monitoring and management system

Real-time monitoring of vital signs in the elderly at home is essential, along with providing health and disease predictions to enhance their self-health management and quality of life. Among the available data models for disease prediction, the neural network prediction model stands out due to its consideration of implicit relationships within vital sign data, ability to handle uncertainties, deep learning capabilities in prediction algorithms, and superior accuracy. Therefore, this system utilizes a neural network prediction model for effective health monitoring and disease prediction in elderly individuals at home.

3.3. System function module and its technical realization

3.3.1 Medical Worker Management

The Medical worker management interface allows users to configure the worker's identification number, name, and schedule within the medical care management system for efficient medical care operations. This page facilitates comprehensive information management and visualization of medical personnel, showed in Figure 7.

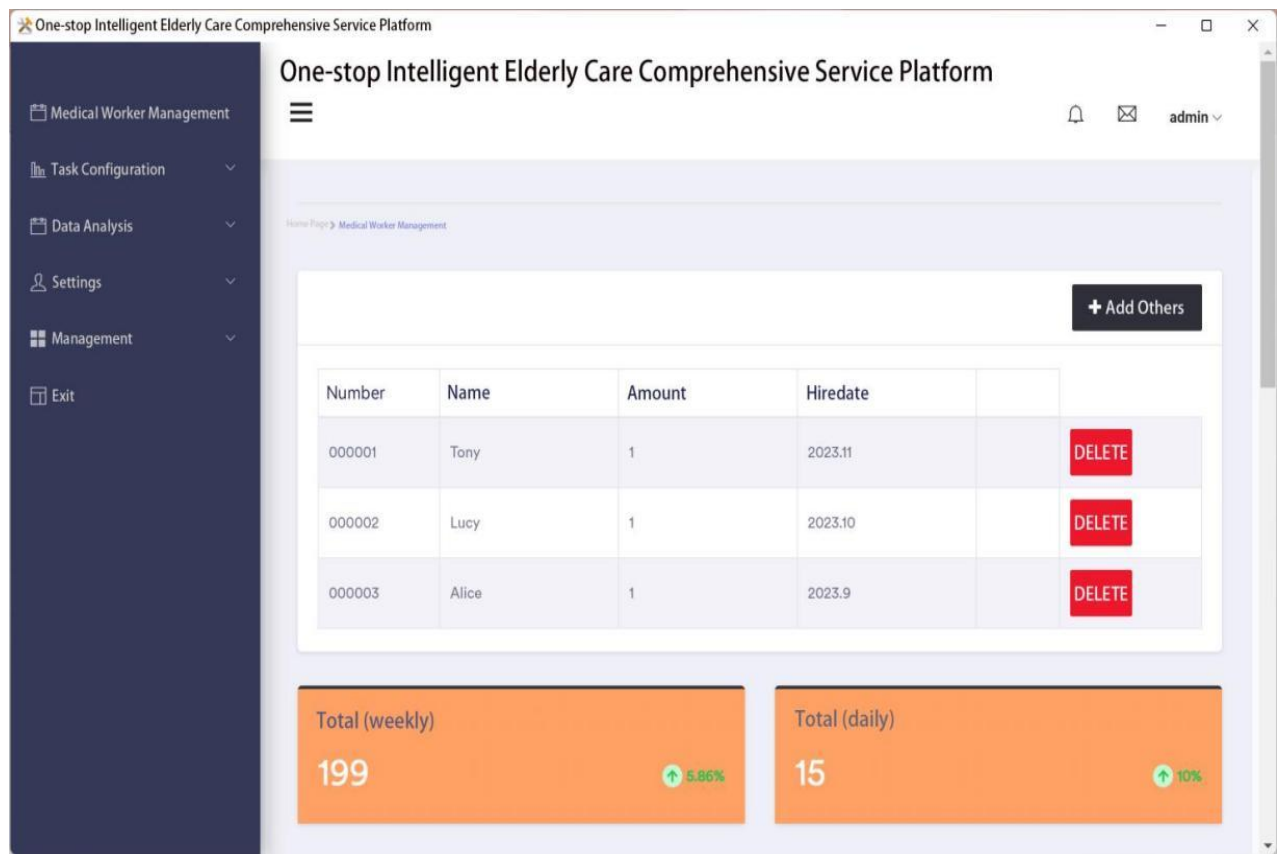


Figure 7. Medical worker management interface

3.3.2 Task configuration

On the task configuration interface, depicted in Figure 8, the system collects users' service requirements or emergencies detected by the health monitoring system and generates tasks to be assigned to medical personnel. Administrators have the capability to configure tasks, dispatch them to medical personnel, and monitor task progress.

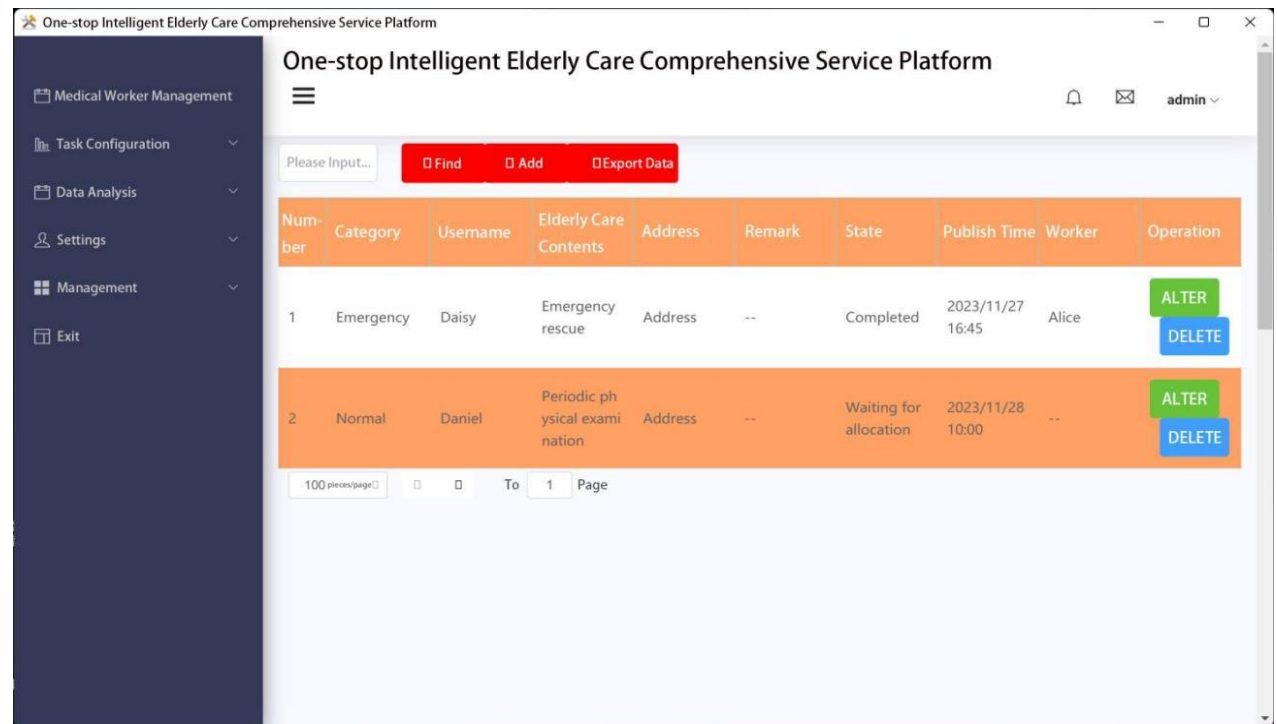


Figure 8. Task configuration interface

3.3.4 Data analysis

The service data analysis interface, as shown in Figure 9, presents users with visual graphical displays of nursing service data analysis including data statistics charts, proportion analysis pie charts, distribution analysis pie charts, and more. The user's health data records are displayed on the health monitoring data page.

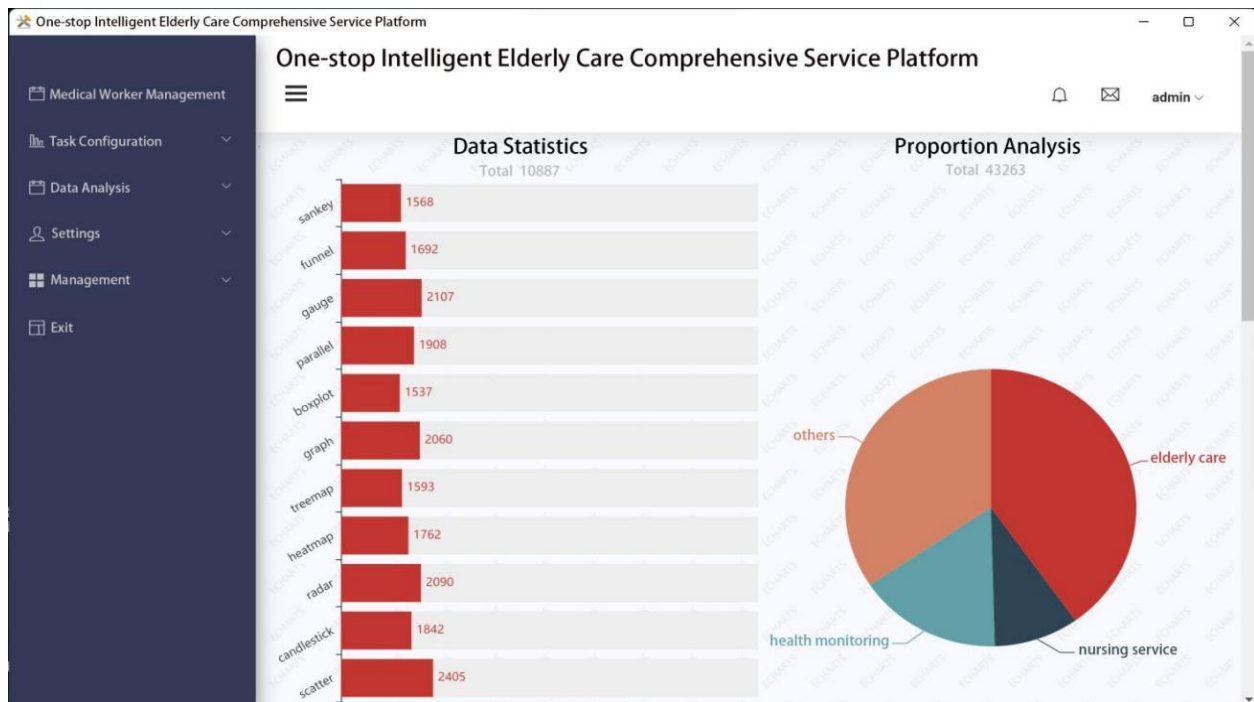


Figure 9. Data analysis interface

4. Conclusions

Owing to favorable policy backing and the prevailing social situation, the realm of smart elderly care technology is still evolving, presenting an opportunity for advancements in technological innovation within the field of elderly care services aimed at enhancing quality and convenience. Characterized by intelligence, convenience, and comprehensiveness, this platform integrates diverse resources such as medical services, nursing care, health management, and community support with the aid of Internet of Things technology. It can offer personalized medical advice, nursing assistance, and health management recommendations based on individual needs and health conditions while providing tailored, precise, and intelligent services for older adults. This platform is of great practical significance to enable the elderly to enjoy their old age in peace while reducing the burden on their children.

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