



# Design and Implementation of Digital Copyrights Management System Based on Blockchain Technology

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**Abstract.** With the advent of the digital age, the dissemination and sharing of digital content is becoming more and more normal, and the copyright disputes brought about by it are becoming more and more serious. The traditional copyright protection mechanism has some shortcomings in dealing with the copyright problems of digital content, such as difficult confirmation rights, high cost and low efficiency, which has been difficult to meet the actual needs of copyright protection of digital content. In this regard, this paper puts forward a design scheme of digital copyrights management system based on blockchain technology to promote the innovative development of digital copyrights management model. Practice has proved that the system can complete the registration of digital content or copyright information of works with Fabric blockchain, thus better protecting the rights and interests of authors. In addition, the system also uses IPFS interstellar file system to make up for the shortage of storing a large number of data files in Fabric blockchain, and provide reliable technical support for the development of digital content industry.

**Keywords:** Blockchain technology; Digital copyright management; Fabric; IPFS Interstellar File System; Application system

## 1 Introduction

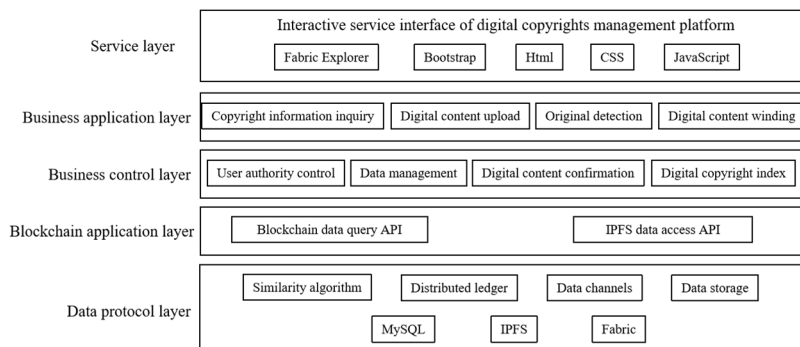
With the advent of the digital age, the dissemination and sharing of digital content has become a part of daily life. However, this has also led to the increasingly prominent problem of digital copyright protection. [1] In the face of the increasingly serious situation of copyright infringement of digital content, the traditional copyright protection mechanism mostly relies on the third-party copyright management organization, and the only copyright information management method adopted is centralized database storage, which not only has the shortcomings of difficult confirmation rights, high cost and low efficiency, but also is prone to adverse events such as theft and disclosure of copyright information. [2] In view of this, this paper believes that accelerating the reform and innovation of digital content copyright management mode by using emerging technologies is not only conducive to solving the current network infringement problem, but also the general trend of digital content industry development. At the same time, combined with the research status of digital copyrights man-

agement at home and abroad, the unique advantages of blockchain technology provide a new development direction for digital copyrights management. For example, literature [3] studies the practical application effect of blockchain technology in digital copyrights management projects; Jehana Afwazi Ahmad [4] and others put forward the implementation scheme of blockchain technology in solving the problem of digital copyrights management (DRM); S. Shireen Siddique[5] and others used blockchain technology to realize the digital file rights management system. In this study, based on the actual demand of digital copyrights management, the author puts forward a design scheme of digital copyrights management system, which gives full play to the practical advantages of blockchain technology, similarity detection algorithm and IPFS interstellar file system, solves the corresponding problems in digital copyrights management and helps the transformation and upgrading of digital copyrights industry.

## 2 System construction

### 2.1 Overall architecture

In the design scheme of the digital copyrights management system proposed in this study, the whole system is divided into five layers, namely, the data protocol layer at the bottom, the blockchain application layer, the business control layer and the business application layer at the middle, and the service layer at the top. The overall system framework is shown in Figure 1. [6]



**Fig. 1.** System frame structure

### 2.2 System process

In the business application system of digital copyrights management system, the copyright registration of digital content belongs to the main process, and the overall process design is planned as six key nodes, namely online submission, transaction request initiation, endorsement processing, consensus policy adjustment, delivery block and return identification code. [7] After the finally verified block is added to the local

blockchain, the system will automatically return an identification code to the user terminal as the final result of this uploading digital content confirmation operation.

### 2.3 Smart contract design

In blockchain technology, smart contract is essentially a contract clause written by algorithms and programs, and it is a digital protocol that is deployed in blockchain and automatically executed according to predetermined trigger conditions. [8] In this study, the blockchain module of the system is built by Hyperledger Fabric framework, and the smart contract is written by GO scripting language. Table 1 shows some design information of the smart contract.

**Table 1.** Design information of the smart contract part functions

Function name	Parameter	Description
Init	Chaincode Stub Interface	Contract initialization
Invoke	Chaincode Stub Interface	Receive and process requests from the user
Copy-right Register	Chaincode Stub Interface, [ ]string	Copyright registration
GetWorks	Chaincode Stub Interface, [ ]string	Inquire about the digital content of confirmation right
Record_Operation	Chaincode Stub Interface, [ ]string	Record user operations
Get_OperationInfo	Chaincode Stub Interface, [ ]string	Get user operations

### 2.4 Data storage design

In the design scheme of digital copyrights management system, the data storage module is divided into three parts. Among them, MySQL database is mainly responsible for storing user information; CouchDB database is located on Fabric framework, which is mainly used to store users' copyright information and user operation information. The IPFS system can make up for the lack of storage in the Fabric framework and complete the storage task between all uploaded digital contents. [9] Table 2 and Table 3 are the design schemes of user copyright information data table and user operation information data table respectively.

**Table 2.** User copyright information data table

Field	Data type	Allow null	Description
ID	String[0,255]	No	User number
HashAddress	String[0,255]	No	Hash address generated by IPFS file system
Title	String[0,255]	No	Digital content title
DataHash	String[0,255]	No	Hash value of digital content

**Table 3.** User copyright information data sheet

Field	Data type	Allow null	Description
OperationID	Int[0,32]	No	Operation ID
OperaUserName	String[0,255]	No	User name
OperaTime	String[0,255]	No	Operate time
Operation	String[0,255]	No	Specific operation content

### 3 Application test

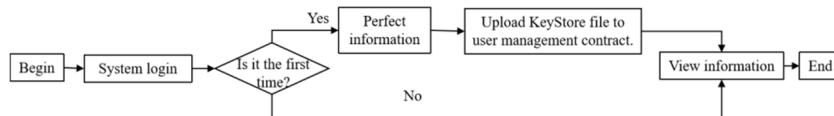
#### 3.1 Construction of operation test environment

The overall design of the digital copyrights management system is based on B/S architecture. According to the structural framework and functional requirements of the system, the overall development process of the system involves two technical lines, one is the blockchain construction under the Hyperledger Fabric framework, and the other is the development and deployment of Javaweb applications by combining the front-end framework Bootstrap and the back-end framework SpringBoot. The running test environment of the system is set as follows: the operating system is Linux Ubuntu 16.04, the development environment is Java, JDK version is 1.8.0\_181, Fabric framework is V2.4, IPFS file system is V0.4.19, MySQL database is V5.7, Spring-Boot version is 2.1.5, Bootstrap version is 3.3.7, and Web is selected. Among them, the blockchain network under the framework of Hyperledger Fabric is set to five functional nodes, including four Peer nodes and one Orderer node. [10]

#### 3.2 Functional test

##### A. Login and home page.

The digital rights management system has a unified interface, and users can log in from any client browser. Before logging in, users need to use command-line tools or SDK under Fabric CA client to register their identity, that is, by providing necessary information such as user name, email address and contact information, to generate a unique user name. After that, Fabric CA will automatically generate the user's certificate (public key) and the corresponding private key, and export the KeyStore file. Users need to upload the KeyStore file and the password filled in when they log in to the system. The system will verify the user's information, and only when the verification is successful will users be allowed to enter the system to use the services provided by the system. The control flow of system user login process is shown in Figure 2.

**Fig. 2.** System user login process

### B. Copyright information registration.

Users can initiate digital content uploading operation and confirmation operation online by selecting copyright registration management function on the left. At the same time, users also need to input information such as the name, creation time and brief description of the uploaded digital file. After the system automatically completes the confirmation operation, the registration success interface will appear and the confirmation code will be returned, as shown in Figure 3.

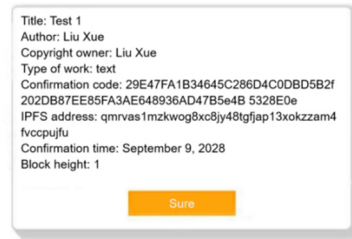


Fig. 3. Successful registration interface

In order to test the system's efficiency in copyright registration of digital files, this study selected 10 digital files for copyright registration processing in turn. Among them, 10 files were successfully registered, and the grade accuracy rate was 100%. Because of the different formats and sizes of 10 numbers, the registration time spent is also different, as shown in Figure 4. The test results show that the copyright registration processing efficiency of the system for digital files has been greatly improved compared with the traditional management methods.

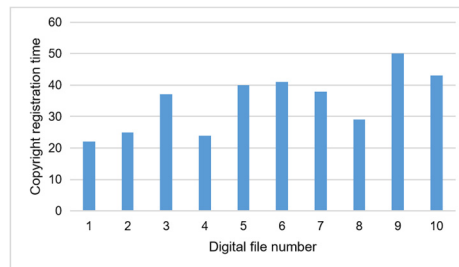


Fig. 4. Statistics of Registration Time of Digital File Copyright

### C. Infringement tracking.

The smart contract function in the system can be used to monitor and collect evidence of infringement, that is, through the preset monitoring rules, the smart contract can automatically monitor the infringement on the network, and once the infringement is found, it can automatically collect evidence and record it. The following pseudo-code for monitoring infringement and recording the realization of evidence function:

Function: Monitor infringement and record evidence under smart contract	
1.	@Transaction()
2.	public void reportInfringement(Context ctx, String infringementData) {
3.	String blockHash = ctx.getStub().getTxTimestamp().toEpochMilli() + "_" + ctx.getStub().getTxId();
4.	ctx.getStub().putStringState(blockHash, infringementData); }
5.	String infringementData = ctx.getStub().getStringState(blockHash);
6.	if (infringementData.isEmpty()) {
7.	throw new ChaincodeException("Infringement data not found", "No infringement data found for the given block hash"); }
8.	return infringementData; }

## 4 Conclusion

In order to promote the innovation and development of digital copyrights management mode, based on the many difficulties faced in the current digital content copyright management process, this paper puts forward a design scheme of digital copyrights management system based on blockchain technology. Practice has proved that the overall application process of the system is simple, and the online processing greatly improves the actual efficiency of digital content copyright management. At the same time, it can complete the tracking and recording of infringement with preset monitoring rules, and achieve the purpose of protecting the legitimate rights and interests of the author. In the follow-up research, deep learning algorithm will be further introduced to strengthen the judgment of the originality of works, enrich the functional application system of the system, and provide reliable technical support for the development of digital content industry.

## References

1. Zhao Weihua. Research and Thinking on Digital Copyrights (Assets) Transaction I [J]. Property Rights Guide.2022.10.53-61.
2. Luo Shuangling et al. Digital Content Governance Based on Blockchain: Investigation and Thinking[J]. Technology Intelligence Engineering.2021.04.15-32.
3. Song Luyan. Research on Digital Copyrights Management of Blockchain Empowering Copyright Bureau[D]. China University of Mining and Technology.2023.06.
4. Jehan Afwazi Ahmad Teduh Dirgahayu. The Role of Blockchain To Solve Problems Of Digital Right Management (DRM)[J].Jurnal Teknik Informatika.2023.08.85-95.
5. S. Shireen Siddique N. Sabiyath Fatima. Digital File Rights Management System Using Blockchain[J].Procedia Computer Science.2022.12.309-320.
6. Dai Shan. Digital Copyrights Management System Based on Alliance Chain[J]. Science and Technology & Innovation.2020.10.104-106.
7. Wu Yanbing, Xi Mengna. Research on Application of Digital Copyrights Management Based on Blockchain Technology[J]. Journal of the Hebei Academy of Sciences. 2021.12. 20-24.

8. Wang Yongju et al. A Review of Research on Blockchain Smart Contract Technology[J]. Computer Simulation.2023.08.1-4.
9. Liu Wenxuan, Zhao Jindong. A Data Storage Framework Based on Hyperledger Fabric and Interstellar File System[J]. Journal of Zhengzhou University.2022.06.28-34.
10. Luo Ting. Research and Implementation of Blockchain Consistency Performance Based on Hyperledger Fabric Framework[D]. Beijing University of Posts and Telecommunications. 2020.06.

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