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Analysis of Innovative Applications of General Artificial Intelligence in Smart Aging Systems

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***Abstract*—As the aging problem in China intensifies, the traditional senior care model is facing challenges, and it is difficult to fully meet the growing demand for senior care services. Against this background, we propose smart old-age care as a new model of old-age care that integrates cutting-edge technologies such as the Internet of Things, big data, cloud computing artificial intelligence, etc. "Xianshouzhishou" smart old-age care system. Based on the Yolov9 target detection algorithm, the GLM-6B multimodal language model, and the Generalized Efficient Layer Aggregation Network (GELAN), the system provides a comprehensive solution aimed at improving the quality of life and safety of the elderly. Real-time Monitoring and Emergency Response: Real-time behavioral monitoring including fall detection and abnormal behavior recognition using the Yolov9 algorithm to quickly respond to potential emergencies. Emotion Understanding and Personalized Service: Analyze expression and voice features with the help of the GLM-6B model to understand the needs and emotional state of the elderly more deeply, so as to provide personalized care and service. Data processing optimization: The GELAN network is used to improve the data processing efficiency, enhance the accuracy and response speed of the system, and ensure the timeliness and effectiveness of the service. This study explores in detail the architectural design, application scenarios, and practical implementation effects of the "Xianshouzhishou Smart Guard" system, which not only demonstrates the broad prospects of smart aging technology but also provides valuable empirical support for future development.**

Keywords-Generalized artificial intelligence; Smart aging system; Target detection algorithms; Multimodal language models

I. INTRODUCTION

In contemporary society, with the increasing ageing of the population, the problem of the elderly has become an increasingly prominent social issue. The arrival of an aging society not only creates a huge demand for elderly resources, but also puts forward higher requirements for the efficiency and quality of elderly services. Therefore, how to innovate the elderly service model to better meet the needs of the elderly has become an urgent issue. However, in the face of the growing and increasingly diversified demand for senior care services, traditional senior care models such as family care and community care have become insufficient.

To meet this challenge, smart aging has emerged as a new aging model that integrates cutting-edge technologies such as the Internet of Things, big data, cloud computing, and artificial intelligence. Through the use of modern information technology means, smart aging aims to improve the level of intelligence, precision and personalization of elderly services, so as to better meet the needs of the elderly in life and spirit. Existing approaches mainly include smart home, smart wearable devices, online medical consultation and other initial attempts to apply smart aging technologies. Although the above solutions have improved the intelligent level of senior care services to a certain extent, there are still many shortcomings. Some of the intelligent senior care products have a single function and can only realize simple monitoring or service functions, temporarily lacking a comprehensive solution. At the same time, some products have deficiencies in data processing efficiency and response speed, which to a certain extent affects the quality of service and the experience of elderly life. In addition, the popularity of smart aging technologies is also low, and many older people lack the ability to understand and use new technologies, leading to a waste of technological resources. Against this background, we have developed the intelligent aging system "Xianshouzhishou".

The scientific novelty of this system lies in the integration of new algorithms and models, integrating IoT sensors, computer vision, multimodal interaction, deep learning and cloud computing into a framework, and proposing a closed-loop model of "data collection-real-time analysis-personalized service". The system is based on the Yolov9 targeting model. The system is built based on cutting-edge technologies such as Yolov9 target detection algorithm, GLM-6B multimodal language model and generalized efficient layer aggregation network (GELAN). The integration of these technologies enables the system to realize real-time monitoring and emergency response to the daily behaviors of the elderly, as well as fall detection and abnormal behavior recognition through the Yolov9 algorithm, ensuring that the elderly can receive timely assistance in emergency situations. At the same time, using the GLM-6B model for in-depth analysis of the expression and voice characteristics of the elderly, the system is able to more accurately understand the needs and emotional state of the elderly, so as to provide more personalized care and services. In addition, the application of GELAN network further optimizes the data processing process, improves the accuracy and response speed of the system, and ensures the

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timeliness and effectiveness of the service. The innovation of the system lies in the two aspects of emotion-driven personalized service and dynamic health management. By analyzing the voice and expression of the elderly through the GLM-6B model, the system provides emotional state perception services, breaking through the limitation of the traditional elderly care system that only focuses on physiological indicators. Combined with the GELAN network, the system can generate personalized diet and exercise programs based on real-time data, and dynamically adjust the service content, reflecting the shift from passive monitoring to active prevention.

This study aims to explore the architectural design, application scenarios, and practical implementation effects of the "Xianshouzhishou" intelligent elderly care system. By analyzing the technical principles and operational mechanisms of the system, it demonstrates the broad prospects of intelligent aging technology in improving the quality of life and security of the elderly.

II. Overview of Smart Aging Systems

As a product of the deep integration of modern information technology and senior care services, smart senior care is leading the new trend of senior care services with its unique innovative models and case practices. The following will discuss in detail the innovative applications and specific cases of smart elderly care in terms of accurate identification and behavioral analysis, multi-modal interaction technology, personalized service experience, and safety and security capabilities.

In terms of accurate identification and behavioral analysis, smart elderly care systems have achieved real-time monitoring of the behavior and health conditions of the elderly through the use of computer vision technology. For example, some advanced systems have been able to accurately identify the fall behavior of the elderly and issue timely alerts, thus effectively reducing the risks arising from falls. In addition, there are also systems that are able to conduct in-depth analyses of the sleep quality of the elderly and provide personalized improvement suggestions based on their sleep characteristics to help them enhance their sleep quality.

The introduction of multimodal interaction technology has significantly improved the ease of use and user experience of the smart elderly system. This technology allows seniors to interact naturally with the system through voice, gestures, facial expressions, and other means, and to easily access the services they need without complex operations. For example, in some smart aging systems, the elderly can control home devices through simple voice commands or browse and select services through gestures, and this intuitive interaction greatly reduces the learning burden of the elderly.

Personalized service experience is another major innovation of the smart elderly system. Through the combined use of deep learning algorithms and big data analytics, the system is able to dig deep into the interests, habits, and needs of the elderly, and then provide highly personalized service recommendations and customized service solutions. For example, one system tailored a reasonable diet plan and exercise program for the elderly based on their health status and nutritional needs, helping them better manage their health. This personalized service approach not only enhances the satisfaction of the elderly but also reflects the humanistic care of smart aging.

As one of the core functions of a smart elderly care system, the importance of safety and security capability is self-evident. Modern smart elderly care systems usually have powerful real-time monitoring and early warning functions, which can promptly detect abnormalities in the elderly and quickly take corresponding relief measures. For example, in some systems, once the vital signs of the elderly are monitored to be abnormal, the system will immediately and automatically notify the family members or medical staff to ensure that the elderly can be rescued the first time. This safety and security mechanism greatly enhances the sense of security of the elderly and their families.[1]

The innovative mode and case practice of smart aging fully demonstrates the great potential and broad prospects of modern information technology in the field of elderly services. In the future, with the continuous progress of technology and the increasing richness of application scenarios, we have reason to believe that smart aging will bring more convenient, efficient, and comfortable life experiences to more elderly people.

III. The Technical Architecture of the Xianshouzhishou System

A. Implementation and optimization of core technologies

The implementation and optimization of the core technology of the Xianshouzhishou Smart Guard Smart Elderly System is the key to its success. Among them, the application of the Yolov9 target detection algorithm enables the system to accurately recognize and track the movements of the elderly, and then analyze their health status. By improving the detection accuracy and speed of the algorithm, we have not only improved the accuracy of recognition but also reduced the false alarm rate, thus ensuring real-time monitoring and effective analysis of the elderly's behavior.[2][4]

As shown in Figure 1, the GLM-6B multimodal language model enables the system to understand and respond to voice commands and text inputs from the elderly. By optimizing the training process of the model and adjusting the parameter settings, we enhanced the model's ability to understand the language habits of the elderly and improved the naturalness and accuracy of the interaction. This optimization not only enhances the user experience, but also enables the system to provide services more accurately.

The application of a generalized efficient layer aggregation network (GELAN) further enhances the data processing capability of the system. Through efficient network structure design and optimization, we achieve rapid processing and analysis of a large amount of health data and provide personalized health management and service suggestions for the elderly.[3]

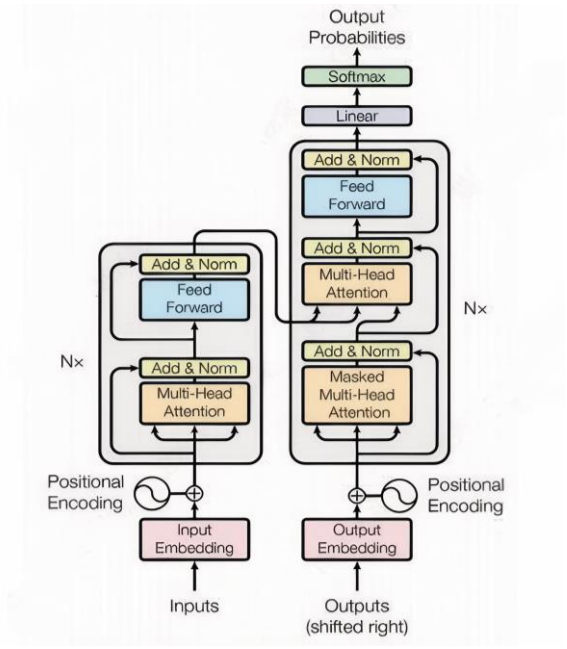

Figure 1. GML-6B Structure Diagram

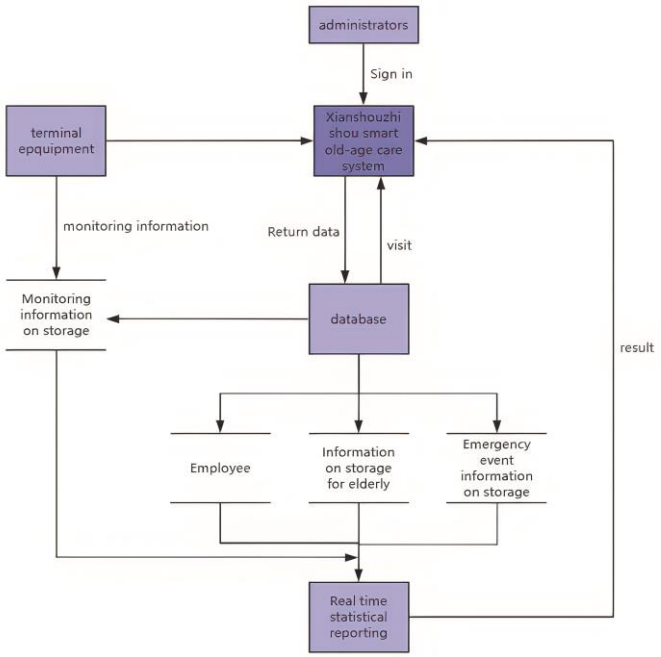

Figure 2. System Workflow Diagram

In the process of optimizing these core technologies, we also pay special attention to system stability and security. Through the use of advanced encryption technology and security measures, we ensure the secure transmission and storage of elderly data and prevent the risk of data leakage and illegal access.

In a word, the core technology realization and optimization of Xianshouzhishou Smart Elderly System is an ongoing process. We will continue to conduct in-depth research and technological innovation, constantly improve the system functions, improve the quality of service, and provide the elderly with more intimate and convenient senior care services. At the same time, we will also actively pay attention to the industry dynamics and technology development trends, timely introduction of new technologies, and new ideas to promote the continuous development of the cause of intelligent elderly.

B. System Architecture and Functionality

The architectural design and functional division of Xianshouzhishou Smart Elderly System are all aimed at better serving the elderly groups and meeting their diversified and personalized elderly needs. The main functional modules, as shown in Figure 2, of the system and their collaboration are described in detail below.

The Data Acquisition and Processing Module is the basic part of the system, which continuously collects health data of the elderly, such as heart rate, blood pressure, blood glucose, and other physiological indicators, as well as information on their daily activities through various sensors and devices. These data are pre-processed and cleaned and then transformed into formatted information that can be analyzed by the system. The efficient operation of this module ensures the accuracy and timeliness of the data, providing a solid foundation for subsequent health condition monitoring and service recommendation.[5][9]

The real-time monitoring and analysis module is the core of the system. It applies advanced algorithms and technologies to deeply analyze the collected data to realize real-time monitoring of the health status of the elderly. Once abnormalities are detected, such as abnormal heart rate and fluctuating blood pressure, the system will immediately activate an early warning mechanism to notify medical staff or family members in a timely manner to ensure that the elderly receive timely assistance and treatment. The powerful functions of this module greatly improve the safety and reliability of elderly services.

The two modules collaborate with each other to build a comprehensive, convenient, and efficient intelligent elderly service system. The data acquisition and processing module provides the system with rich and accurate data resources; the real-time monitoring and analysis module ensures that the health conditions of the elderly are monitored in real-time and responded to in a timely manner. This modularized design idea not only improves the scalability and maintainability of the system but also lays a solid foundation for the future development of smart elderly services.

IV. System Implementation Methods and Processes

A. Optimization of deep learning algorithms

The optimization of the deep learning algorithm is a crucial part of the Xianshouzhishou Smart Elderly System. This optimization process involves the adjustment of the algorithm network structure, the improvement of parameter settings, and the expansion of the training dataset, aiming to improve the detection accuracy and speed of the algorithm, so as to make it better adapted to the characteristics of the health data of the elderly, and to provide more accurate analysis results for the system.[11]

For the optimization of the network architecture, we focus on improving the expressive power and generalization performance of the model. By introducing more advanced network architectures, such as convolutional neural networks (CNN) or recurrent neural networks (RNN), the system is able to capture the features in the data more effectively. In addition, we employ technical tools such as residual join and batch normalization to enhance the stability and convergence speed of the network.

In terms of parameter setting, we employ techniques such as gradient descent optimization algorithm, regularization strategy, and learning rate adjustment to achieve a more efficient training process and more accurate model prediction. The adoption of these technical tools not only enhances the training efficiency of the model but also significantly improves the prediction accuracy of the model.[10]

To further enhance the generalization ability of deep learning algorithms, we employ data augmentation techniques to expand the training dataset. By rotating, scaling, and panning the original data, we generate more training samples with diversity. This not only enriches the input data of the model but also helps the model learn more robust feature representations, thus improving its adaptability to elderly health data in different scenarios.

By comprehensively optimizing the network structure, parameter settings, and training dataset of the deep learning algorithm, we have significantly improved the data processing and analysis capabilities of the Xianshouzhishou Smart Elderly System. These improvements provide the system with more accurate and efficient analysis results, thus enabling it to better serve the aging needs of the elderly.

B. Collection of user requirements

In the development process of the Xianshouzhishou Smart Elderly System, an in-depth understanding and precise grasp of users' needs is the key to ensuring the practicality of the system and user satisfaction. In order to comprehensively collect the needs and interests of the elderly, we have adopted a variety of methods and channels.

Through the design of exhaustive questionnaires, we conducted extensive data collection on the daily living habits, health conditions, and interests of the elderly, as well as the difficulties and needs they encountered in the process of aging. These questionnaires not only covered basic life care and health management needs, but also explored in depth the expectations of the elderly in terms of socialization, recreation, and learning.

We organized a series of interviews and symposiums, inviting representatives of older persons of different ages, genders, and health conditions. During these events, we encouraged older people to share their real thoughts and experiences so as to gain a deeper understanding of their specific needs and expectations. Through these face-to-face exchanges, we not only gained valuable user feedback but also established an emotional connection with the elderly, laying a solid foundation for subsequent system design and optimization.

We also conducted field trips to senior care institutions and communities to observe the daily lives of the elderly and the environment in which they live. This direct observation helped us to gain a more intuitive understanding of the actual needs of the elderly and the pain points in the aging process.

After collecting a large number of user requirements, we have analyzed and organized these data in detail and refined the core needs and desired functions of the elderly in the smart elderly system. These needs not only involve basic life care and health management, but also include a variety of aspects such as social interaction, cultural entertainment, and spiritual comfort.

To ensure that the system continues to meet the needs of the elderly, we have also established a comprehensive user feedback mechanism. We continue to collect users' experiences opinions and suggestions through regular user satisfaction surveys, online feedback channels, and regular user forums. These feedbacks not only help us identify and solve the problems in the system in time but also provides us with valuable optimization suggestions and innovative ideas.[6][7]

Through in-depth and comprehensive collection and analysis of user requirements, we have provided strong support for the design and optimization of the Xianshouzhishou Smart Elderly System. This not only ensures the practicality of the system and user satisfaction but also points out the direction for our subsequent R&D work.

C. Technical realization

The technical realization of Xianshouzhishou Smart Elderly System is a comprehensive project, which covers not only the careful selection and configuration of hardware but also the in-depth development and integration of the software platform, as well as the strict protection of data security and privacy. The perfect combination of these aspects ensures that the system can operate stably and efficiently, thus providing quality senior care services for the elderly.

In terms of hardware equipment, we know that data accuracy and real-time are the cornerstones of a smart elderly system. Therefore, we have carefully selected high-performance sensors and intelligent terminal devices that can accurately collect various health data of the elderly, such as heart rate, blood pressure, blood glucose, and so on. At the same time, we also consider the ease of use and comfort of the devices to ensure that the elderly can feel convenient and comfortable in the process of using them.

In terms of software platforms, as shown in Figure 3, we have taken full advantage of cloud computing and big data technology to develop an efficient data processing and analysis platform. This platform is able to quickly process and analyze the massive amount of data collected to provide personalized service recommendations and health management solutions for the elderly. At the same time, we also focus on the scalability and flexibility of the platform so that it can be expanded and optimized in the future according to actual needs.

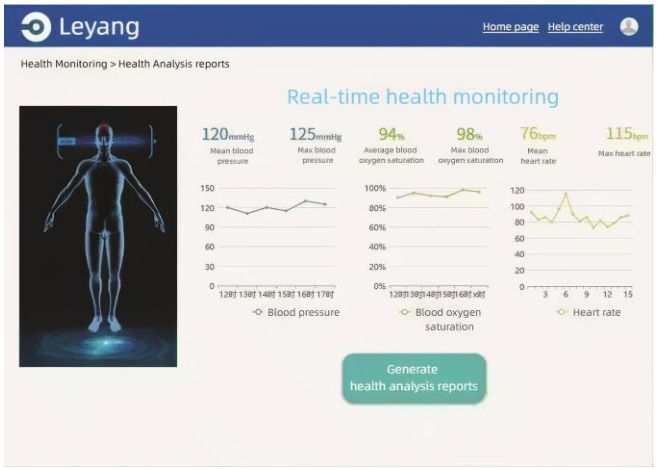

Figure 3. System real-time health monitoring module

Figure 4. WeChat Mini Program Side of the System

Data security and privacy protection are a top priority in our technical implementation. We understand the importance of seniors' personal information and health data and therefore employ advanced encryption technologies and strict access control policies to ensure the security and privacy of these data. Only authorized personnel can access sensitive data, thus effectively preventing data leakage and misuse.

D. User Interface Design

The user interface design of Xianshou Smart Guard Smart Elderly System is not only a simple operating interface, but also an interactive experience carefully crafted after we deeply understand the needs and usage habits of the elderly. We know that for many elderly people, complicated operation interfaces and cumbersome operation steps may become obstacles for them to use technology products. Therefore, we always adhere to the principle of "simplicity, intuition, and ease of use" when designing the user interface.

Graphical interface design, as shown in Figure 4 and Figure 5, is an important tool for us to enhance the user experience. With well-designed icons and buttons, we strive to make every operation easy to understand at a glance. Older people can quickly find the functions they need with just a tap on the screen, without having to get lost in complicated menus.

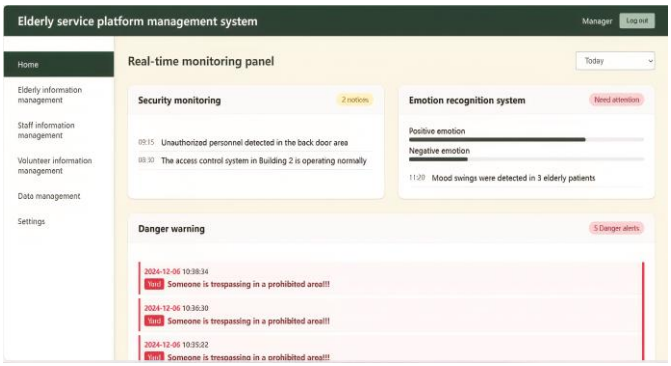

Figure 5. System Administrator's End Page Display

We understand the importance of voice interaction and gesture recognition in smart aging systems. For seniors with poor eyesight or limited mobility, these interactions can greatly enhance their ease of operation. Therefore, we have integrated efficient voice interaction and gesture recognition into the system so that seniors can easily control the entire system through simple voice commands or gesture operations.

In addition to the above interactions, we have carefully optimized the font size and color scheme of the interface. We understand that the eyesight of the elderly may gradually deteriorate with age. Therefore, we chose large fonts and high-contrast color combinations to ensure that seniors can clearly see every character and icon on the screen.

The system is able to accurately capture the sleep status of seniors through sensors installed in the room, including data on the time of falling asleep, sleep duration, and sleep quality. These data are intelligently analyzed to generate personalized sleep improvement suggestions for each senior. At the same time, the system can also monitor the activity trajectory of the elderly in real time to understand their daily activity habits and interest preferences.

Based on these precise data analyses, elderly care organizations are able to provide more attentive services to the elderly. For example, they can adjust the light and temperature of rooms according to the sleeping habits of the elderly to create a more comfortable sleeping environment, and customize personalized recreational activities and exercise plans for the elderly based on their activity trajectories and interest preferences.

The remote monitoring and management functions of the Xianshouzhishou Smart Elderly System also bring great convenience to elderly organizations. Institutional staff can view the health status and behavioral data of the elderly at any time through the system, and discover abnormalities and deal

with them in a timely manner. At the same time, the system can also automatically generate various types of statistical reports to help organizations better assess the effectiveness of services and improve the service process.[8]

V.Conclusion

This study provides an in-depth discussion around the innovative application of general artificial intelligence in smart elderly care systems, especially taking Xianshouzhishou Smart Elderly Care System as an example, and analyzes in detail the system's excellent performance and practical value in improving the quality of life of the elderly, optimizing the process of elderly care service, and enhancing the safety and security capabilities. The system utilizes advanced computer vision technology and deep learning algorithms to achieve real-time monitoring and accurate analysis of the behavior of the elderly. Meanwhile, the combination of multimodal interaction technology enables the system to provide more comprehensive, convenient, and efficient senior care services for the elderly, effectively solving the problems and deficiencies of the traditional senior care model. This study fully demonstrates the great potential and value of the innovative application of generalized AI in the smart aging system. Although this study has achieved some results in exploring the field of smart aging, there are still some limitations and shortcomings, such as the problem that lying down and falling down are sometimes indistinguishable, so how to provide differentiation accuracy, which will serve as for the main research direction in the future.

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