

Mechanisms and Pathways for Metaverse-Empowered Innovation in Ancient Book Utilization

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Abstract

[Purpose/Significance] To address the current issue of limited utilization of ancient books in China, employing metaverse technology to empower the expansion of access to ancient books and revitalize their vitality in the new era constitutes a creative initiative for promoting the creative transformation and innovative development of excellent traditional Chinese culture, as well as a move that aligns with contemporary developmental trends. [Method/Process] The article proceeds from an exposition of the metaverse's origin, development, and fundamental architecture, analyzes the logical mechanism by which the metaverse empowers the utilization of ancient books, proposes new approaches for ancient book utilization integrated with metaverse technology, and outlines fundamental pathways for realizing innovation in ancient book utilization. [Results/Conclusion] Empowering ancient books through the metaverse, guided by the content of excellent traditional culture and integrated with technology to create new cultural connotations and spiritual identifiers, provides new perspectives for constructing a Chinese-style metaverse system.

Full Text

The Mechanism and Path of Metaverse Empowering Innovative Utilization of Ancient Books

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Abstract

[Purpose/Significance] To address the current limitations in the utilization of ancient books in China, empowering the expansion of access pathways and revitalizing these resources with metaverse technology represents both a creative initiative for promoting the creative transformation and innovative development of excellent traditional Chinese culture and a move aligned with contemporary trends. **[Method/Process]** This article begins by elaborating on the origin, development, and foundational architecture of the metaverse, analyzes the logical mechanism through which the metaverse empowers ancient book utilization, proposes new approaches for ancient book use in conjunction with metaverse technology, and outlines fundamental pathways for achieving innovation in ancient book utilization. **[Results/Conclusion]** The metaverse empowers ancient books by using excellent traditional cultural content as a guide, combining it with technology to create new cultural connotations and spiritual symbols, thereby providing novel ideas for constructing a Chinese-style metaverse system.

Keywords: utilization of ancient books; metaverse; mechanism and path

Classification Numbers: G255.1; G250.7

Introduction

Ancient books represent the condensed wisdom of sages and the memory of eras, serving as crucial carriers for showcasing national characteristics and promoting excellent traditional Chinese culture. Revitalizing these books holds profound significance for continuing Chinese cultural lineage, carrying forward national spirit, and realizing the Chinese Dream of national rejuvenation. During his inspection at Renmin University of China, General Secretary Xi Jinping emphasized the need to “employ modern technological means to strengthen the protection, restoration, and comprehensive utilization of ancient book collections, deeply excavate the philosophical thoughts, humanistic spirit, value concepts, and ethical norms contained within them, and promote the creative transformation and innovative development of excellent traditional Chinese culture” [1]. The “14th Five-Year Plan and Long-Range Objectives Through 2035” explicitly states the goal to “accelerate digital development and build a digital China” [2], while the “Opinions on Promoting the Implementation of the National Cultural Digitalization Strategy” further proposes using digital technology to foster cultural innovation and achieve panoramic presentation of Chinese culture with universal sharing of digital cultural achievements [3]. In the information age, the rational utilization of various information technologies for systematic organization and content mining of massive ancient book resources to promote their “dual innovation” development and application, build modern Chinese civilization, and enable universal sharing of digital achievements—while endowing ancient books with modern significance and injecting new-era vitality—represents a cultural mission that benefits both present and future generations.

In recent years, the metaverse, characterized by features such as decentraliza-

tion, integration of virtual and real, creator sharing, and universal connectivity, has rapidly sparked global discussion across economic, educational, technological, and social domains through its immersive, low-latency, panoramic interactive virtual spaces built upon blockchain, digital twin, virtual reality, and 5G communication technologies. The term “Metaverse” first appeared in the 1992 science fiction novel *Snow Crash*, in which author Neal Stephenson envisioned a fully holographic digital space parallel to real society, where people originally separated by geography could communicate through their digital avatars [4]. In the early 1990s, Chinese academician Qian Xuesen proposed a new information space based on virtual reality technology—“Lingjing” (Spiritual Realm)—which aligns with today’s metaverse concept. He believed this technology could expand human brain perception and usher people into unprecedented new realms [5]. Both perspectives recognize that information technology will construct an emerging space.

The rapid development of information technology has created conditions for metaverse infrastructure. In 2021, with the listing of “the first metaverse stock” Roblox and the global spread of COVID-19, the metaverse officially became a new focus of public attention. Academic research has mushroomed, extending into many new directions in both technology and theory. Currently, domestic and foreign scholars have engaged in heated discussions about the definition of the metaverse, with varying opinions but clear commonalities. Wikipedia defines the metaverse as a shared virtual space that integrates virtual worlds, augmented reality, and the internet [6]. Foreign scholar D. Baszucki proposes that the metaverse has eight basic characteristics: identity, friends, immersion, low latency, diversity, anywhere, economic system, and civilization [7]. From a spatial perspective, the metaverse is considered a fully immersive three-dimensional digital environment, while domestic scholars, from a technical perspective, mostly view it as a collection environment of internet elements such as virtual reality, blockchain, cloud computing, and digital twinning—the ultimate digital medium connecting reality and the virtual world [8]. In September 2022, the National Committee for Terms in Science and Technology held a symposium on metaverse and core terminology concepts, reaching consensus on the name and definition of “metaverse”—the English term “metaverse” is defined as “a virtual world constructed by humans using digital technology, mapped from or transcending the real world, and capable of interacting with the real world” [9].

Metaverse empowerment of ancient books responds to the national ancient book digitalization project, achieving aggregation and sharing of digital ancient book resources. Since the systematic implementation of ancient book digitalization, the organization of digital ancient book resources has provided a solid data foundation for metaverse technology to empower ancient book protection and development, while the metaverse offers new methods for inheritance and dissemination of ancient books. The metaverse approach opens infinite possibilities for innovative utilization of ancient books, enabling originally obscure content to leap beyond paper carriers and be presented to readers through images, videos, and even holographic displays, fully engaging readers’ senses for immer-

sive reading. Through deep content mining, it creates cultural products such as classical-style digital audio-visual works, digital collections, and digital cultural creations. Relying on emerging technologies like extended reality, digital twinning, and holographic imaging to build library cultural scenes and experience spaces, ancient books can be displayed to readers in multidimensional forms, enhancing comprehension and stimulating divergent thinking.

2.1 Real-Time Rendering Cloud Infrastructure

The cloud infrastructure primarily builds the foundational facilities for metaverse-enabled ancient book utilization based on cloud storage, cloud computing, and 5G communication technologies, providing real-time response to user demands and service frameworks for platform construction. To achieve high immersion and low latency, the metaverse must rely on real-time rendering technology with massive computational power. The characteristics of 5G technology—high speed, low latency, and wide connectivity—make real-time interconnection of all things a reality, enabling instant user interaction and upload/download of multi-source, heterogeneous, multimodal ancient book data from cloud storage. Cloud computing can satisfy the real-time rendering demands for ancient book content reproduction and high-definition three-dimensional cultural scenes under VR/XR applications. The massive data generated during ancient book development and utilization can likewise be uploaded to cloud storage securely, instantly, and reliably, significantly improving security.

2.2 Data Processing Terminal

The processing terminal builds an ancient book development and utilization platform based on powerful artificial intelligence, supercomputing, and blockchain technologies to analyze, decompose, reorganize, and package digital ancient book resources, laying the data foundation for revitalizing ancient books. Blockchain technology integrates and reorganizes ancient book data, transforming infinitely reproducible digital resources into identifiable, traceable, and 溯源 individual digital modules uploaded to consortium chains within the blockchain. It provides full-process management services including content encapsulation and registration, distributed storage, knowledge processing, scheduling, and infringement tracking [10], reducing trust issues arising during data processing. Big data technology supplies the metaverse with real-time, precise data provisioning, supervision, analysis, and exchange. Interaction data generated when readers use ancient book resources while wearing smart devices can be intelligently tracked, identified, and monitored under certain protocols, facilitating subsequent user behavior standardization, reading habit analysis, and personalized recommendations. As a core technology, AI applies ancient book data and reader interaction data to machine learning, natural language processing, and intelligent speech, enhancing immersion and diversity in metaverse-enabled ancient books.

2.3 User Terminal Integrating Virtual and Real

The user terminal provides users with an interactive multidimensional virtual reality space where they are endowed with virtual digital identities and possess perceptual functions such as hearing, vision, touch, and taste found in the real world. Based on artificial intelligence, virtual interaction, digital twinning, and other technologies, real-time interaction between users and the metaverse will be truly realized. Users entering library cultural experience scenes to learn and use ancient books can operate freely and receive the most authentic environmental feedback, enjoying diversified library services and deeply immersive cultural experiences. After knowledge organization of ancient book content, multidimensional, three-dimensional, and interactive presentation methods are adopted to build textual content scenes, set interactive elements, and expand panoramic reading approaches for ancient books, enabling readers to obtain rich knowledge input during cultural experiences. Regarding interaction, metaverse libraries will give birth to a group of AI-core virtual digital librarians providing services such as guidance, reference consultation, personalized recommendation, and operation instructions. Users can also “meet” each other in metaverse libraries to jointly participate in online ancient book exhibitions and other activities. Furthermore, the user-centered UGC model grants users sufficient authority to participate in ancient book cultural creativity, fully unleashing user creativity and imagination.

[Figure 1: see original paper] Basic Architecture of Metaverse Empowering Innovative Utilization of Ancient Books

3.1 Metaverse, Libraries, and Ancient Book Resources as Continuously Growing Organisms

As an institution for preserving social memory, libraries bear the responsibility for protecting and organizing ancient book resources while also undertaking the social function of disseminating and popularizing excellent traditional Chinese culture. According to librarian Ranganathan’s “Five Laws of Library Science,” a library is a growing organism. Ancient book resources collected by libraries, as part of this organism, have evolved from paper resources to digital and even intelligent resources following rapid IT development and the transformation of digital humanities research paradigms. Ancient book content has undergone deep analysis and mining through knowledge graphs, semantic analysis, knowledge extraction, and visualization practices. In terms of presentation, ancient book resources have achieved two-dimensional, three-dimensional, and multidimensional integrated displays, with continuously growing resources providing new ideas for development and utilization.

Self-evolution represents one metaverse characteristic. Based on blockchain infrastructure and decentralized computer architecture and collaboration models, the metaverse organically mobilizes real-world computing power and human resources to form a neural network supporting metaverse operation. The itera-

tive updating of information technology supports the sustainable growth of the metaverse, creating infinite momentum for its development and maintaining its state-of-the-art status, ultimately forming the “intelligent entity” characteristic of self-evolution [11]. In fact, the core technologies and paths for metaverse advancement overlap with those of libraries, which had already conducted considerable exploration in related areas before the metaverse concept emerged.

In recent years, both metaverse and ancient book organization/utilization have shown trends toward intellectualization, primarily due to continuously developing information technology. In the information age, reading and research on ancient books no longer remain limited to original texts and images; diversified reading demands drive libraries to seek new technologies to meet new requirements. The metaverse, from its inception, has been a virtual space constructed based on various information technologies, continuously integrating new technologies during its development to improve user experience. Virtual reality technology, for instance, plays a key role in both metaverse virtual scene construction and ancient book content reproduction. It can be said that metaverse empowerment of ancient book utilization opens more possibilities for content innovation. Combining rich ancient book content with emerging technologies like VR/AR, AI, and blockchain creates diverse cultural content products such as digital collections and digital cultural creations. Introducing distinctive ancient book content scenes into extended reality, digital twinning, and holographic imaging technologies has led to the development of digital cultural experience spaces such as metaverse libraries, virtual social spaces, and ancient book virtual reading rooms. Guided by the excellent cultural content of ancient books, extracting the spiritual symbols and cultural essence of Chinese civilization and constructing a Chinese-style metaverse cultural system will promote high-quality development of the national cultural digitalization strategy and contribute to Chinese-style modern civilization.

3.2 Synergy Points Between Metaverse and Smart Libraries

Both metaverse and smart libraries are user-centered. As the third-generation library, smart libraries comprehensively upgrade library space, resources, services, and management in four directions to better conduct library affairs around users. Smart librarianship excels not only in researching data and relationships between data but also emphasizes the relationship between humans and data and the role humans play in the data world [12], which aligns precisely with the situation of “citizens” in the metaverse. One metaverse characteristic—“decentralized power”—specifically refers to citizens’ autonomous control over digital rights such as data, assets, identity, and service acquisition without centralized authority control, allowing users to freely participate in construction and governance [13]. Both center their services around users, share a consensus on pursuing knowledge services and user experience oriented by user needs.

A mutually empowering relationship exists between metaverse and libraries. Whether in virtual or real worlds, libraries, as human memory institutions,

always bear the responsibility for preserving and inheriting human knowledge and culture, remaining the hub for disseminating and sharing various knowledge information in the metaverse. Although smart libraries have limited physical space, they can participate in metaverse construction through resource sharing, scene co-creation, standard co-construction, and responsibility sharing by leveraging their massive information resources, fully releasing their value to create infinite possibilities in the metaverse. In fact, libraries have already established solid theoretical and practical foundations in organizing information resources and knowledge systems, providing digital resources and implementation pathways for metaverse empowerment of ancient book utilization innovation. Conversely, the metaverse provides multidimensional expression methods for libraries' multi-source heterogeneous ancient book resources, enriching users' reading senses. Therefore, the metaverse can expand library space construction through its concepts, technologies, thinking, and environment. Meanwhile, libraries can also empower the metaverse by using their vast collections and knowledge organization systems to build the metaverse. As one of the crystallizations of traditional Chinese culture, ancient books are renowned worldwide for their rich national spirit and excellent traditional culture. Incorporating ancient books into metaverse construction to achieve cultural interaction integrating virtual and real will undoubtedly endow the metaverse with greater cultural depth and Chinese spirit.

3.3.1 Building Real-Time Interactive Smart Spaces

In the future, libraries, particularly university libraries, will create "learning centers" around users, emphasizing students' collaborative, personalized, and interdisciplinary learning abilities to cultivate lifelong learning and innovation capabilities [14]. Empowered by metaverse technology, libraries will break limitations in four aspects: resource integration, talent cultivation, space reconstruction, and information services. Breaking the shackles of physical space and developing virtual smart spaces that interact with users in real-time, provide immersive experiences, and feature operable functions based on existing learning and maker spaces will create information centers supporting student learning and teaching. Employing modern science and technology enables self-directed learning methods and improves digital literacy. Under these conditions, ancient book enthusiasts or researchers can fully utilize various functions of the learning center to interpret and research ancient book content, achieving intelligent integration of people, resources, and space.

Real-time interaction meets users' immediate needs. Digital twinning and virtual reality technology project physical libraries into virtual space, perfectly presenting facilities such as tables, chairs, bookshelves, and plants. Scenes can be changed according to user needs, and ancient book readers can choose antique-style reading halls to deepen immersion in virtual space and create a free and diverse reading environment. Regarding collection resources, whether ancient books or other materials, readers can access them anytime. Based on user se-

lection, documents can be presented visually. For instance, retrieved ancient book information will be displayed in three-dimensional form before users, with visualizations such as cluster diagrams, time distribution maps, and spatial distribution maps revealing hidden knowledge and relationships within ancient books, providing valuable data for readers to construct knowledge systems. This visualization process endows ancient books with new interpretations, allowing readers to directly perceive implicit knowledge and deepen their understanding.

Fully utilizing data improves service efficiency. Smart spaces analyze user behavior data to fully excavate user needs and preferences, matching them with precise personalized information services and achieving adaptive user-information services across various contexts [15]. Under blockchain technology, ancient book data can be effectively preserved on-chain, allowing readers to access needed resources anytime while recording any tampering attempts, eliminating library concerns about resource theft or loss.

Through the metaverse's powerful social functions, exclusive ancient book reading or research groups can be created, allowing users with similar interests to communicate freely in smart spaces and enhancing information exchange efficiency and value. Using tools such as GIS and knowledge graphs, readers can conduct immersive learning, creation, and research in smart spaces and real-time publish research progress, viewpoints, and conclusions related to ancient books and history, truly reflecting China's historical position and role in human social development.

3.3.2 Creating Professional Digital Avatars for Ancient Books

With the rise of AIGC, AI-core virtual digital humans have gradually become new carriers for traditional culture dissemination in the digital age. Virtual digital humans are computer-synthesized entities existing in virtual worlds with multiple human characteristics including appearance, expression capabilities, and behavioral actions. Supported by AI computing power, they easily achieve transformation from human-computer interaction to human-“human” interaction, widely applied in professions such as virtual teachers, anchors, and idols. Currently, globally developed virtual digital humans mainly fall into two categories based on core functions: functional types that provide services and identity-based types with distinctive personalities, both offering possibilities for expanding ancient book utilization through creating national-style virtual idols for cultural inheritance.

Identity-based virtual digital humans conduct cultural promotion through short videos or live broadcasts with cultural connotations. In April 2022, the first national-style virtual digital idol “Tianyu” gained numerous fans upon launching on short video platforms, receiving collective praise from mainstream media including *People's Daily*, *Xinhua Net*, and *Guangming Net*, sparking heated discussion at home and abroad. The “breakout popularity” represents modern expression of technology empowering culture. Tianyu's costumes and makeup

were designed with participation from the Dunhuang Clothing Research Institute. After consulting extensive ancient book literature, experts customized makeup and attire for Tianyu, with production teams maximizing restoration of Dunhuang historical styling in model development, visually displaying the beauty of Dunhuang culture. This demonstrates how characters from ancient books can transcend millennia to be reproduced materially in the virtual reality world, allowing the Chinese beauty and cultural concepts dormant in ancient books to be revitalized through digital virtual humans as media.

Developing service-oriented digital virtual humans for ancient books. Based on advances in 5G communication, ChatGPT, and other AI technologies, real-time “face-to-face” interaction between virtual digital humans and real people has become reality. Through deep integration of computer vision, speech recognition, natural language processing, and other AI technologies, authentic and perceptible dialogue interaction between virtual digital humans is achieved, pursuing multi-sensory feedback effects. On this foundation, massive ancient book data is incorporated into virtual human retrieval databases. Based on ChatGPT, services can be provided through full real-time dialogue, enabling ancient book database or bibliography retrieval through simple conversation. According to readers’ retrieval targets, the virtual human automatically summarizes entities such as names, places, and times in target ancient book content into concise core information, facilitating readers’ quick understanding of ancient books.

3.4.3 Creating Deeply Immersive Panoramic Reading

In the metaverse, to achieve broader promotion of ancient book reading and revitalize the excellent traditional culture contained within, the problem of ancient book regenerative protection must be effectively solved. Empowered by virtual reality, augmented reality, and 5G technologies, ancient book reading content is no longer just obscure text; content reconstructs time and space to reproduce classic scenes and characters from ancient books in three-dimensional panoramic form, fully engaging readers’ senses for immersive reading experiences. This innovative panoramic reading method breaks traditional two-dimensional reading approaches, reshaping reading content by concretizing abstract material and creating holographic, multidimensional reading scenes.

In panoramic reading, the National Library has provided application examples. Using 5G+VR technology, it pioneeringly conducted three-dimensional display of text and scenes from the *Yongle Encyclopedia*, injecting new vitality into ancient books. The project immersively introduced the “past and present” of the *Yongle Encyclopedia*, presenting to readers through images and films the formal beauty of this encyclopedia’s binding, paper, layout, seals, as well as the historical evolution of its compilation, completion, digitalization, and 3D modeling [16]. It presents the history and full picture of classic ancient books to readers and the public from multiple perspectives. In the metaverse, through interactive sensor devices, readers extend from visual and auditory to tactile experiences of ancient books’ real conditions, perfectly resolving the contradiction

between preservation and use. Utilizing the metaverse for ancient book reading promotion, with its rich content display, lowers the threshold for ancient book reading to some extent. Readers no longer need strong backgrounds in classical philology or history. While enhancing readers' interest in ancient books, the immersion brought by panoramic reading improves reading efficiency, helps users excavate the knowledge value contained in ancient books, and promotes high-quality development of universal ancient book reading and lifelong learning.

3.4.4 Developing Cultural and Creative Ancient Book Resources

Ancient books possess diverse material manifestations and profound cultural connotations, providing conditions for creative development. Ancient book carriers have evolved from animal bones and tortoise shells to bamboo slips, silk, and paper, with paper ancient books featuring classical binding forms such as scroll, butterfly, and thread binding. Calligraphy has evolved from oracle bone script to various styles including cursive, running, and regular script, all exuding the charm of Chinese art. The seals used by officials and literati across dynasties are equally unique. In terms of content, the “Jing-Shi-Zi-Ji” (Classics-History-Masters-Collections) categories each represent treasures of traditional Chinese culture and crystallizations of the Chinese national spirit. Such colorful ancient book resources, combined with creative development themes and empowered by metaverse technology, will inevitably promote the creative transformation and innovative development of excellent traditional Chinese culture. Using metaverse technology to expand directions for ancient book cultural creation not only enriches the spiritual and cultural needs of the general public but also innovates library service content and forms, representing another measure for promoting supply-side reform.

Current ancient book cultural and creative products are primarily physical objects, whose fixed forms limit the dissemination and inheritance of ancient book content. The “metaverse + ancient books” combination will broaden new directions for ancient book cultural product development. The integration of VR, AR, and other technologies with ancient books enables multi-sensory, multi-angle full display of creative products' innovation and expressiveness, enhancing cultural value while enriching display effects. Using blockchain technology to attach exclusive digital certificates to any form of ancient book and transform them into digital collections leverages blockchain's immutability 特性, where usage and transaction information of ancient book digital collections can be recorded and verified, attracting large numbers of young readers through their security, artistry, and literary value. Therefore, whether digital ancient book derivative products, NFTs based on ancient book prototypes, or “ancient book +” cross-border fusion NFTs can all boost the influence of ancient books. In February 2022, the first digital collection of ancient Chinese medicine book IP—the Jinling engraved edition of *Compendium of Materia Medica*—was signed and released. This NFT launch not only used ancient books as development content but also incorporated user co-creation and blind box elements, enriching

product sociality and 趣味性 while helping readers understand the value behind ancient books. Exploring ancient book digital collections requires element collection, digital processing, storage management, restoration, and dissemination—different from traditional products.

Implementation Paths

4.1 Leveraging Digital China Construction to Consolidate New Digital Infrastructure for Ancient Books

Digital China infrastructure construction forms the basic guarantee for achieving digital utilization of ancient book resources and building metaverse libraries. Ancient book literature resources constitute important library collections. To implement metaverse empowerment of ancient book utilization, libraries must strengthen existing network support, information transmission, and real-time data interaction functions. Therefore, consolidating new infrastructure is a necessary condition for metaverse empowerment of ancient books. Substantial investment should be made in metaverse-related communication and cloud infrastructure, grasping 5G network development trends to improve communication capabilities and accelerate deployment of VR and AR-based ancient book application virtual scenes. In terms of shaping, development plans for virtual-real integration should be formulated with immersive services as the focus, laying out dual spaces for virtual-real interaction in ancient book reading to explore new ideas for ancient book promotion in virtual space. Development of AI, cloud computing, and cloud storage technologies should be strengthened to improve collection, organization, development, and supervision of ancient book and user data, developing exclusive ancient book virtual digital humans serving teachers and students. Blockchain technology should be used to enrich ancient book utilization directions, excavate and develop digital resources, and create digital collections. Cross-industry collaborative development should combine library ancient book resources with enterprise information technology advantages to strengthen R&D in various ancient book databases, library information management systems, and data security technologies, establishing a complete metaverse-enabled ancient book application innovation ecosystem. Smart library buildings should be constructed with intelligent equipment to strengthen libraries' role as metaverse technology platforms, contributing to the inheritance and dissemination of excellent Chinese culture.

4.2 Upholding Data Security Principles to Formulate New Data Security Guarantees

The social attributes of the metaverse determine that its interaction forms include person-to-person, human-computer, and computer-computer interactions, all of which constantly generate data, bringing data security issues that users must face. Simultaneously, libraries' uploaded digital collections face risks of leakage or tampering. As important institutions applying metaverse technology, libraries must uphold data security principles and participate in formulat-

ing safety governance standards for metaverse virtual-real spaces. As a highly digitalized product, the metaverse presents extremely high data security risks. The massive data generated by readers using ancient books in the metaverse—including interaction data with virtual scenes and digital virtual humans, purchased ancient book NFT collections, user identity authentication, and social life data—greatly increases the difficulty of data security maintenance. Therefore, it is necessary to further clarify the scope and authority of data storage, custody, processing, and handling [17]. Additionally, vigilance is required regarding security vulnerabilities and adverse effects that may arise from technological advances such as blockchain. Libraries must pay attention to intellectual property rights of ancient book resources, reader privacy, and information technology security issues in the metaverse, actively participating in constructing a security system for ancient book utilization within the metaverse.

4.3 Strengthening Digital Humanities Research to Cultivate New Talent for Ancient Book Utilization

The knowledge system carried by ancient books is vast, with the four major categories each containing rich knowledge units. The processing, organization, semantic analysis, and content mining of these multi-source heterogeneous ancient book resources down to data units form databases themed around figures, geography, culture, etc., providing necessary data support for subsequent construction of virtual cultural scenes in the metaverse, AI digital virtual human services, and GIS and knowledge graph-based ancient book knowledge content reorganization, discovery, and services, broadening directions for innovative ancient book utilization. The key to innovative ancient book utilization lies in talent cultivation. Whether for ancient book digitalization or metaverse technology empowerment, talent cultivation is crucial. The current main challenge is that librarians or researchers with backgrounds in classical philology or history are generally unfamiliar with information technology, while information management professionals who understand technology have limited knowledge of ancient book literature. Facing the torrent of scientific and technological progress and the urgent need to revitalize ancient books, libraries must build diverse, multi-background composite librarian teams, improving librarians' overall awareness of information technology, new user needs in information academic environments, and personal information skills, and developing their ability to use new technologies, tools, and knowledge to conduct information academic research and solve practical problems. Additionally, universities should establish digital humanities majors or related research projects during talent cultivation, actively promoting the implementation of ancient book resource-centered research projects in digital humanities.

Empowering innovative utilization of ancient books through the metaverse revitalizes long-shelved ancient books with new-era vitality. Using information technology to reproduce classic scenes from ancient books, restore authors' expressed thoughts, fully excavate implicit knowledge, and expand utilization pathways

represents a cross-temporal research topic full of contemporary value. Systematic organization, inheritance, and dissemination of the excellent traditional culture within ancient books to make the past serve the present and inspire people will make greater contributions to the creative development and innovative transformation of excellent traditional Chinese culture and the creation of Chinese-style modern civilization.

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