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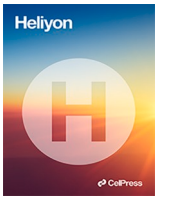

Research article

The development and dissemination of intelligent storage management software of Chinese excellent traditional culture based on blockchain in the era of financial media

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ABSTRACT

With the advent of the era of media convergence, the storage management and inheritance of excellent traditional Chinese culture will usher in new opportunities, creating new opportunities for tapping the contemporary value of traditional culture. This work aims to explore the current protection and innovation of excellent traditional Chinese culture. It takes the digital storage and communication of intangible cultural heritage as an example to summarize the status quo of its storage management and communication, leading to the necessity of intelligent storage of excellent traditional culture. Meanwhile, in terms of intelligent storage management and communication, the application innovation of media convergence combined with blockchain technology has entered the public's vision. To better realize the intelligent storage and communication of excellent traditional Chinese culture, this work mainly studies how to operate the clever integration mechanism of media convergence and blockchain technology and summarizes the advantages of the two. The software development and design of the traditional culture storage system platform are carried out, and the platform's structural characteristics and development process are clarified. Finally, the mechanism is applied to the intelligent storage management and communication of traditional culture to test the time consumption of its network storage and information query. The results show that the test network has a good overall performance, short time consumption and stable operation when the storage network access is not blocked. This work can provide a more diversified information storage management and communication scheme, and provide a theoretical and practical basis for the intelligent storage management and communication of excellent traditional Chinese culture.

1. Introduction

The excellent traditional Chinese culture is an outstanding advantage of the Chinese nation and the foundation for the Chinese to stand firm in the world's cultural turmoil. Chinese must inherit and carry forward it in combination with the new era conditions. As the unique spiritual symbol and the deepest cultural soft power of the Chinese nation, the excellent traditional Chinese culture contains rich nutrition and wisdom. It is the glorious mission of every Chinese people to inherit and disseminate it for a long time [1]. Folk intangible cultural heritage (ICH) is a crucial part of excellent traditional Chinese culture and the foundation for the sustainable development of the Chinese nation. Currently, while relying on digital technology and platform to store the original materials of folk

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ICH, ICH's cultural spirit and connotation should also be stored, managed and disseminated in a diversified way. The rapidly developing blockchain technology at this stage can accomplish the digital collection and storage of folk ICH resources, thus realizing the inheritance of the excellent traditional Chinese culture [2].

As a new network technology system, blockchain is characterized by decentralization, smart contract and tamper-proof. In order to promote the protection, inheritance and industrial development of excellent traditional culture, the existing technology has applied blockchain combined with media convergence technology to the field of cultural industry and reshaped the moral order of cultural industry. Moreover, immoral behaviors such as privacy leakage, data theft and copyright infringement in the operation of the cultural industry have been difficult to eradicate. It is urgent to establish a feasible intelligent storage management and communication system to protect the inheritance of excellent traditional culture [3]. The emergence of blockchain technology in the media convergence platform can establish a new authenticity traceability and verification method. Encryption technology can be adopted to ensure that the stored content cannot be modified and form a transparent and efficient trust mechanism. It is conducive to the protection and trade of cultural copyright and brings innovation to industrial inheritance [4].

This work aims to explore how blockchain technology can be utilized for the intelligent storage, management, and dissemination of outstanding traditional Chinese culture in the context of the multimedia era. Leveraging the decentralized, transparent, and tamper-resistant features of blockchain, this work experimentally constructs a secure and efficient cultural information storage system to achieve traceable management and protection of traditional cultural resources. Simultaneously, through an intelligent dissemination mechanism, the aim is to enhance the contemporary societal impact of traditional Chinese culture, facilitating its better integration into modern society and realizing an organic fusion of cultural heritage and innovation. This experimental study seeks to provide new insights and practical solutions for the sustainable development of traditional Chinese culture in the digital age.

Based on the above problems, this work studies the application mechanism of encryption algorithm combined with blockchain technology in the era of media convergence and applies it to the intelligent storage and communication of excellent traditional culture to ensure that this technology can be used for a long time and widely respected. This work mainly takes ICH's digital storage and communication as an example to summarize its storage management and communication status and lead to the necessity of intelligent storage of excellent traditional culture. Meanwhile, how the clever integration mechanism of media convergence and blockchain technology works is studied, and the advantages of both are summarized. Finally, the mechanism is applied to the intelligent storage management and communication of traditional culture to test the time consumption of its network storage and information query.

The objective of this work is to leverage blockchain technology in developing an intelligent storage management software focused on the digital preservation and dissemination of outstanding traditional Chinese culture. Through digital identification, the design and application of smart contracts, as well as the integration of user participation and social communication mechanisms, this work aims to construct a secure, efficient, and user-friendly system. This system seeks to facilitate the intelligent storage and organic inheritance of traditional Chinese culture in the multimedia era. Privacy and security measures are incorporated to ensure the sustainable development of cultural resources.

2. Literature review

2.1. Conceptual definition

What is 'Outstanding Traditional Chinese Culture'? Up to now, the cultural research field has not produced a universally accepted definition. Since the cultural fervor of the 1980s, there have been numerous works discussing this topic. However, most research has focused on the developmental processes, major content, and historical and contemporary values, revealing little about its essence. In outstanding traditional Chinese culture, 'outstanding' is manifested in cultural elements that exhibit exceptional qualities in profound thoughts, exquisite arts, moral ethics, etc. This includes profound insights into the philosophy of life, unique expressions of emotions, nature, and social order. Literature and arts refer to enduring, impactful works reflecting the values of the times. In ethical and moral aspects, it emphasizes traditional virtues such as rituals, benevolence, and filial piety, reflecting interpersonal harmony and social order. Additionally, outstanding achievements in technological innovation have added unique brilliance to traditional culture. In summary, 'outstanding' in traditional Chinese culture is a high evaluation of cultural expressions that are profound in thought, outstanding in value, and have a far-reaching influence.

From the academic research results, scholars often use enumerative methods to describe its essence. For example, Zhang Dainian believes that interpersonal harmony and the harmony between man and nature are the main ideas. Mr. Qian Xun believes that benevolence, self-improvement, and indomitable spirit are concepts worth inheriting from humanity. From the descriptions of these scholars, each scholar has a different understanding of what constitutes 'Outstanding Traditional Chinese Culture.' This is because there has been no official and clear definition of its concept.

There are also scholars who positively summarize the essence. Scholars such as Zhang Jigong, Li Fanxiu, and Li Sen believe that traditional cultural factors that enhance human abilities and promote social development belong to the outstanding category. Li Shenshen and others, considering the dimension of historical continuity, believe that only after being tested by history and practice is it worth inheriting and being useful to contemporary people. From the perspective of cultural values, Li Zonggui believes that the 'vitality' displayed in ancient Chinese thought and culture is the outstanding part, fully expressing the spiritual temperament of the people.

Based on the discussions of these scholars, this work considers outstanding traditional Chinese culture as the essence of Chinese traditional culture, which fully embodies the national spirit. It is a cumulative result of spiritual achievements, including distinctive thinking features, value choices, aesthetic arts, etc., with Chinese characteristics. It mainly manifests in three aspects: philosophical

thoughts, humanistic spirit, and moral concepts.

2.2. Research status

With the proposition of maintaining cultural confidence and building cultural power, the inheritance of excellent traditional Chinese culture has once again become a hot topic in the academic circle. Wu et al. used the combination of big data and calligraphy art to facilitate the spread of Chinese calligraphy, so that anyone could understand and learn Chinese calligraphy anywhere, which had far-reaching significance for the forward development of Chinese traditional culture [5]. When researching the inheritance and development of excellent traditional Chinese culture, Song et al. pointed out that people should take the innovation of traditional culture as the goal and return to the issue of how to inherit and develop excellent traditional Chinese culture. Moreover, cultural inheritance should be transformed into the behavior of creative output and mutual learning and progress [6]. Liu et al. studied the inheritance path of excellent traditional Chinese culture from the perspective of new culture and innovation and analyzed it from both theoretical and practical aspects. They concluded that new culture and innovation could provide a carrier for the inheritance of excellent traditional Chinese culture, and the excellent traditional Chinese culture provided an internal impetus for the development of new culture and creativity [7].

At this stage, there is much research on the application of blockchain technology in the era of media convergence. The development and application of blockchain provide new ideas and directions for solving the problems faced by copyright protection in the era of media convergence. Zachariadis et al. discussed the innovative application of blockchain technology in optimizing the copyright protection mechanism and used the distributed node consensus algorithm to generate and update data [8]. Rella et al. used cryptography to ensure the security of data transmission and access and used smart contracts composed of automated script code to program and operate data [9]. Demirkan et al. used the characteristics and key technologies of the blockchain to propose strategies to solve the information security problems of the media convergence platform. They explored the architecture scheme of the radio and television media convergence platform based on blockchain technology [10].

To sum up, scholars have researched the inheritance of excellent traditional Chinese culture and the intelligent storage management of cultural information. Their research is more reflected in the significance and necessity of cultural inheritance. However, there is no certain conclusion on how to manage and spread the excellent traditional Chinese culture. This work mainly studies how to realize the intelligent storage management and communication of excellent traditional Chinese culture by combining blockchain encryption technology in the era of media convergence. It aims to master the technology's core and application mechanism and apply it to information storage management in various fields.

3. Research methodology

3.1. Digital storage status of ICH

Digital storage is a new storage and development mode for ICH, which conforms to modern science and technology development and consumer demand. Based on the consumption demand of tourists to explore new and different things while relying on digital technology and platforms to store folk ICH raw materials, it displays and spreads the cultural spirit and connotation of ICH in a diversified way [11]. Thereby, the research on digital storage of folk ICH has the following important significance (Fig. 1).

In the inheritance of folk ICH, there is a contradiction between preserving the authenticity of ICH and the resources' development and utilization. Whether in theory or in reality, the contradictions between the historical content of folk heritage and the development of the times as well as the inheritance of national culture, need to be resolved. The storage and inheritance of folk ICH is a systematic project requiring the cooperation of the government, enterprises, and the public to carry out the three-dimensional development of technology. The practical actions of adopting digital storage include establishing a digital network system, sharing cultural information resources, and digital storage involving scientific research institutions [12]. Fig. 2 shows the protection methods used in the digital storage and communication of traditional cultural heritage.

Internet technology is the main technology of digital storage and communication, which can break the limitations of time and

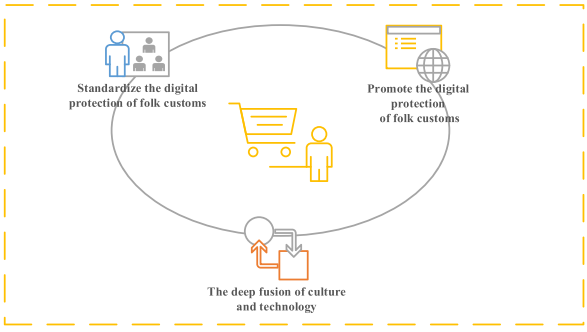

Fig. 1. Significance of digital storage of folk ICH.

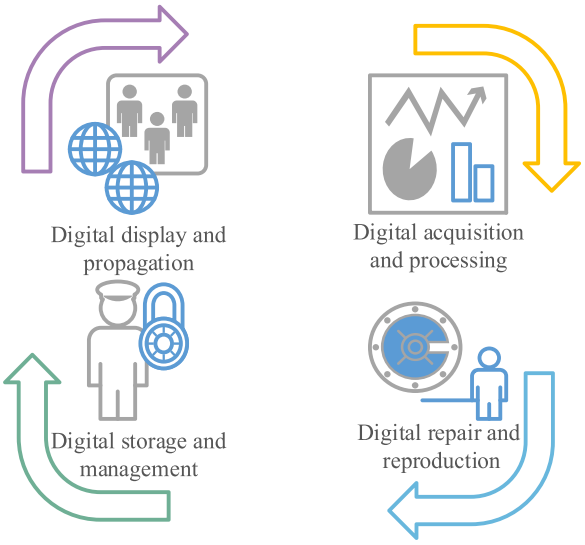

Fig. 2. Digital storage and communication means of traditional culture.

space. It has the advantages of crossing time and restructuring space, making ICH storage free from the constraints of region and era. Digital storage can greatly reduce the cost of ICH replication. The system can easily complete the replication task based on high-quality ICH material input and storage. Moreover, there is no difference between the replica and ICH itself. Low-cost ICH replication also directly promotes the spread and sharing of ICH. Meanwhile, digital storage uses virtual reality (VR) and computer graphics to create a VR environment to provide the audience with a simulation experience. This feeling is not illusory, but the use of human-computer interaction technology to achieve the "on-site feeling" of being absent. Moreover, digital storage can also use perceptual parameters to enhance human perception to achieve the VR effect [13].

Some progress in the digital storage of ICH has been made in resource collection, database construction, and software development and application. However, the application of digital storage mode in folk ICH development still has the problems shown in Fig. 3.

After the launch of the ICH digital storage project, although the formulation of ICH digital standards and specifications has been conducted, they mainly include the standards of traditional folk literature, traditional drama, traditional art, and traditional skills and have not yet involved the digital storage standards of folk ICH. Even though national and local governments at all levels are currently increasing their human, material, and financial investment in ICH storage and development, there is still a waste of resources and cultural distortion. The excessive digitalization of folk ICH is easy to cause ICH distortion and biased experience focus. With folk ICH's continuous development and change, encouraging and driving tourists' on-site participation, experience, and inheritance is the key to ensuring ICH's authenticity [14].

Based on understanding the status quo of digital storage and communication of folk ICH, this work proposes that digital storage of folk ICH can be designed innovatively and improved from its classification and collection, expression and dissemination, protection

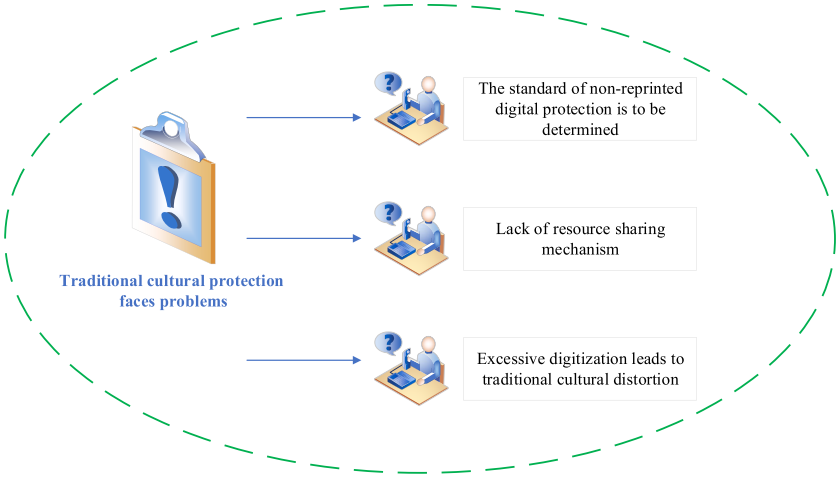

Fig. 3. Storage problem of folk ICH.

and inheritance. Fig. 4 presents the specific countermeasures.

The digital classification should be a scientific and logical fine classification of data based on grasping the connotation of ICH. It starts from the presentation form of time evolution, the geographical scope, and the knowledge characteristics of the reason for development to carry out a complete resource description, establish categories, and then gradually construct the standards and norms for the digital classification of folk ICH [15]. Fig. 5 shows the optimized digital storage and communication system.

The construction of the digital storage system of folk ICH is the exploration and application of digital technology from the simple to the deep. It is mainly adopted to collect and store images, texts, and audio images of ICH manifestations. The diversity of ICH manifestations requires the integration of digital technology, database management and service, scenario modeling and visualization technologies. In order to ensure the construction integrity of folk ICH's digital storage technology system, the system construction should include four digital protection means and related technologies, namely, digital acquisition and processing, digital restoration and reproduction, digital storage and management, and digital display and dissemination [16].

3.2. Application of blockchain technology in the era of media convergence

Blockchain is a data blockchain composed of the block header and block body. It is a chained data structure based on big data network technology and encryption technology. It can use cryptography to ensure that information cannot be tampered with or forged. It is a chained data structure connected in chronological order. It integrates innovative technologies in multidisciplinary fields and can be used as a decentralized distributed accounting system [17]. Fig. 6 displays its structure.

Media convergence is a typical communication concept with distinctive characteristics compared to single-media communication. It can be spread in various carriers such as radio and television, newspapers, and new media in the form of text, image, audio, and video. Under the background of continuous improvement of the information technology level, it can be predicted that the future communication path adopted by media convergence will be closely connected with big data, the Internet of Things, cloud computing, artificial intelligence (AI), and other information technologies [18]. The media convergence technology will also be gradually updated to meet the needs of the times. When using the blockchain for information dissemination, it can achieve the standard of mutual trust and sharing and then complete the construction of the mutual trust mechanism. Specifically, media convergence can use the support of blockchain technology in terms of credibility to effectively reduce the institutional costs arising from the governance process of the media convergence industry [19]. The security strategy of the media convergence platform based on blockchain technology includes the aspects shown in Fig. 7.

Blockchain technology can use the consensus mechanism to make its database store the data in an open and independent distributed accounting mode, effectively ensuring data consistency. Once tampering or deletion occurs, the configuration can quickly be detected. Then, traceable technology can be adopted to find the "inside man" and repair data vulnerabilities to prevent data loss and correct the information and data errors of the platform. Meanwhile, the distributed management of access control policies is realized by using the blockchain's distributed, independent access control system without the participation of a third party, and it effectively improves the system's credibility and security. It can also realize the judgment of access control policies, thus avoiding the ultra vires behavior of internal personnel. It is a truly decentralized access control mechanism that meets the access control management requirements of the media convergence platform and ensures the tamper-proof, auditability, and verifiability of access control information [20]. Fig. 8 presents its mode of information security storage and management.

In Fig. 8, regarding the design of the program code, only a preliminary design framework content is shown here.

This example utilizes the Fernet object from the cryptography library, providing a straightforward symmetric key encryption scheme. The generated key (referred to as 'key') is responsible for both encrypting and decrypting data. Such a simple example may not be sufficient to meet the requirements of highly secure environments. Real-world scenarios demand more complex designs and

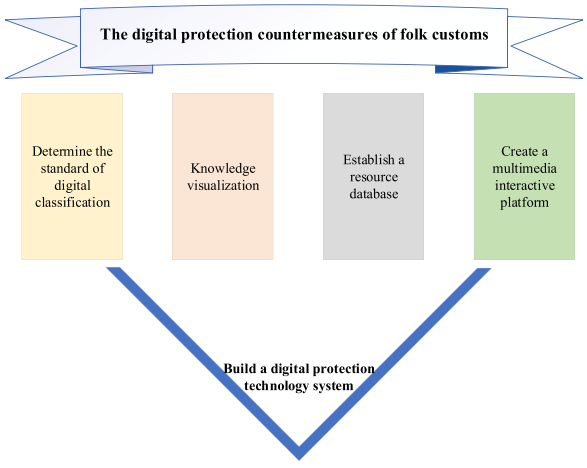

Fig. 4. Countermeasures for digital storage of traditional culture.

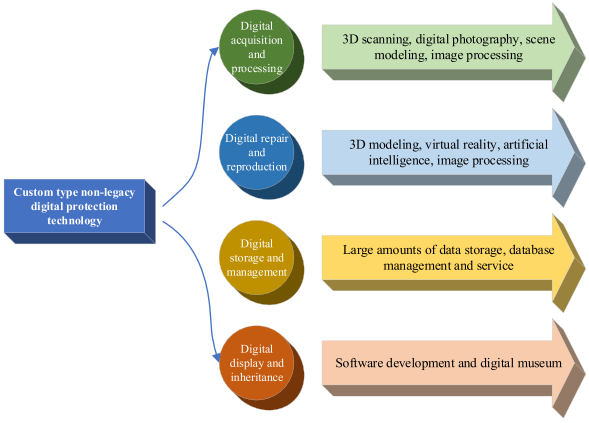

Fig. 5. Optimized digital storage and communication system.

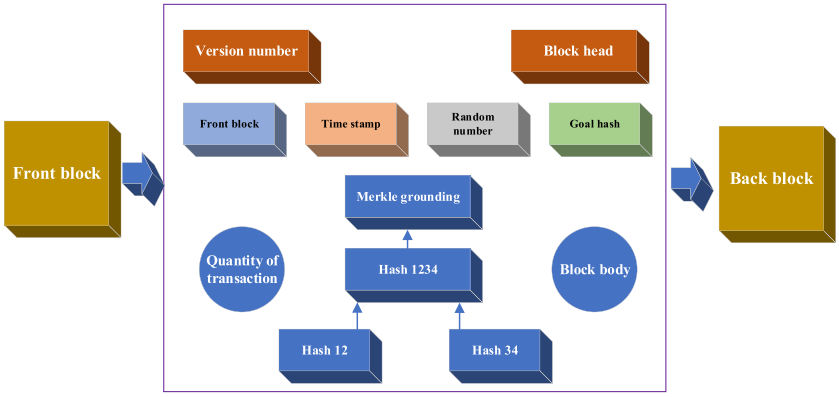

Fig. 6. Blockchain data structure.

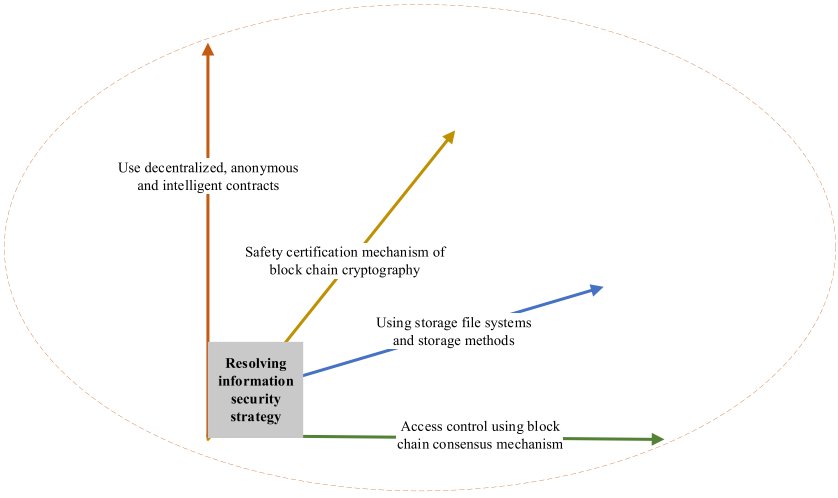

Fig. 7. Security strategy of media convergence platform based on blockchain technology.

consideration of additional security factors.

Based on the decentralized characteristics of blockchain technology, "mutual trust and sharing" is its most significant advantage. Media convergence can reach the standard of mutual trust and sharing when using the blockchain to spread information, and then complete the construction of a mutual trust mechanism. Specifically, media convergence can use blockchain as technical support in

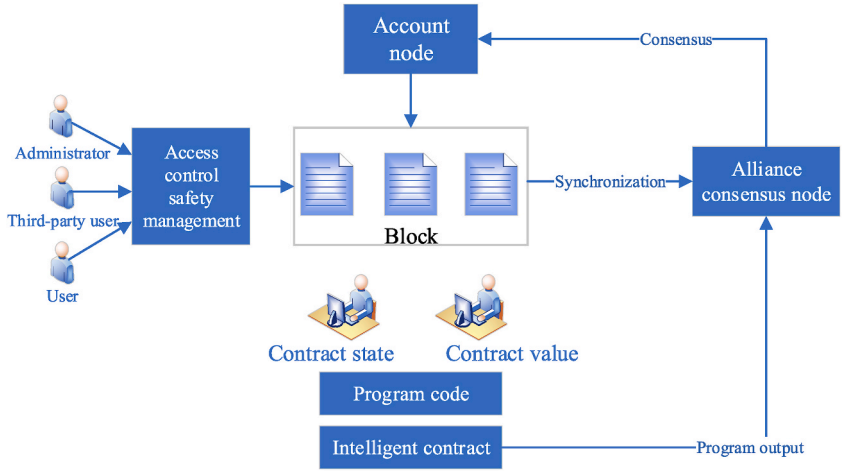

Fig. 8. Information security storage and management mode.

terms of credibility to effectively reduce the institutional cost of the media convergence industry's governance process [21].

3.3. Intelligent storage and communication mechanism of traditional culture based on blockchain in the era of media convergence

In order to strengthen the protection and inheritance of outstanding traditional Chinese culture, it is essential to archive, store, and safeguard cultural heritage. Traditional methods of storage and protection often encounter challenges such as difficult retrieval and traceability. However, the application of blockchain technology can effectively address these issues, making digital archiving and intelligent retrieval no longer arduous. This allows for the digital preservation of some outstanding traditional cultures, achieving parallel goals of protection and inheritance. In the context of cultural storage, blockchain technology needs to consider different types of cultural information, including images, videos, audios, texts, etc. Each form of information storage may require an appropriate blockchain mechanism to meet different needs and characteristics. Specifically, for different types of cultural information.

1. Text Information: For traditional literary works, classical literature, and other textual information, recording them in an immutable form on the blockchain can ensure copyright and integrity. Smart contracts can be utilized for copyright management and automatic execution of related agreements.

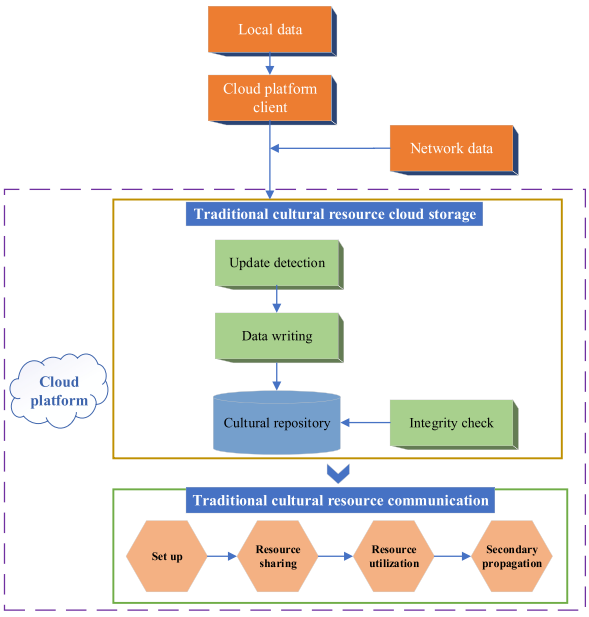

Fig. 9. Cloud platform for storage and communication of traditional cultural resources.

2. Image Information: Storage of traditional paintings, artworks, and other image information can consider using decentralized storage and digital identification technology to protect the authenticity of the works. Smart contracts can define related copyright and usage rules.
3. Audio Information: For traditional music, folk music, and other audio information, blockchain can provide decentralized storage to ensure copyright and traceability. Smart contracts can also be used for music copyright management and revenue distribution.
4. Video Information: Storage of traditional opera, dance, and other video information can leverage blockchain's distributed storage to ensure the security and long-term preservation of the works. Smart contracts can manage related copyright and dissemination rules.
5. Other Information: Any other forms of cultural information, such as traditional medical knowledge, craftsmanship, etc., can be stored and managed using blockchain technology to ensure their inheritance and protection.

AI is profoundly changing the thinking mode and lifestyle of human beings. AI technology has been used in many countries to promote cultural heritage and economic development and to ensure social stability and national security. AI is open. The huge social and economic benefits brought by its integration of technology and culture into industry also provide the possibility for long-term cooperation among the government, enterprises, and the public. AI has incomparable advantages in cultural inheritance. Using AI to spread excellent traditional culture can make traditional culture radiate new vitality in contemporary society to meet people's needs for diverse cultures, enrich their lives, and make the Chinese nation more cohesive and centripetal [22].

Cloud storage and communication of excellent traditional Chinese cultural information resources is the whole process from academic information resources to target users' acquisition and secondary propagation. In the era of media convergence, the storage and communication of traditional cultural resources are mostly concentrated on the cloud platform, which includes three links: cultural resources transmission, cultural resources cloud storage, and cultural resources communication, as shown in Fig. 9 below.

In the transmission phase, academic information resources primarily come from two aspects: local data and network data. Local data is typically uploaded to cloud storage platforms by logging into the cloud platform client, while network data is usually collected directly from the internet using relevant programs and transmitted to the storage platform. The key steps in the cloud storage phase of academic information resources include academic information resource update detection, data writing into the database, and integrity verification of academic information resources in the academic resource repository. Due to the presence of multiple versions and resource updates in the resources stored by users on cloud storage platforms, resource update detection is usually adopted to control the storage resources to ensure the synchronization of traditional cultural resources and local resources in cloud storage. On this basis, traditional cultural information resources are written into the resource library according to the allocated storage media. Finally, the integrity of the resources after the storage is verified to ensure the successful storage of excellent traditional cultural information resources. The communication of traditional cultural resources is the process of users' acquisition, utilization and secondary propagation of shared information resources. It can be specifically divided into four aspects: cultural resources setting, cultural resources sharing, cultural resources utilization and secondary propagation.

The fundamental principles of the blockchain-based intelligent storage and dissemination mechanism for traditional culture in the era of converged media involve the organic integration of blockchain technology and converged media. The main principles are as follows.

(1) Decentralization and Immutability of Blockchain: Blockchain is a distributed ledger technology where data is stored across multiple nodes without relying on a single centralized management entity. Each block contains information from the previous block, forming a chain structure, and cryptographic algorithms ensure the immutability of the data. This principle ensures the security and transparency of traditional cultural information during the storage process.
(2) Programmable Smart Contracts: Smart contracts on the blockchain are self-executing computer programs used to define and execute rules for the storage and dissemination of traditional cultural information. Through smart contracts, intelligent management of cultural resources can be achieved, such as ensuring compliance with specific copyright provisions or formulating dissemination strategies.
(3) Digital Identification Technology: Using blockchain technology, unique digital identifiers such as digital signatures or hash values can be assigned to traditional cultural resources. This helps ensure the authenticity and integrity of cultural heritage while making it more traceable in network dissemination.
(4) Distributed Storage and Sharing: Blockchain technology enables cultural information to be stored in a distributed manner across multiple nodes rather than centralized on a single server. This distributed storage not only enhances data security but also facilitates more effective information sharing and dissemination.
(5) Integrated Application of Converged Media: By combining the dissemination methods of converged media, such as social media, mobile applications, and online platforms, with blockchain technology for the dissemination of traditional culture, diverse, interactive, and widely spread information can be achieved. Through the integration of converged media, traditional culture can better adapt to the diverse communication networks of modern society and engage in deep interactions with the younger generation.

In summary, the blockchain-based intelligent storage and dissemination mechanism for traditional culture in the era of converged media aims to protect, manage, and inherit traditional culture while enabling its better integration into the diverse communication networks of the digital age.

The encryption algorithm using blockchain technology can ensure the security of transmission and storage of traditional cultural

resources. Its main steps are the initial setting stage, encryption stage, key generation stage, and decryption stage [23]. In the initial setting stage, the encryption algorithm is randomly initialized. The initialization data includes the hidden security parameter λ, the Public Key (PK), and the Master Key (MK). The key distribution center performs the initial distribution of keys:

$$Input(\lambda) \rightarrow (PK, MK) \tag{1}$$

The encryption phase is a random algorithm. The algorithm inputs are the system PK, the message m to be encrypted, and the access control structure A_{cp} associated with the access policy. They can generate the ciphertext Em based on attribute encryption. The purpose of the encryption phase is to safeguard the confidentiality of the original data, ensuring that only authorized users or devices can comprehend its content. The operational process involves utilizing specific encryption algorithms and keys to transform plaintext data into ciphertext. Symmetric encryption employs the same key for both encryption and decryption, while asymmetric encryption uses a pair of related public and private keys, with one key used for encryption and the other for decryption. Only the requester with access policy can decrypt the ciphertext Em:

$$Encrypt\ (\ PK, \mathrm{m}, A_{cp}\ )\ \rightarrow Em \tag{2}$$

The key generation phase is still a random algorithm. A set of attributes Y, system MK, and system PK are input. In the key generation phase, ciphertext data is transmitted through a network or other communication channels, and it is crucial to prevent unauthorized access and data tampering. The operational process involves transmitting the encrypted data through a secure channel. Even if attackers intercept the data, they cannot comprehend or restore the original data due to the lack of the corresponding decryption key. Additional measures, such as the use of secure protocols (such as TLS/SSL), are necessary during the transmission phase to ensure the integrity and confidentiality of communication. A decryption key UK for the data requester is output:

$$KenGen(MK, PK, Y) \rightarrow UK \tag{3}$$

In the decryption phase, based on the ciphertext Em encrypted based on the access structure A_{cp}, the decryption key UK of the corresponding attribute group Y, and the system PK. The decryption phase ensures that only the legitimate recipient can restore and comprehend the original plaintext data. The operational process involves the recipient using the corresponding decryption key to revert the ciphertext to plaintext through a specific decryption algorithm. The decryption key is possessed only by the authorized recipient, ensuring that only authorized users can access the original data. If $Y \in A_{cp}$, the message m can be output:

$$Decrypt\ (\ PK, U, K, Em\ )\ \rightarrow m \tag{4}$$

In terms of information source credibility, media convergence issues the digital identity of the information publishers through the collection records jointly maintained to achieve the digital verification of information source qualification in the whole regional chain. It uses blockchain technology to encrypt traditional cultural data and distribute it to multiple user nodes. In this way, a single user will not tamper with cultural information at will, and AI will give dynamic trust points and full chain user evaluation. Each node of the blockchain combined with the media convergence database retains all information exchange data, and generates data fingerprint verification and regional chain to ensure that the information content can prove its credibility without a trusted third party. Due to the embedded smart contract regulation, the enforced code makes the information exchange automatically complete as agreed and cannot be interfered with. For example, the smart contract can directly shut down the source account whose trust score is lower than the threshold.

3.4. Development of intelligent storage software for traditional culture

Currently, availability, maintainability, and self-evolution are the main challenges for intelligent storage systems in traditional culture. They are even more important than performance. This work brings Availability, Management, and Evolutionary (AME) into a large-scale and intensive storage system to achieve storage intelligence and management automation [24]. How to incorporate the

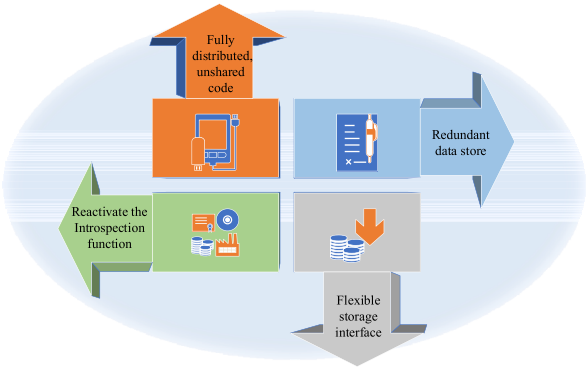

Fig. 10. Software structure characteristics of traditional culture intelligent storage platform.

principles of Availability, Management, and Evolution into storage systems characterized by their extensive scale and high density. Firstly, Availability in a storage system refers to the capability of the system to provide data access when needed. By employing redundancy and backup strategies, system availability can be enhanced. For example, technologies such as data replication, distributed storage, and load balancing ensure the system continues to operate normally in the event of hardware failures or other issues. Secondly, management of a storage system involves effective configuration, monitoring, and maintenance of storage resources. This includes aspects such as allocation of storage resources, performance monitoring, fault detection, and automated management. By introducing intelligent management, the workload of administrators can be reduced, enhancing the efficiency and stability of the storage system. Finally, evolutionary aspects require storage systems to be adaptable to evolving needs and technologies. This involves scalability, compatibility, and continuous improvement. Through modular design, flexible architectures, and ongoing technological innovation, storage systems can evolve over time to meet new challenges and requirements. Fig. 10 presents the software structure characteristics of the established traditional culture intelligent storage platform.

The software structure characteristics of traditional culture intelligent storage platforms are as follows. (1) Fully distributed, no code sharing. It can expand the system infinitely, avoiding the defect of single-point failure caused by using front-end opportunities in the storage cluster. (2) Redundant data storage. It meets the requirements of high availability and simple self-test. Meanwhile, when applying object replication, a data consistency strategy can be used, and there are more opportunities to optimize data storage location. (3) Flexible storage interface. The demand-based driver will submit data to applications and automatically adapt to changes in

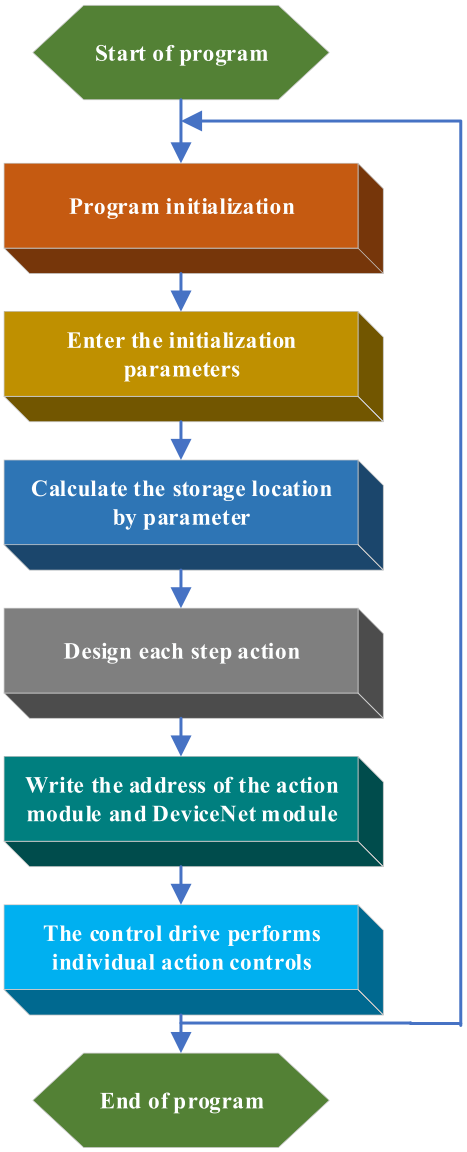

Fig. 11. Block diagram of software development.

performance of producers and consumers. (4) Reactivate the introspection function. Statistical techniques are employed to determine normal behavior and test deviations accordingly. Once the abnormal behavior is tested, the policy-based driver automatically adapts to it, starts to rely on managers to specify policies, and finally learns to solve problems by itself [25].

The system uses ControlLogix5000 controller to control the storage platform. By writing labels to the DeviceNet module, it sends out high-speed pulses to control the motor speed and revolutions. Fig. 11 is a block diagram of software development.

After the program starts, the staff inputs the storage content code and selects Save or Retrieve. After that, the system starts to calculate according to the information, determines the horizontal and vertical coordinates of the stored content to be operated, and executes each step. Then, each module controls each part of the motor to execute each action, thus completing the picking and placing process. The system is configured with a detection subprogram to monitor the mechanical arm and data rack operation at any time. Once an error occurs, the mechanical arm will automatically return to the original point to avoid damage to the mechanical device [26].

Finally, an experiment is carried out to verify the running phenomenon of the software storage system. It can test the overall performance of the network when the intelligent storage network access is unimpeded, and verify that the designed storage platform has efficient, intelligent, and intensive storage and scalable functions.

4. Results and discussion

4.1. Results

The construction of the "media convergence + blockchain" system provides a platform for the all-round storage and communication of excellent traditional culture. Its main functions include data collection and processing, traditional cultural heritage's restoration and reproduction, storage and management, and integrated application of display and communication. Its design can meet the requirement that the information system with "object" as the center can be transformed into the information system with "knowledge" as the center, and realize the continuous inheritance and sustainable development of the excellent traditional Chinese culture. Regarding services for different individuals, the system has made corresponding content settings. Table 1 shows the details.

Through the cross-institutional and cross-platform collection, the digital traditional culture resources scattered in each library collection are collated, edited and summarized to present relatively complete thematic traditional cultural resources. The searcher can scan the content related to the search subject words through a single search and query, shorten the time for multiple queries, and improve the efficiency of queries.

This work conducts a test experiment on the extraction of image features and image matching for ceramics to validate the performance of blockchain-based intelligent storage management for traditional Chinese culture in the context of converged media. Firstly, it summarizes the quantity of features extracted by different algorithms, as shown in Table 2.

The algorithm presented in this work is an improved version based on the SIFT algorithm. While ensuring the stability of feature points with minimal impact, it optimizes the speed of the latter. Therefore, theoretically, the speed should be faster than SIFT. However, in practical applications, the speed of feature point extraction and description is significantly discounted due to the dual impact of algorithm implementation and the number of feature points. In the extraction of micro-scale ceramic image features for the same image, the algorithm presented in this work consistently maintains the quantity of extracted feature points in the thousands, far exceeding the SIFT algorithm.

The performance analysis mainly includes two aspects. Firstly, a comparison of retrievability proof-of-work schemes. So far, there are only two schemes using retrievability proof-of-work as a consensus algorithm, namely Permacoin and Retricoin. In their schemes, the retrievability proof used is the SW scheme. In the performance analysis section, this work will compare the storage overhead and communication overhead of the SW scheme with the blockchain-based intelligent storage scheme proposed in this work. Secondly, this work analyzes the performance of the intelligent storage protection scheme for outstanding traditional Chinese culture. The performance of the proposed storage mechanism based on blockchain technology-proof improvement will be analyzed in terms of storage overhead and bandwidth.

Firstly, assuming a security parameter $\lambda = 128$, in the verification phase of retrievability proof, the communication overhead is the size of the proof. According to the scheme of retrievability proof, the proof can be represented as a triple (χ, φ, σ), and the proof is generated by a random challenge QC, data blocks, and tags. The challenge is composed of a subset QC and two group elements v, r, with a value range of $[1, 2^{80}]$, so the size of QC is 280 bits. Therefore, the communication overhead for each verification is $3\lambda + 440$. Assuming the selected total file size is 1 GB, let Θ represent the storage burden. When Θ is set to 20, 40, 60, and 80 MB, the comparison between the retrievability proof storage burden and the communication quantity for each verification is shown in Fig. 12. From Fig. 12, it can be observed that as the storage overhead increases, the proposed solution in this work maintains a constant communication bandwidth for each verification, while the SW scheme decreases in communication as storage overhead increases. Clearly, the blockchain-based intelligent storage solution proposed in this work is superior to the SW scheme.

The overall performance of the established intelligent storage management and communication mechanism of excellent traditional culture is evaluated. After verifying the feasibility of each stage of the network, the system functions are integrated into storage and query by writing an automatic running program to test their running speed. The test is to conduct ten storage and query operations and record the use time, including the time required to upload and download images and feature information. Fig. 13 presents the test results.

Fig. 13 reveals that the test network has good overall performance, short time consumption, and stable operation when the access to the intelligent storage network is unimpeded. However, in practice, it is also essential to consider the network access in the non-local

Table 1
Setting of different individual service demands.

Demands	Individual	Service Items
Browsing information, Visiting the digital exhibition, Personalized retrieval	The general public	Design and recommendation of the tour schedule, Database retrieval, Community discussion
Teachers' education and teaching, Student learning and experience	School groups	Database retrieval, Multimedia material library, Online teaching video
A large amount of original storage materials	Academic researchers	Database joint search, Information authorization

Table 2
Quantity of features extracted by different algorithms.

	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	Group 9	Group 10
Algorithm	1829	4461	1761	2249	1969	919	2068	2442	1058	1372
SIFT algorithm	160	59	171	32	807	362	139	459	539	511

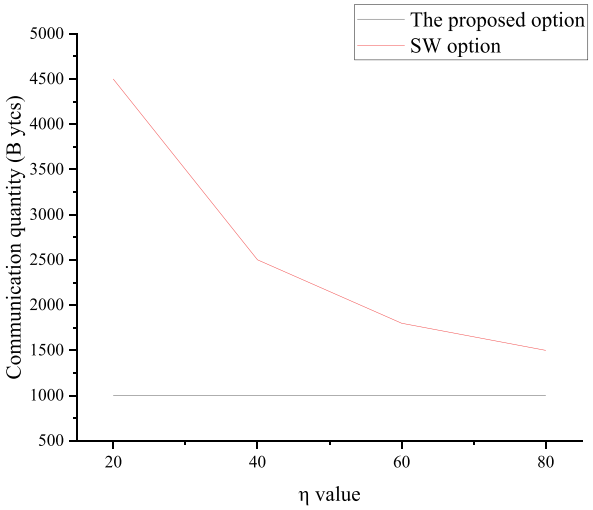

Fig. 12. Performance analysis comparison.

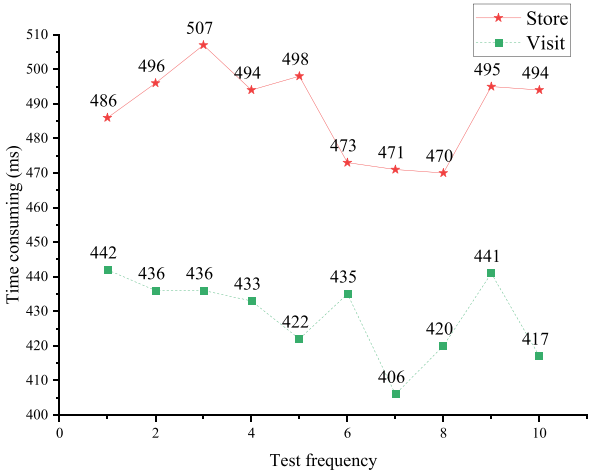

Fig. 13. Performance test results.

area network situation, which depends on the network deployment in the real application scenario. Compared with the traditional centralized network, the "media convergence + blockchain" structure combines two relatively independent networks. When accessing data, it needs to go through the interaction of a two-layer network, and the time consumption will be increased. The test results suggest that a distributed storage network is an application scheme worth considering for intelligent storage and communication of traditional culture.

4.2. Discussion

In the ceramic certification and storage research, Qiao et al. better integrated the image-matching algorithm and the blockchain-based network into a system. After fully comparing the differences between the micro characteristics of ceramics and other characteristics, the research method of establishing ceramic certification from the perspective of micro characteristics is clarified. The scheme to improve blockchain storage is proposed to enhance the security of its data storage and strengthen the protection and identification of excellent traditional cultural processes facing counterfeiting [27]. In the research on the application of blockchain technology to the media convergence platform, Hisseine et al. mainly proposed the application of blockchain technology in the digital copyright protection, content audit, and traceability of the media convergence platform. After analyzing the problems of weak digital copyright protection, complex content review, and difficult content traceability of traditional media convergence, blockchain technology and media convergence platforms are combined to propose relevant solutions [28].

In the comparison of algorithm performance, the quantity of feature points extracted by the algorithm presented in this work consistently remains in the thousands, far exceeding the SIFT algorithm. Additionally, from the comparative performance analysis chart, as the storage overhead increases, the communication bandwidth for each verification in the proposed solution remains constant. In contrast, the SW scheme sees a decrease in communication as storage overhead increases. Clearly, the blockchain-based intelligent storage solution proposed in this work is superior to the SW scheme. In conclusion, based on the performance test results, it is evident that in the smart storage network with unhindered access, the overall performance of the test network is excellent, with short and stable processing times. A distributed storage network is a highly worthwhile application solution for intelligent storage and dissemination of traditional culture. This work combines the application of "media convergence + blockchain" to the intelligent storage management and communication of excellent traditional Chinese culture. It confirms that the established platform takes less time and has a high-security factor in data storage and query. Meanwhile, for individuals of different identities, the platform sets corresponding recommended content for users to learn about excellent traditional culture, and provides more diversified information storage management and communication solutions.

5. Conclusion

Under the condition of analyzing the rich value and social function of excellent traditional Chinese culture, this work aims to realize its intelligent storage, inheritance, and development, fully tap the resources of excellent traditional Chinese culture and carry out cultural creativity. The service platform and mechanism of "media convergence + blockchain" integration are designed for the public to understand and learn the excellent traditional Chinese culture. The analysis is conducted from both theoretical and practical aspects to enrich the carrier of cultural inheritance and storage. The blockchain encryption algorithm is adopted to strengthen the confidentiality mechanism of cultural industry information, providing new ideas for building a socialist cultural power and improving the national cultural soft power. Meanwhile, there are still some research deficiencies. In the analysis of the status quo of the storage and communication of excellent traditional culture, only the digital protection of ICH is exemplified. The emphasis is on protection and storage, but there is no status quo analysis of cultural communication. This work lacks problem comparison to highlight the advantages of the scheme design proposed. Future research should also focus on studying external communication, telling stories about Chinese traditional culture, adapting to Internet thinking, and using advanced carrier platforms to increase the strength of external communication.

CRediT authorship contribution statement

XiaoHong Zhong: Writing – review & editing, Writing – original draft, Methodology, Funding acquisition, Data curation, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Xiaohong Zhong reports financial support was provided by Research on Intelligent Storage and Dissemination of Chinese Traditional Art based on financial media. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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