

Research on Application of Blockchain Technology in Digital Resources Construction

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Abstract

Blockchain, as a new technology rising gradually and popularizing day by day, is a comprehensive application of many mature technologies, which can be effectively applied to the construction of digital resources in the digital transformation of libraries. This paper analyzes the characteristics of block chains, discusses the practical application of these features in the construction of library digital resources, realizes the sharing and copyright protection of digital resources by using decentralization and unauthorized attributes, and realizes the sustainable evolution and development of future transformation by using the programmable intelligent contract. This paper puts forward the framework of Library Digital Resources Platform Based on block chain, analyzes on the shortcomings and difficulties to realize the platform, and advances that libraries should pay attention to the development of block chain technology.

Keywords

Blockchain; digital resources; library; resource sharing; copyright protection.

1. INTRODUCTION

With the increasing development of blockchain technology and the gradual transformation of library digitization, people attach more and more importance to the combination of blockchain technology and library. How to apply blockchain technology to library is a problem we are thinking about actively at present. In the mid-1990s, the United States set up the institute of museum and library services, the institute's officials are providing grants to help San Jose State University's research foundation, which focuses on exploring the use of blockchain technology in library digital management, and hopes to eventually roll it out in library systems. On September 19, 2017, On September 19, 2017, "Forum on the Application and Development of Block Chain Technology" was held at Qianhai Shenzhen and Hong Kong Youth DreamWorkshop. The first "Block Chain" theme library in China was also unveiled in Shenzhen.

1.1. Basic Concepts of Blockchain

Blockchain, as the underlying technology of Bitcoin, first appeared in 2008. It originated from the founding paper Bitcoin: A Peer-to-Peer Electronic Cash System published by the legendary Satoshi Nakamoto. [1]

Blockchain is a linked list composed of several data blocks connected by hash pointers in time sequence. It can also be regarded as a distributed database. It uses cryptography to encrypt block chain information to store and verify data, uses node consensus algorithm to generate and update data, and uses smart contracts (Automation scripts) to write and operate data to ensure that the data can't be forged and tamper with. [2]

The basic structure of the block chain is shown in Figure 1, and the information contained in the block is shown in Figure 2. When generating a new block, it is necessary to package the hash value, time stamp, transaction of the previous block connected by the new block to broadcast to all nodes for reconciliation, so that each node can supervise.

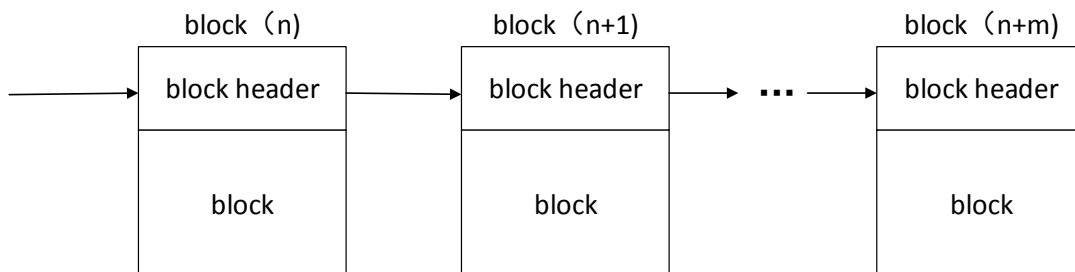


Fig 1. Block Chain Basic Structure

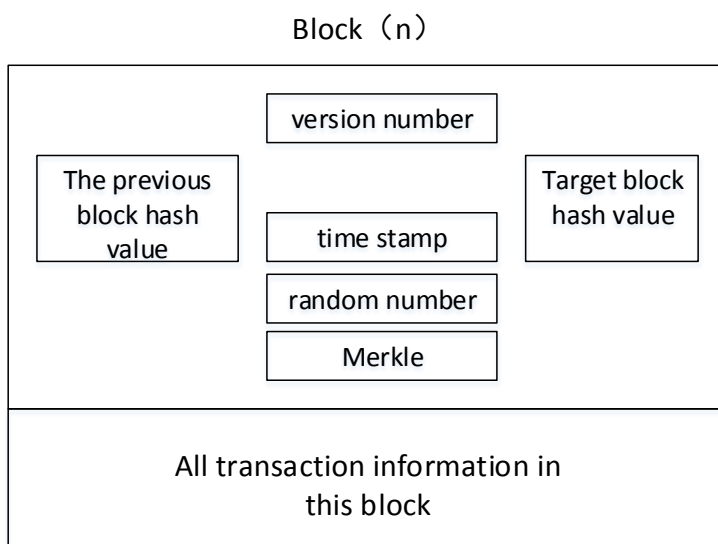


Fig 2. Block Basic Structure

1.2. Features of Blockchain

(1) Decentralization

In the blockchain system, there is no need for centralized hardware or supervision and management, and no intermediary is needed in the whole transaction process, using distributed storage and computing, any node has the same obligations and rights. Each node keeps accounts and stores. When one or several of the nodes make mistakes, there will be no server down in the storage mode and it will not affect the operation of the whole blockchain. The existing data can still be stored and updated to maintain the data security of the whole system.

(2) Autonomy

Blockchain allows all nodes to participate in free and secure communication on the basis of consensus protocols and specifications without manual intervention [3], and even if manual intervention is invalid. Any node participates in the reconciliation, avoiding the fraud between nodes, and each node is responsible for other nodes, eliminating the intervention of auditors [4].

(3) Distributed Accounts Can't Be Modified

Blockchain is stored in a distributed network system composed of multiple nodes. The generated data blocks are encrypted by workload proof mechanism (PoW) and cryptography to ensure that the information data can't be modified. Each data block contains the whole network transaction data. The new information needs to be verified by all nodes, added to the blockchain in chronological order, and then stored permanently. Each node stores a copy of the whole block chain. With the help of the "timestamp", each node can record the whole network's historical transactions. The historical transaction records of the whole network can be tracked and checked. If someone want to modify the data on the blockchain, he has to control more than 51% nodes at the same time to calculate a branch chain, otherwise the modification of single or several nodes is invalid, which ensures the immutability of distributed accounts.

(4) Openness and Consensus

Each node in the blockchain has a complete copy of the blockchain, all data is open to the whole network except the private information of both sides of the transaction is encrypted. The algorithm of blockchain is open source, which uses asymmetric cryptography to establish trust mechanism and operate in an open and transparent way. Each node monitors and verifies the data on the blockchain and avoids the Byzantine Generals Problem through node consensus.

(5) Anonymity

The open and transparent data of block chain does not include personal information. The public key address is used to replace the personal information of both sides of the transaction, so the anonymity of blockchain is realized, and the privacy of both sides of the transaction is effectively protected.

2. APPLICATION OF BLOCK CHAIN IN LIBRARY DIGITAL RESOURCES CONSTRUCTION

The technologies involved in blockchain include P2P technology, database technology, asymmetric encryption technology, digital currency technology, and other mature technologies such as Merkle tree, timestamp technique, the Hash algorithm and a variety of consensus mechanisms. Blockchain is made up of these mature technologies and new technologies, so it is a comprehensive application of these technologies [5].It can be found that blockchain technology is applicable to the field of library digital resources from the characteristic attributes of blockchain.

2.1. Decentralized Characteristic to Realize Library 2.0 Digital Resource Sharing

Library 2.0 (Lib2.0) was proposed by Michael Casey and others on the basis of Web 2.0 in 2005. For a long time, Library 2.0 doesn't have an accepted and accurate definition. It is based on Web 2.0 model and modeled on Web 2.0. Since Library 2.0 was put forward, it has not been ideal for physical libraries.

Compared with library 1.0, which is centered on library and document source, readers and document source are two different roles. Library 2.0 removes the centralized control of document source, readers can be regard as document sources, any reader can provide uploaded document source. That is to say, Library 2.0 is decentralized [6].The Library 2.0 model is shown in Figure 3.

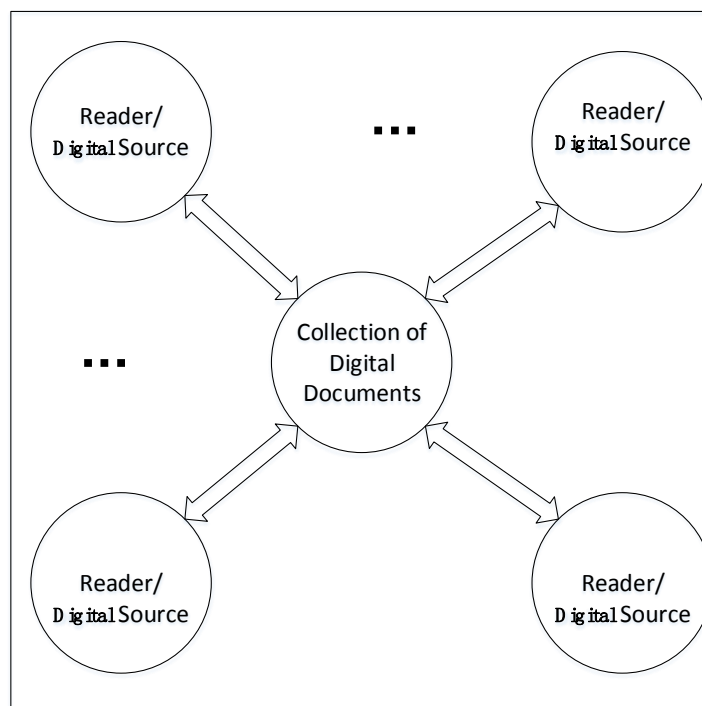


Fig 3. Library 2.0 Model

From the characteristics of blockchain in Chapter 1.2, we can know that the decentralization characteristic of blockchain is very consistent with the Library 2.0 model. The decentralization of blockchain is reflected in the fact that each node is logically equal. In Library 2.0, we represent nodes as readers. As a node, each reader can not only get information from the digital document collection of the library, but also upload and provide digital document to the library's digital document collection. Data communication and exchange between readers does not require the participation of intermediaries or regulatory agencies, and information is directly shared from point to point, so as to realize the decentralization of Library 2.0.

Library 2.0 based on the blockchain stores information directly in data blocks, gathers information in blockchain, and stores a copy of complete blockchain in each node. It can aggregate information and share information at the same time. The complete information can be stored and recorded in each node of the blockchain, which is open and transparent. Any reader can participate equally in the construction and sharing of Library 2.0 digital resources based on blockchain, so as to solve the problem of information asymmetry in Library 1.0, and realize the sharing mode of Library Digital Resources Based on blockchain.

Using blockchain technology to realize Library 2.0 can also prevent the data from modifying and forging. Blockchain is a decentralized distributed database, all nodes participate in maintaining the verification of the transaction process and each node has a complete copy of the whole blockchain. When new data is written, all nodes participate in monitoring and accounting, keeping new complete copy. If one or several of the nodes fail or are attacked, as long as there is a complete node, the complete information on the blockchain can be restored, and data disaster tolerance can be realized by relying on multiple nodes, which can resist various network attacks and improve the security and reliability of the whole system.

2.2. Copyright Protection of Digital Resources is Realized by the Unchangeable feature of Distributed Account

With the digital transformation of libraries, the infringement of digital resources has always existed. The piracy of online digital resources is different from the traditional piracy problem.

Nowadays, the popularity of P2P technology and cloud disk makes the piracy of digital resources upload fast, download fast, spread widely, time is short and cost is low, which can quickly cause the proliferation of network piracy, damage the rights and interests of authors, and the copyright can't be effectively protected.

The problem of copyright protection of digital resources can be solved by the unchangeable property of distributed ledger of blockchain. In the block, in addition to the private information of both sides of the transaction, distributed encryption stores all past transaction records, activity contents, historical data and other information, which is public. The node consensus mechanism maintains the consistency of digital resources and can update and record the transactions and status that occur. In the block header, there is a "timestamp", which can prove the occurrence time and actor of all activity records in the block and verified new block creation process [7].

When the creator finishes the creation, the original works will be uploaded to the digital resources platform in digital form, recorded on the blockchain, the hash of these works will be written into the block. Through the node consensus and checking, the creator will obtain the copyright. The "time stamp" will be implanted into the block header to mark the property rights of digital resources and knowledge information. Through declaring the ownership and use rights of the relevant data, the rights can be traceable in the blockchain. Since the data on the blockchain can't be tampered or forged, if someone wants to modify the data on a block, that is, to modify the privileges that have been marked, he needs to recalculate all blocks after the current block. It is impossible to complete without mastering 51% of the whole network computing power. Therefore, if someone maliciously destroys the node or modifies the data, the nodes on the blockchain will be universally recognized and traced back to the source of the destroyed node data.

After the creator claims copyright on the blockchain, he can obtain the public key of the blockchain. If the copyrights need to be traded or transferred by the normal way, the original copyright owner can set the key privilege to ensure the transaction goes smoothly [8]. The copyright owner writes the copyright transfer information into the blockchain so that everyone can query the transaction information and changes of the copyright through the blockchain.

The unchangeable property of blockchain can record all copyright change process of works in the block completely. Blockchain starts bookkeeping from the original works. Each record of citation registration and copyright transfer will be recorded in the blockchain. Through blockchain, information such as the originator, citation record and citation time can be inquired [9].

2.3. Intelligent Contract Realizes the Future Sustainable Evolutionary Development of Library

Although the data on the blockchain is not allowed to tampered with, the blockchain is not constant. It can extend new versions with the change of environment and the different requirements. When the data of the blockchain is updated, each node will still need to verify and consensus to connect the new data block to the blockchain, but this does not affect the original data blocks, and the transaction records that have occurred will remain intact.

The birth of bitcoin can be seen as the age of the blockchain 1.0, while the birth of Ethereum can be seen as the age of blockchain 2.0. At the end of 2013, Vitalik Buterin, founder of Ethereum, released the first white paper of Ethereum, and launched the Ethereum project, which is the next generation of smart contracts and decentralized application platform [10].

The biggest difference between blockchain 2.0 and 1.0 is the introduction of smart contracts that allow for flexible programming. Based on the principle of programmability, blockchain technology has embedded the concept of "script", which makes the construction and

management of library digital resource platform based on blockchain technology become a flexible and intelligent programmable mode. Through programmable smart contract, diversified services can be realized. Based on the blockchain 2.0, all service modes can be published through compiling smart contracts and run on the blockchain, so that the blockchain technology can evolve and develop sustainably in the future library transformation process.

3. ARCHITECTURE OF LIBRARY DIGITAL RESOURCE PLATFORM BASED ON BLOCKCHAIN

On the basis structure of blockchain, this paper proposes a library digital resource platform architecture based on blockchain, which is composed of user layer, application layer, contract layer, incentive layer, core layer and foundation layer.

(1) User Layer: the entrance to general readers and librarians, accessible to any general reader or user.

(2) Application Layer: the composite layer of application sets built on the contract layer, mainly realizes various specific applications of library resource services.

(3) Contract Layer: smart contract, algorithm and script writing.

(4) Incentive Layer: realize the reward distribution and distribution mechanism of library digital currency. The library issues digital currency Token, and readers get Token rewards by contributing and publishing personal digital resources, and readers can use Token to purchase interested digital materials.

(5) Core Layer: core function layer, including consensus mechanism between nodes (PoW, PoS, PBFT, etc.), data transmission and verification mechanism, encryption, privacy protection, digital signature module, to ensure that data is not tampered.

(6) Basic Data Layer: block and blockchain structure, basic data of the whole network, providing the data and basic environment needed for the operation of the whole library digital resource platform, such as storage and network, etc.

The specific layered architecture is shown in Figure 4:

User Layer(entrance of general users)
Application Layer(composite layer of application sets)
Contract Layer(smart contracts, algorithms, scripts)
Incentive Layer(reward distribution of library digital currency)
Core Layer(consensus mechanism, data dissemination and verification mechanism, encryption, privacy protection)
Basic Data Layer(data storage, network communication)

Fig 4. Library Digital Resource Platform Architecture Based on Blockchain

The system architecture proposed above still needs to be further improved, and some problems need to be solved. First of all, the block size restriction restricts the storage of digital resource platform based on blockchain, which makes it difficult to meet the requirement of

large-capacity digital resource storage. However, if the block is expanded, the running speed of blockchain system will decrease. Secondly, due to the unchangeable property of blockchain, the data in block can be viewed but can't be changed, it is difficult to delete even if the information is wrong. Finally, the total amount of library digital currency issued in the incentive layer is limited because it is associated with the blockchain, it is difficult to meet the growing needs of readers and digital resources in the future. These shortcomings still need to be improved and perfected in the future.

4. CONCLUSION

This paper discusses the basic concepts and characteristics of blockchain. Because of its characteristic of decentralization, autonomy, non-tampering, node consensus and anonymity, blockchain can be widely used in the field of library digital resources construction and sharing. This paper discusses the possibility of applying blockchain technology to digital resource platform, and puts forward the application of the decentralized of blockchain in the mode of sharing digital resources in Library 2.0. It realizes the copyright protection of digital resources by using the non-tampering property of blockchain. With the smart contract introduced by Blockchain 2.0, the sustainable extension of future library digital resource mode transformation is realized. On this basis, this paper puts forward the architecture of library digital resource platform based on blockchain, and considers the problems and deficiencies existing in the application of blockchain in libraries.

At present, the application of blockchain technology in the field of library digital resources construction is still at the early stage, and the library is still at the end of the application of new technology. There are still some deficiencies in the application of blockchain technology in the field of digital resources construction. To apply blockchain technology to libraries, it is necessary to improve the structure, capacity and consensus mechanism of blockchain. Looking forward to the future, libraries should pay enough attention to the development of blockchain, actively use blockchain to promote the transformation of libraries, effectively improve the service mode of libraries, fully protect the copyright rights of digital resources, and provide better and more efficient services for readers.

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