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Contents

Construction of a Health Promotion Service Platform for Integrating Care Under the Background of the Internet

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Abstract. With the growing improvement of the healthcare system, the standard of living of the population has risen significantly. Their health awareness has gradually increased, and people are paying more attention to their physical health. In modern society, the phenomenon of population aging is severe, and medical resources are scarce. In order to alleviate medical needs, improve health service efficiency, optimize medical procedures, facilitate elderly medical treatment, and improve the satisfaction of elderly patients, this article analyzed traditional medical processes and elderly care models. Starting from the general needs of the elderly, combined with advanced internet technology, it built a health promotion service platform Integrating Care care to better meet the medical needs of the elderly for healthy living. This article first introduced the advantages and challenges of combining medical care and elderly care in the context of the Internet, and analyzed the significance and importance of promoting healthy living for the elderly. After that, the requirements for the health promotion service platform were discussed, and an architecture plan for the health promotion service platform was proposed based on actual needs. Finally, to verify the feasibility and rationality of optimizing the health promotion service platform in this article, application comparative experiments were conducted. The experimental results showed that compared to traditional health promotion service platforms, the optimized health promotion service platform had an average improvement of about 11.2% in four indicators: queue registration speed, professional level of consultation, medical experience, and post diagnosis feedback. The optimized health promotion service platform in this article has a more complete medical process and work structure, and can effectively integrate medical and elderly care resources, improving the health of the elderly and promoting the innovative development of healthcare integration, thereby contributing to responding to national policies and achieving sustainable social development.

Keywords: Internet Background · Combination of Medical and Nursing Care · Health Promotion · Process Optimization · Integrated Care Models

1 Introduction

In recent years, with the rapid development of internet technology and the intensification of social aging, the medical and elderly care fields are facing increasingly severe challenges. The traditional medical care model is no longer able to meet the diverse, personalized, and convenient needs of the elderly. In order to better meet the social needs of the elderly for healthy elderly care, the innovative service model combining network technology and healthcare has become an important development direction in the current healthcare and elderly care fields. Although the current medical system is in a new stage of reform and innovative development, overall it still belongs to a "top-down" management model. The traditional service process still lacks attention to the needs of the elderly and lacks social organization construction. Therefore, this paper analyzed the current state of healthcare services from the point of view of the current trend of healthcare integration.

The continuous changes in social culture and economic structure have promoted the popularization of elderly health service concepts, and the implementation of the elderly health service platform architecture plan has also become the trend of social reform. The application of elderly smart homes and remote care in the health service structure has opened up a new direction for the optimization and development of health service platforms. Unlike traditional platform service focuses, health service platforms based on elderly smart homes not only focus on policy driven, but also pay attention to technology driven, providing new strength for the structural innovation of health service platforms [1, 2]. The aging population has made the health issues of the elderly increasingly prominent. With the increasing health needs of the elderly, a sampling analysis of the unmet health needs of the elderly in the health service platform is conducted to explore how to build an integrated health service platform, combined with the medical experience of elderly patients and the implementation of local policies, in order to better meet the health needs of the elderly [3, 4]. Directly driven by the economy and the times, the implementation of healthcare integration is based on a platform of healthcare information and common services. However, advanced electronic devices are difficult for elderly patients to learn and use, indicating the necessity of an easy-to-use health service platform architecture [5, 6]. The current health service platform plan for the elderly is not yet mature, and more challenges need to be met in practice.

The widespread application of internet technology has provided new opportunities and challenges for the optimization design of health service platforms, which requires increasing general awareness of the application of internet technology. The elderly population who have been severely affected by the epidemic virus generally suffer from serious psychological problems. Based on an internet questionnaire, a survey and analysis were conducted on the multiple symptoms of the elderly. The results showed that the current medical process has overlooked the diagnosis of the psychological health of the elderly, and more cases need to be summarized [7]. The business scope that the Internet of Things has taken over is very extensive, and its application in medical care is deeply rooted in people's hearts. Traditional medical care services have lost their effectiveness in meeting the health needs of elderly patients, and they need to be assisted at various levels based on advanced internet technology [8, 9]. With the rapid development of Internet technology, the concept of smart medicine has gradually emerged. Based on

a new generation of information technology such as Internet of Things, big data, cloud computing, the traditional health promotion service platform has been comprehensively transformed to make medical care and recuperation activities more efficient and fast [10, 11]. The improvement of internet technology not only brings innovation to the optimization of health service platforms, but also challenges. Therefore, the mission goal of building a healthcare-integrated health enhancement service platform in the context of the Internet still needs to be further explored.

Currently, there is a large population in society, and the average life expectancy continues to extend. Human beings have increasingly high requirements for quality of life. However, with the development of the social economy, there is a serious shortage of medical and health resources, and the phenomenon of population aging is becoming increasingly severe. There is an urgent need for public attention and reflection [12, 13]. The purpose of this paper is to explore how to build a health promotion service platform that integrates healthcare in the context of the Internet, in order to improve the living experience of elderly people's healthy elderly care. Firstly, the current situation and development trend of the society was analyzed to understand the goal of the progress of healthcare integration in the context of the Internet. Starting from the history, this paper analyzed the influence of the the Internet age on the combination of medical care and elderly care, as well as the advantages and challenges of the combination of medical care and elderly care under the Internet background. This article summarized the role and significance of health promotion services, and proposed suggestions for addressing the vulnerabilities and deficiencies of traditional health promotion service platforms. By combining advanced internet technology and adopting a scientific and reasonable platform architecture plan, the traditional health promotion service platform was optimized. Finally, after experimental verification, the optimized health promotion service platform in this article has higher medical and nursing quality and smoother medical and nursing work structure compared to traditional health promotion service platforms. It promotes the physical and mental health of elderly patients and promotes innovation and development of medical and nursing integrated services.

2 Advantages and Challenges of Combining Medical and Nursing Care in the Context of the Internet

The popularization and development of Internet technology is the trend of the times. Since the maturity of the technology came out and relied on, it has completed market occupation at all levels at a high speed. Healthcare integration in the context of the Internet can bring more benefits and convenience to the elderly, and its potential application in the field of healthcare integration is widely expected by all sectors of society [14, 15]. The Internet can effectively integrate medical and maintenance resources and allocate service resources reasonably. By connecting medical institutions, government agencies, and family and friends, all management entities related to the rights and interests of the elderly are connected to the health promotion service platform. This not only improves the efficiency of resource utilization, but also achieves resource sharing and multi-party assistance, providing more comprehensive and convenient medical care services for the elderly.

The Internet can achieve information collection, dissemination, and sharing functions on a global scale. Elderly people can obtain professional knowledge popularization from experts and life advice from relevant medical staff on health promotion service platforms, so as to better understand their physical and mental state, clarify health needs, and provide clearer needs for future professionals in the process of providing health services [16, 17]. In the context of the Internet, health services that integrate medical and elderly care have become more intelligent. Based on advanced Internet of Things technology and highly sensitive sensor devices, real-time monitoring and evaluation of the physical condition of the elderly can be achieved, and more personalized service solutions can be provided according to the actual health needs of the elderly. This not only improves the intelligence of healthcare integration, but also enhances the experience of elderly patients in their old age.

With the rapid progress of internet technology, the integration of medical care and elderly care can improve the social level between elderly patients. Elderly patients can easily share their daily lives and exchange elderly care experiences with their family and friends, greatly reducing their psychological loneliness and social distance. In the background of the Internet, a unique model of healthcare integration has enriched the means of communication and exchange between the elderly and the outside world, and expanded the field of life for the elderly, thereby providing professional advice and assistance more timely. Figure 1 shows the advantages of combining medical and nursing care in the context of the Internet.

The era background supported by Internet technology is inseparable from the frequent interaction of massive data, and the security of a large number of personal health and pension information data is threatened. How to protect the privacy of the elderly's personal information and the security of pension data, and prevent information data
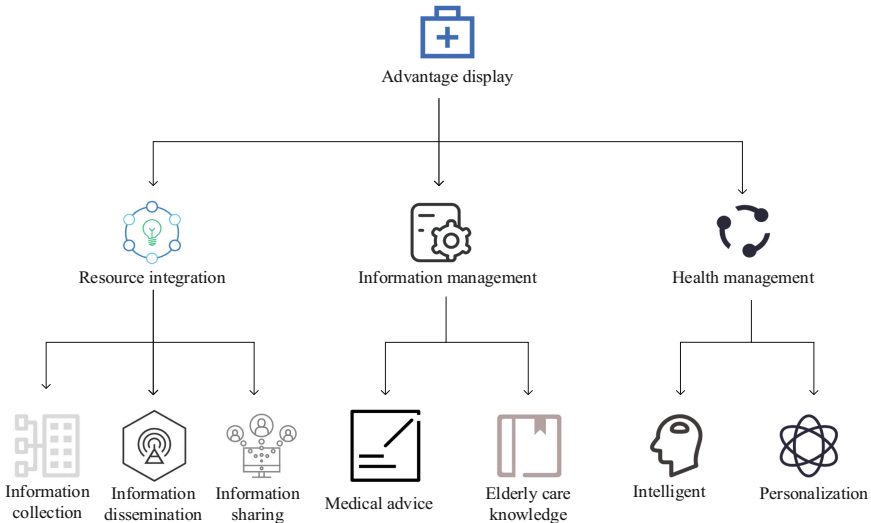
Fig. 1. Demonstration of the advantages of combining medical care and elderly care in the context of the Internet

breach or abuse by criminals is the first prerequisite for establishing an optimized health service platform. In addition to this, the digital divide between older persons and the Internet age needs to be taken into account. The majority of older persons' advancing age and declining energy levels have left them without sufficient learning capacity to develop relevant digital literacy and device use. Therefore, measures need to be taken to improve the use of electronic technology among older people and to provide more reliable information services. How to ensure the quality of service is also an important challenge for integrated health promotion services. There is a large amount of false information on the Internet, and the level of service capabilities for health promotion is uneven. The phenomenon of false advertising is also repeatedly prohibited. Therefore, it is necessary to strengthen the information regulation of healthcare combined health service providers and regularly assess their service quality. Figure 2 shows the analysis of the challenges faced by healthcare integration in the context of the Internet.
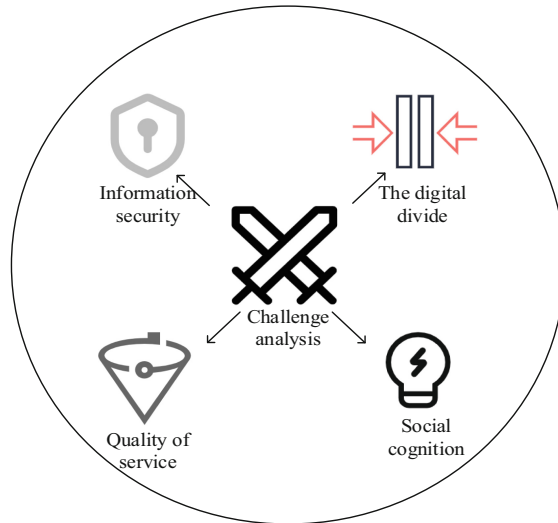
Fig. 2. Analysis of the challenges of healthcare integration in the context of the Internet

3 Requirements and Architecture of Health Promotion Service Platform

By fully utilizing internet information technology, the architecture concept of high degree of freedom and precise management can be adopted, and a mature and stable universal structure can be adopted to analyze based on the actual needs of the elderly [18]. According to the coverage level of the business scope of the health promotion service platform, it is necessary to optimize the practicality of traditional health promotion service platforms and fully consider the actual connotation of local policies. It is important to support existing business needs, but also to respond to the policy call to look to the future based

on the present, thus providing a smoother transition to future industry needs [19]. Based on the long-term development of device applications, the uninterrupted operation of the platform is the foundation for smooth business activities. Optimizing the reliability and stability of traditional health promotion service platforms using more stable and reliable internet technology and advanced equipment is also of utmost importance.

While complying with relevant laws and regulations on national information security, based on advanced internet information technology and stable intermediate electronic devices, combined with the multi-level security system construction of the health enhancement service platform, and preventing malicious theft of information, it ensures the privacy and security of elderly patients [20]. The optimized health promotion service platform in this article focuses on elderly patients and establishes a mobile information model to cover the entire process of consultation, treatment, and recovery for elderly patients, including patient appointment, online queuing, expert consultation, and hospitalization payment. Based on the actual needs of patients, personalized plan decisions can also be made to provide more comprehensive and convenient health services for elderly patients. Figure 3 shows the online work interface of the health promotion service platform.
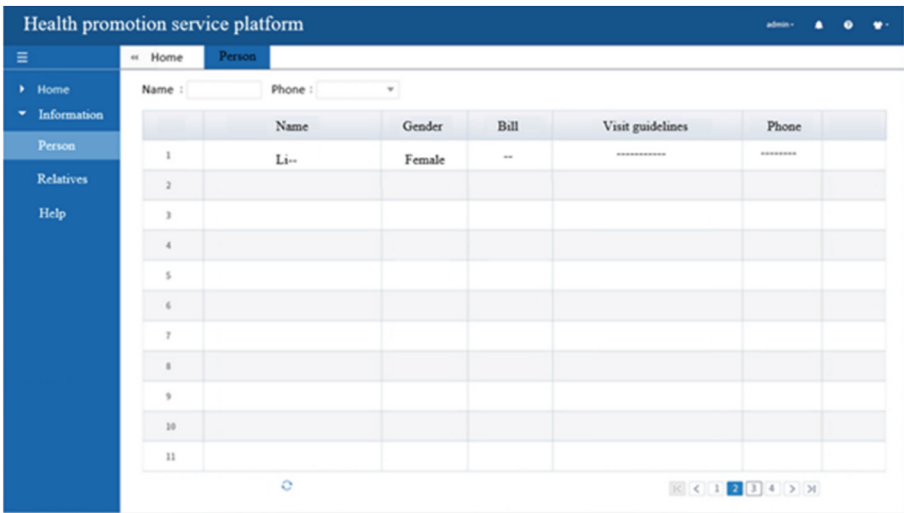
Fig. 3. Online work interface of health enhancement service platform

4   Application and Effectiveness Evaluation of Health Enhancement Service Platform

With the deepening of population aging, the building of the healthcare service system is facing many problems, and there is an urgent need to optimize it in combination with the medical care model. This article conducted a comparative experiment in an elderly

nursing institution to verify the application effect of optimizing the health promotion service platform. 20 elderly patients were randomly sampled to participate in the experiment, with a male to female ratio of 1:1. The 20 elderly patients were evenly divided into two groups, and different service modes were applied starting from the initial registration consultation process. This experiment used the traditional health promotion service platform as the control group and the optimized health promotion service platform as the experimental group. The service experience of different health promotion service platforms was evaluated by patients from four aspects: queue registration speed (A), professional level of consultation (B), medical experience (C), and post diagnosis feedback (D). The evaluation index was online at 9, with 1–3 being average, 4–6 being good, and 7–9 being excellent. Table 1 shows the comparison of the application effectiveness of the health promotion service platform.

Table 1. Comparison of Application Effects of Health Promotion Service Platform

	A		B		C		D	
	Traditional platform	Optimized platform	Traditional platform	Optimized platform	Traditional platform	Optimized platform	Traditional platform	Optimized platform
1	6.79	6.10	5.06	6.12	5.79	6.36	6.75	7.46
2	6.53	6.61	5.17	6.14	5.23	6.10	5.30	7.53
3	6.04	7.61	5.40	6.87	5.71	6.43	6.34	7.91
4	6.23	7.26	6.80	6.24	6.37	6.28	6.64	7.94
5	6.61	7.55	5.82	7.00	5.07	6.17	6.77	7.62
6	6.56	6.69	5.87	6.02	6.63	6.13	6.94	6.05
7	6.66	6.61	6.29	6.42	5.38	6.51	5.45	7.81
8	6.73	7.27	6.16	6.14	6.06	6.22	5.05	6.85
9	6.85	7.56	5.71	6.39	6.12	6.96	6.30	6.21
10	6.32	6.89	6.40	6.02	5.08	6.78	5.21	6.27

In Table 1, in the control group experiment using traditional health promotion service platforms, the average indices evaluated from four aspects: queue registration speed (A), professional level of consultation (B), medical experience (C), and post diagnosis feedback (D) were 6.53, 5.87, 5.74, and 6.08, respectively; in the experimental group experiment that applied the optimized health promotion service platform, the average indices of the four indicators were 7.02, 6.34, 6.40, and 7.17, respectively. Compared to traditional health promotion service platforms, the application effect of optimizing health promotion service platforms was better, with an average increase of about 11.2% in four indicators.

5   Conclusion

With the continuous development of internet technology and the promotion of relevant national policies, a mobile processing system for health promotion service platforms is constructed based on advanced internet technology and combined with medical care

models. It digitizes offline processes such as queuing and registration, appointment and consultation, and completes various preparatory processes through the internet, becoming a key indicator for evaluating the intelligence level of health promotion service platforms. This article aimed to solve the problem of traditional health promotion service platforms struggling to cope with the increasingly complex health needs of elderly people. It analyzed the advantages and challenges of the integrated medical and nursing model under the background of the Internet, and proposed tentative suggestions for the construction of a health promotion service platform based on the actual health needs of elderly patients. Finally, through experimental verification, the optimized health promotion service platform in this article has a higher medical experience compared to traditional health promotion service platforms. While improving the quality of medical services, it also promotes the intelligent process of medical care services.

References

1. Zhang, Q., Li, M.: Smart home for elderly care: development and challenges in China. BMC Geriatr. **20**(1), 1–8 (2020)
2. Macis, S., et al.: Design and usability assessment of a multi-device SOA-based telecare framework for the elderly. IEEE J. Biomed. Health Inform. **24**(1), 268–279 (2019)
3. Gao, L., et al.: Can the organization of health resource integration be analyzed in terms of the current state of unmet demand for health services? Take the health needs of the elderly in a place in Zhejiang province, china, as an example. BMC Primary Care **23**(1), 1–6 (2022)
4. Lee, D.: A model for designing healthcare service based on the patient experience. Int. J. Healthcare Manage. **12**(3), 180–188 (2019)
5. Zhao, Y., Liu, L., Qi, Y., Lou, F., Zhang, J., Ma, W.: Evaluation and design of public health information management system for primary health care units based on medical and health information. J. Infect. Public Health **13**(4), 491–496 (2020)
6. Nymberg, V.M., Bolmsjö, B.B., Wolff, M., Calling, S., Gerward, S., Sandberg, M.: 'Having to learn this so late in our lives…' Swedish elderly patients' beliefs, experiences, attitudes and expectations of e-health in primary health care. Scand. J. Prim. Health Care **37**(1), 41–52 (2019). https://doi.org/10.1080/02813432.2019.1570612
7. Wong, S.Y.S., et al.: Impact of COVID-19 on loneliness, mental health, and health service utilisation: a prospective cohort study of older adults with multimorbidity in primary care. Br. J. Gener. Pract. **70**(700), e817–e824 (2020). https://doi.org/10.3399/bjgp20X713021
8. Sundaravadivel, P., Kougianos, E., Mohanty, S.P., Ganapathiraju, M.K.: Everything you wanted to know about smart health care: evaluating the different technologies and components of the internet of things for better health. IEEE Consum. Electron. Mag. **7**(1), 18–28 (2017)
9. Bucci, S., Schwannauer, M., Berry, N.: The digital revolution and its impact on mental health care. Psychol. Psychother. Theory Res. Pract. **92**(2), 277–297 (2019)
10. Tian, S., Yang, W., Grange, J.M.L., Wang, P., Huang, W., Ye, Z.: Smart healthcare: making medical care more intelligent. Global Health Journal **3**(3), 62–65 (2019)
11. Tang, V., Choy, K.L., Ho, G.T.S., Lam, H.Y., Tsang, Y.P.: An IoMT-based geriatric care management system for achieving smart health in nursing homes. Ind. Manag. Data Syst. **119**(8), 1819–1840 (2019)

12. Velmurugan, A.B.: Health-IOT platform that integrates unobtrusive bio-sensor and smart medication box for elderly people. Int. J. Futur. Gener. Commun. Netw. **13**(2), 1703–1709 (2020)
13. Wang, Y., Wei, D., An, H., Shu, N., Guan, Q.: Practicality of promoting brain health and early dementia screening in elderly residents with friendly mobile App: Beijing plan. Chin. J. **65**(14), 1339–1347 (2020)
14. Dwivedi, R., Mehrotra, D., Chandra, S.: Potential of internet of medical things (IoMT) applications in building a smart healthcare system: a systematic review. J. Oral Biol. Craniofacial Res. **12**(2), 302–318 (2022)
15. Furtado, D., Gygax, A.F., Chan, C.A., Bush, A.I.: Time to forge ahead: the Internet of Things for healthcare. Digit. Commun. Netw. **9**(1), 223–235 (2023). https://doi.org/10.1016/j.dcan.2022.06.007
16. Kwasnicka, D., Keller, J., Perski, O., Potthoff, S., ten Hoor, G.A., Ainsworth, B., et al.: White Paper: open digital health–accelerating transparent and scalable health promotion and treatment. Health Psychol. Rev. **16**(4), 475–491 (2022)
17. Bao, J., Zhou, L., Liu, G., Tang, J., Xiang, L., Cheng, C., et al.: Current state of care for the elderly in China in the context of an aging population. Biosci. Trends **16**(2), 107–118 (2022)
18. Furstenau, L.B., et al.: Internet of things: conceptual network structure, main challenges and future directionsDigit. Commun. Netw. **9**(3) 677 687 (2023).https://doi.org/10.1016/j.dcan.2022.04.027
19. Takagi, H., Ohno, M., Kobayashi, M., Nakada, T.: Evaluating speech-based question–answer interactions for elder-care services. IBM J. Res. Dev. **62**(1), 6:1-6:10 (2018). https://doi.org/10.1147/JRD.2017.2768720
20. Donati, M., Celli, A., Ruiu, A., Saponara, S., Fanucci, L.: A telemedicine service system exploiting BT/BLE wireless sensors for remote management of chronic patients. Technologies **7**(1), 13 (2019). https://doi.org/10.3390/technologies7010013

Construction of Digital Management System for Art Works Based on Artificial Intelligence Algorithm

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Abstract. Digital technology provides new opportunities for preservation, dissemination, display and use. This paper puts forward the digital management system and artificial intelligence algorithm of art works, and analyzes the experimental results of digital management and system construction of art works based on this research. The experimental results show that the preservation rate of works under digital management based on artificial intelligence is significantly better than that under traditional digital management. The preservation rate of F, G, H, I and J works under digital management under traditional mode is 85%, 87%, 83%, 86% and 84%.In a word, the digital management system of artistic works based on artificial intelligence algorithm can improve the preservation rate of works and increase the attractiveness of artistic works compared with the traditional mode of digital management of artistic works. At the same time, it also reflects the diversity of the forms of artistic works.

Keywords: Works of Art · Digital Management · Artificial Intelligence · System Construction · Questionnaire

1 Introduction

With the continuous improvement of network bandwidth and the continuous improvement of digital display technology, the display and collection methods of digital art, calligraphy and painting and other exhibits have gradually changed from physical to digital. In recent years, major art museums, galleries, auction houses and even portal websites at home and abroad have established quite complete digital exhibition halls, so that customers and the general public can enjoy works of art around the world without leaving home. This is a major contribution of the computer industry to human civilization.

Ivashkevych, E. E. pointed out that translation should arouse readers' similar emotions, just like the original text. The task of the interpreter is to find a match that has no difference in style from the original vocabulary unit and has the same or at least similar emotional and social color. When translating language words in artistic works, interpreters often face the fact that there are not always enough equivalents in the original language and the translated language [1]. Snyder S. discussed the claim that artists,

critics and philosophers often put forward that art works have personality characteristics. Rejected the view that artists have the power of Pygmalion to bring artistic works into life, but seriously examined the similarities between the ontological structure of artistic works and human personality [2]. Because Russian modernism reflects the transformation of art and spiritual culture in Russia at the end of the 19th century and the beginning of the 20th century, Zhukova O A O.E. attempts to highlight and analyze the symbolism and the main philosophy and aesthetic principles of Acmeism discussed by Russian poets in the Silver Age [3].

Through the research and analysis of the digital management of works of art and the experimental results of system construction, this paper draws the following conclusions: compared with the traditional digital management mode of works of art, the digital management system of works of art based on artificial intelligence algorithm can not only improve the retention rate of works, but also enhance the charm of works, and can also be displayed in various forms.

The main contents of this paper are as follows:

In the first part, the research background and significance of art digital management system based on artificial intelligence algorithm.

In the second part, the digital management method of ART work based on artificial intelligence algorithm, including the problems faced by the digital management of art works and the digital management system of art works.

In the third part, the experimental analysis of art engineering digital management and system construction.

In the fourth part, the limitations and future prospects of the art digital management system based on artificial intelligence algorithm.

2 Digital Management Method of Art Works Based on Artificial Intelligence Algorithm

2.1 Problems Faced by Digital Management of Art Works

(1) Copyright security issues

Copyright protection is of utmost importance when it comes to art collections, and many websites enforce strict copyright agreements to safeguard the intellectual property of artists [4, 5]. Typically, these websites engage in display contracts with users, allowing them to view high-quality images but prohibiting actions such as downloading, copying, or reposting. The implementation of such restrictions requires advanced technological measures.

In recent times, there has been a growing concern regarding the unauthorized downloading and misuse of digital images. Although many websites restrict direct downloading of photos, users can still resort to methods like screen capture or image stitching to obtain high-definition versions of the artwork. This poses challenges in effectively protecting copyright and necessitates further development and improvement in copyright protection measures.

To address these issues, advancements in technology and innovative approaches are essential. One potential solution involves the implementation of robust digital rights

management (DRM) systems. These systems can utilize encryption techniques to protect digital content, ensuring that it cannot be easily replicated or manipulated without proper authorization. Additionally, watermarking techniques can be employed to embed copyright information directly into the images, making it easier to track and identify any unauthorized use.

Another approach is the use of digital fingerprinting or content identification technologies. These methods create unique identifiers for each digital artwork, enabling efficient tracking and monitoring of their usage across various platforms. By employing automated algorithms and artificial intelligence, unauthorized copies or misuse of copyrighted materials can be quickly detected, allowing for prompt action to be taken.

Collaboration between art collection platforms, copyright holders, and technology experts is crucial for the development of effective copyright protection systems. By continuously improving and updating these measures, it is possible to mitigate the risks associated with copyright infringement and ensure that artists' rights are respected in the digital realm.

Furthermore, raising awareness among users about the importance of copyright protection and fostering a culture of respect for intellectual property can contribute to the overall success of these efforts. Education and proactive communication regarding copyright laws and ethical use of digital artworks can play a significant role in reducing unauthorized access and encouraging responsible behavior.

(2) Information management issues

In evaluating a digital art gallery, one of the primary criteria is the clarity and comprehensiveness of the artworks and their accompanying descriptions. The ability to upload works to the gallery offers convenience in accessing a vast amount of data. However, as the volume of information grows, managing and processing it becomes increasingly challenging. Many individuals find themselves overwhelmed and lost amidst the abundance of information, struggling to locate the specific information they desire.

To address this issue, effective information organization and retrieval systems are crucial. The digital art gallery should implement intuitive and user-friendly search functionalities that allow users to easily navigate and locate the desired information. This can be achieved through features such as advanced search filters, categorization based on genres, artists, styles, or themes, and the provision of comprehensive metadata for each artwork.

Furthermore, implementing recommendation systems can enhance the user experience by suggesting relevant artworks based on users' preferences, browsing history, or similar artworks they have shown interest in. These recommendations can help users discover new and relevant content, reducing the likelihood of feeling lost in the vast amount of available information.

Additionally, providing curated collections or thematic exhibitions can assist users in exploring specific topics or genres, guiding them through the gallery's offerings. Curatorial expertise can help curate and present artworks in a meaningful and coherent manner, facilitating users' understanding and navigation within the gallery.

(3) Single classification method

The grading mode of the China Art Museum starts from the two categories of art and folk art, and then divides them according to the material. However, in the art works,

there are also categories such as comics, comics and comics. Looking down, a total of 2040 works with 200 pages are stacked in this section. There is no clear time and author classification, which will make users lost in this section [6, 7]. From this point, we can see that the current classification method of art works is not only single, chaotic, but also not high level.

2.2   Digital Management System of Art Works

The digital artwork management system serves as an effective platform for interpreting and classifying various digital artworks [8, 9]. To fulfill the functional requirements of the system, several features are implemented. Firstly, users are provided with the ability to classify and upload digital artworks. These uploaded artworks are then subjected to classification management, enabling efficient organization and retrieval within the system. Other functionalities, such as administrator management, user information center, and actions like uploading, deleting, adding, and evaluating digital artworks, are also incorporated into the system [10, 11].

From a technological perspective, the digital artwork management system adopts the classic PHP + Apache + MYSQL architecture. This choice is driven by the openness, cost-effectiveness, and resource consumption efficiency of the Hypertext Preprocessor (PHP) language. The system follows the Browser/Server (B/S) mode, ensuring stability, consistency, and compatibility for users. By utilizing the B/S architecture, the system can be accessed and operated through a web browser, making it widely accessible to users.

In terms of functional design, the system employs a method of classified upload, management, and viewing of digital artworks. This approach enhances the professionalism of the system and provides a meticulous division of artworks, allowing for effective organization and navigation within the system [12, 13].

The interface design of the system focuses on applicability, flexibility, and reliability. The user interface is designed to meet the functional requirements of users while minimizing complexity and burden during usage. A lightweight user interface approach is adopted to ensure a smooth user experience and successful interactions. Additionally, considering that the system itself is dedicated to managing digital artworks, a fresh and visually appealing style is selected for the user interface. The front end of the system employs a color scheme consisting of brown, blue, green, and purple. These colors are carefully chosen to complement the digital artworks uploaded by users without distracting from the visual focus. The background design for the administrator interface follows a simple and clear layout, primarily using gray tones [14].

Testing of the system encompasses both black box and white box testing, with a focus on the former. The comprehensive black box testing of each main function module ensures optimal performance and user experience. By conducting these tests, any potential issues or bugs within the system are identified and resolved, guaranteeing a robust and reliable digital artwork management system.

2.3   AI Algorithm

The new generation of artificial intelligence, also known as "machine intelligence", is a new scientific theory based on traditional computer technology to simulate and expand

human intelligence activities. This course will cover mathematics, logic, financial control, simulation, information management, linguistics, industrial automation, engineering psychology, medicine and philosophy. In artificial intelligence technology, there are four major branches: computer machine teaching, data analysis and discovery, model recognition, and intelligent computing. At present, many applications of AI technology, including logical derivation, mathematical optimization and search, are still in the exploration stage in probability theory, bionics, economics, cognitive psychology and other aspects.

Machine learning is an interdisciplinary subject composed of statistics, probability theory, approximation theory, convex analysis, computational complexity theory, etc. However, the application of machine learning is diverse, because machine learning has a wide range of applications and is a branch of artificial intelligence. It can optimize specific computing capabilities through empirical learning; This method is to learn how to use your own practical experience to improve the computer algorithm you have learned; This method can use statistics or previous practical experience to automatically analyze it, so as to optimize the performance standards of computer programs.

In this way, the distance between each basic point and the classification plane is $\delta_n = b_n(u^R a_n + y)$, and is always positive. The final result is that the geometric spacing of the algorithm is $\varphi = \frac{|f(a_n)|}{\|u\|}$, and it is converted into the optimal solution:

$$min\frac{1}{2}\|u\|^2 \tag{1}$$

$$subject\ to\ b_n\left(\left(u^R a_n + y\right)\right) - 1 > 0, n = 1, \cdots, p \tag{2}$$

Here, $u \in D^p$ and $y \in D$ are the parameters that control the classification plane. Therefore, AI algorithm can play a full role in the construction of digital management system for art works.

3   Experimental Analysis of Digital Management and System Construction of Art Works

3.1   Experimental Method

Today, with the development of digital media art, the integration of digital technology and mass art has better solved the diverse requirements of the public for culture and art. In recent years, major art museums, galleries, auction houses and even portal websites at home and abroad have set up quite perfect digital exhibition halls, so that customers and the general public can enjoy the works of art from all over the world at home. At the same time, with the progress of science and technology, the digital management system of artistic works based on artificial intelligence has emerged. This paper compares the digital management system based on artificial intelligence with traditional digital management, and analyzes the advantages of the digital management system of artistic works based on artificial intelligence.

This paper extracts 10 art works from an art museum, and carries out digital management based on artificial intelligence and digital management under traditional mode

respectively. Among them, 5 works are subject to digital management based on artificial intelligence, represented by A, B, C, D and E respectively, and the other 5 works are subject to digital management under traditional mode, represented by F, G, H, I and J. Explore the differences between these works of art in terms of preservation integrity and attraction to tourists, so as to analyze the advantages of digital management of works of art based on artificial intelligence.

3.2 Preservation Integrity of Various Artistic Works
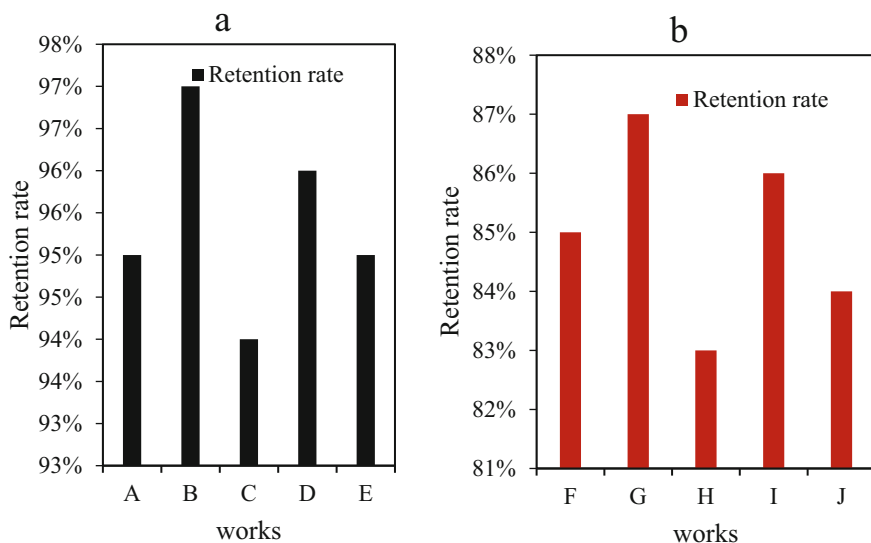
Fig. 1. Preservation rate of works under digital management based on artificial intelligence and traditional digital management

Through the digital management of these works of art for a certain period of time, the experiment can find that there are certain differences between the digital management based on artificial intelligence and the digital management under the traditional mode in terms of work preservation. The preservation rate of A, B, C, D and E works under digital management based on artificial intelligence is 95%, 97%, 94%, 96% and 95%, and the preservation rate of F, G, H, I and J works under digital management under traditional mode is 85%, 87%, 83%, 86% and 84%, as shown in Fig. 1, where Fig. 1 (a) is the preservation rate of works under digital management based on artificial intelligence, and Fig. 1 (b) is the preservation rate of works under digital management under traditional mode.

## 3.3 Public Preference for Various Artistic Works

This paper explores the public's preference for works under digital management based on artificial intelligence and traditional digital management through questionnaire. A

Table 1. Public Preference for Works Under Different Digital Management Modes

	Very satisfied	Quite satisfied	Not very satisfied
A	64	32	4
B	71	27	2
C	69	30	1
D	72	28	0
E	65	29	6
F	55	29	16
G	60	30	10
H	58	28	14
I	53	33	14
J	57	25	18

total of 100 questionnaires were distributed in this paper. The question options for each work were set as "very satisfied", "relatively satisfied" and "not very satisfied". The experimental results showed that for A, B, C, D and E works under digital management based on artificial intelligence, 68.2% of the people thought "very satisfied", 29.2% thought "relatively satisfied" and 2.6% thought "not very satisfied"; For the works of F, G, H, I and J under the traditional digital management mode, 56.6% of the people think "very satisfied", 29% think "relatively satisfied" and 14.4% think "not very satisfied", as shown in Table 1.

Based on the above questionnaire, this paper summarizes the attractiveness of various works to the public under different digital management modes, as shown in Fig. 2. Figure 2 (a) shows the attractiveness of works to the public under digital management based on artificial intelligence, and Fig. 2 (b) shows the attractiveness of works to the public under traditional digital management.

3.4 Advantages of Digital Management of Art Works Based on Artificial Intelligence

(1) Improve the preservation rate of works

Many art museums have perfect digital exhibition halls, which allow customers and ordinary people to view art works around the world without leaving home. The digital management of art works based on AI has greatly improved the preservation rate of works.

(2) Increased artistic attraction

In the construction of modern urban culture, whether it is stations, cultural parks, urban study, characteristic blocks, etc., can create conditions for the emergence and development of digital public art. The digital management system of art works based on artificial intelligence can do its best to promote this and increase the artistic attraction of the works.

(3) Reflects the diversity of forms

Compared with traditional digital management, digital management based on artificial intelligence has a faster grasp of the characteristics of the times. In terms of the diversity of forms of the same cultural and artistic content, the performance of digital management based on artificial intelligence can find an exhibition form that is more acceptable to the public.
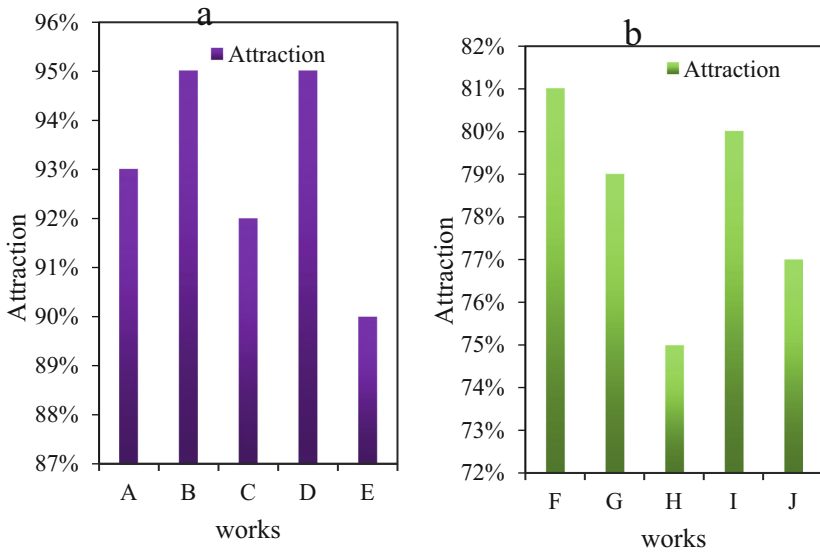
Fig. 2. People's attraction to works under different digital management modes

4 Conclusions

The rapid development of the Internet has also produced many problems, such as how to effectively manage a large amount of information and documents; How to screen effective data in the blue ocean of information; When opportunities are scarce and high-quality resources are scarce, how to seize opportunities and so on are all problems faced in the information age. This paper studies and analyzes the advantages of the digital management system of art works based on artificial intelligence. This paper first introduces the digital management system of art works, discusses the difference between the digital management based on artificial intelligence and the digital management under the traditional mode, and emphatically analyzes the advantages of the digital management based on artificial intelligence. The digital management of art works is still in the development stage, and people have not formed a correct and good understanding of the digital management of investment art works. I hope that collectors and art lovers can realize the value of digital management of art works as soon as possible, promote the digital management of art works to scale, standardization and marketization, and help the development and expansion of digital management of art works.

References

1. Ivashkevych, E.E.: The features of the translation of artistic works, taking into account the category of expressiveness. Probl. Mod. Psychol. Collect. Res. Papers Kamianets-Podilskyi Natl. Ivan Ohiienko Univ. G S Kostiuk Inst. Psychol. Natl. Acad. Educ. Sci. Ukraine **40**(40), 138–148 (2018)

2. Snyder, S.: Artistic conversations: artworks and personhood. Croatian J. Philos. **19**(56), 229–248 (2019)

3. Zhukova, O.A.O.E.: Mandelstam's works in the context of Russian modernist philosophy and artistic practice. Russ. J. Philos. Sci. **64**(2), 7–20 (2021)

4. Valeriyevich, T.G., Yahyapour, M.: Linguistic and cognitive tactics of representing religious ideas in Leo Tolstoy's journalistic and artistic works. Issledovatel skiy zhurnal russkogo yazyka i literatury **8**(2), 93–112 (2020)

5. Navruzov, B.B.: Comparative literature in the interpretation of artistic and scientific works. Theoret. Appl. Sci. **84**(4), 999–1004 (2020)

6. Vlasiuk, O.: Design of artistic ceramics in the context of scientific and technological progress (by the works of Yurii Musatov). Demiurge Ideas Technol. Perspect. Des. **4**(1), 83–92 (2021)

7. Babicheva, M.E.: Writers' artistic biographies that received the "Big Book" award (the genre typology and works' specificity). Obs. Cult. **17**(2), 202–213 (2020)

8. Chistyakova, O.: Artistic and stylistic features of Yusupov glassworks in Arkhangelskoye. Sci. Anal. J. Burganov House Space Cult. **15**(3), 125–138 (2019)

9. Kim, W.H.: Artistic virtual reality as a boundary space between labor and leisure - based on my works. Contents Plus **17**(3), 75–89 (2019)

10. Kuchukova, Z.A., Berberova, L.B.: For what works the Nobel prize is awarded or artistic measurement of KadzuoYsiguro's Novel "Do Not Let Me Go." Polyling. Transcult. Pract. **16**(3), 398–405 (2019)

11. Lindstrm, S.: It usually works out, but you never know'. Emotion work as a strategy for coping in the insecure artistic career. Culture Unbound **9**(3), 345–364 (2018). https://doi.org/10.3384/cu.2000.1525.1793345

12. Machado, J.T., Lopes, A.M.: Artistic painting: a fractional calculus perspective. Appl. Math. Model. **65**(JAN.), 614–626 (2019). https://doi.org/10.1016/j.apm.2018.09.009

13. Gimaletdinova, E.R., Sunaeva, G.G.: The use of artistic means in teaching economic theory (section «microeconomics») Bull. USPTU Sci. Educ. Econ. Ser. Econ. **2**(32), 144–150 (2020). https://doi.org/10.17122/2541-8904-2020-2-32-144-150

14. Llamas-Pacheco, R.: A theoretical comparison between the restoration of two contemporary works of art made of plastic. J. Cult. Herit. **51**, 132–137 (2021). https://doi.org/10.1016/j.culher.2021.07.007

Construction of a New Type of Business Management System in the Supply Chain Using Multi-agent Technology

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Abstract. With the development of the times, the new supply chain business management system is used more and more widely. The management system can handle customer logistics, capital flow, information flow and other data, which is of great significance for improving the efficiency of the supply chain. However, the current supply chain new business management system is not perfect, and there are still some problems in management. Therefore, this article studied the construction of multi-agent technology in the supply chain new business management system, aiming to further improve the management ability of the system through multi-agent technology. This article experimentally tested the profit improvement of enterprises using the multi-agent technology in the supply chain new business management system. The data showed that the company's profit increased by at least 12% and at most 19%, indicating that the use of multi agent technology in the supply chain new business management system has achieved good results.

Keywords: Supply Chain · Business Management · Management Systems · Multi-Agent Technology

1 Introduction

The supply chain system has long been a popular system, and through system management, it can further enhance the rigor of management, thereby improving the efficiency of the supply chain. The new business management system of the supply chain can further control the process of the supply chain, so the research on the new business management system of the supply chain is of great significance.

Many scholars have studied the supply chain, and Chauhan C believed that competitive pressure and changes force the management of multinational corporations to reassess the operation [1]. Garay-Rendero C L provided the leading idea of "supply chain management thinking". The characteristic of this idea is the effectiveness and efficiency of operation, but the current supply chain management thinking has been criticized as non-theoretical and descriptive [2]. Wieland A believed that if a single entity managed supply chain company can ensure the appropriate use of tools and technologies to meet market demand, it would not fall behind in the battle for survival [3]. Although

there is a lot of research on the supply chain, there is still relatively little research on new business management systems in the supply chain.

The construction of a new supply chain business management system is very meaningful. This article describes the demand analysis of the new supply chain business management system, as well as the design and implementation of the system. It also conducts experimental research on the satisfaction of companies using multi-agent technology for the new supply chain business management system. This article finds a high level of satisfaction and tested the company's profit improvement, which is also good. This proves that multi-agent technology has a good fit with the new supply chain business management system.

2   Use of Multi-agent Technology in the New Business Management System of the Supply Chain

2.1   Overview of Supply Chain Management

The planning and control of supply chain system operation processes, as well as the optimization of resource allocation in operation management and other management practices. It is one of the seven emerging disciplines in the international community in the 21st century, which has been developing for over 50 years [4, 5]. To this day, it has integrated technology and management, and has begun to take the efficiency and benefit management of the system as its research object. The application scope of supply chain management is not limited to production and manufacturing industrial enterprises, but it is also widely applied in energy, retail distribution, transportation logistics, services, and commerce, and even in the operation and management systems of military and government organizations as a whole [6, 7]. Narrowly speaking, supply chain management refers to sales, and inventory centered around the flow of goods within an enterprise. Broad supply chain management involves the entire process of transaction logistics, including logistics, transportation, quotation, inquiry, etc. [8, 9].

2.2   Characteristics of Supply Chain Management

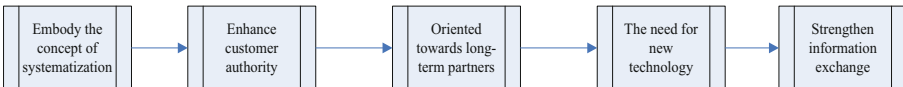The characteristics of supply chain management are shown in Fig. 1:

Fig. 1. Characteristics of supply chain management

(1) Reflecting the concept of "systematization": Integrated management refers to the process of integrating various enterprises in the supply chain. From the perspective of strategic management, supply chain enterprises should consider how to reduce their overall costs in order to maximize their value [10, 11].

(2) Enhancing customer authority in the supply chain emphasizes customer centeredness: customer demand management should not only be the work of a marketing department directly related to customers, but should be the primary goal of enterprises in the entire supply chain to meet customer needs.

(3) Towards long-term partnerships: Enterprises in the supply chain often choose long-term cooperation to form strategic partners in order to maximize profits, but it is also possible for a certain enterprise in the chain to experience a decrease in profits [12, 13].

(4) The demand for new technologies: In today's rapidly developing information technology, cloud computing, and artificial intelligence, supply chain management cannot do without strong technical support.

(5) Strengthening information exchange and cooperation: In the supply chain, effective collaboration is needed between the functions and organizations of various enterprises to achieve complementary advantages and improve the overall competitiveness of the supply chain [14, 15].

Supply chain management has brought opportunities to enterprises, but there are also many obstacles and risks. For example, the interdependence between companies is increasingly deepening. Due to the lack of support and trust from the company's management, it is difficult to maintain long-term cooperative relationships, and there is a risk of information leakage within the company [16, 17].

2.3 Significance of Constructing a New Business Management System for the Supply Chain

Beneficial for strengthening enterprise risk prevention capabilities: In this new supply chain business management model, the functions of the business management department can be maximized, making enterprise leaders aware of the importance of internal business management when facing legal risks [18, 19]. At the same time, one can also feel the driving effect on enterprise operation in the process of enterprise transformation and control. In the systematic mode of business management in supply chain enterprises, the comprehensive function and independence of business management activities can be fully utilized, playing an important role in clarifying the responsibilities of each department and staff [20].

Beneficial to enhancing the intensity of enterprise management system reform: In the process of establishing an enterprise management system, it meets the needs of the reformed management system to the greatest extent. This is a key link and an important way to improve the control and management ability of enterprise managers over the enterprise.