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A Decentralized Music Copyright Operation Management System Based On Blockchain Technology

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Abstract

With the rapid development of the Internet, online music has become a new trend. The low cost of access and fast spread speed greatly enriches people's spiritual life, but it also poses great challenges to the protection of intellectual property rights. Nowadays, although the intellectual property rights of music works have been better valued and protected, there are still some problems that limit the development of the music industry and affect the users' experience. For example, the copyrights of different music works may be exclusively represented by different companies, resulting in limited choices for users and vicious competition among music operating companies, which affects the users' experience and is not conducive to the long-term development of the music industry. In order to solve the above problems, we present a decentralized music copyright operation management system based on Blockchain technology. By using the Blockchain's shared ledger mechanism and smart contracts as the basic framework of the Ethereum platform, we realize decentralized music copyright management. The system not only protects copyright better, but also coordinates the interests of creators, copyright owners, operators and users, which is beneficial to the further development of the music industry, and creates more value and better experience for users.

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1. Introduction

The popularization of Internet technology greatly promotes the development and progress of social culture, but also brings a lot of impacts to some traditional industries [1]. The main impact [2] on the traditional music industry is that online music has become a new trend, and the cost of music resources is cheaper and the way of spreading is more

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convenient, which brings great pressure on the copyright protection of music copyright owners and music creators. Although the development of the music industry has gradually become more stable and copyright has been valued and protected, copyright disputes are still a major obstacle to the development of the music industry due to imperfect copyright protection mechanisms [6].

We believe the following are the main problems in the music industry today.

- Copyright protection of online music. The rapid development of the Internet has shortened the distance between people and improved the spreading efficiency of music. Zhao et al. [8] mentioned that some listeners can buy music and download or copy it from the Internet and then share it with others for free, which violates the copyright of music. This will lead to an imbalance between what singers pay for their music and what they receive, which will greatly dampen their enthusiasm for creating music.
- Operating model problems. The emergence of operators has improved the problem of copyright protection. However, there are also significant problems with the current operating model: for competing user resources, operators generally sign exclusive agency agreements with copyright owners or copyright owner companies, which results in music resources being scattered across different platforms. When users access certain music, they are forced to use multiple platforms to listen to or download the music, and because the copyright resources of different platforms are relatively limited, the music services provided are different and cannot meet the diversified needs of different user groups (e.g., users who have purchased music on platform A cannot enjoy the sound effects provided by other platforms), which causes great inconvenience to users.

Copyright protection research has shown that applying Blockchain to the construction of copyright protection systems can be very effective [5, 7]. Blockchain technology is essentially a decentralized distributed ledger [4], which cannot be interfered with by third parties because records entered into the Blockchain storage are public, and records can only be added to the system as additions [3], and records cannot be deleted or tampered with once they are deposited in the chain. Inspired by this, we proposed to realize decentralized music copyright management by using the shared ledger mechanism of the blockchain and smart contracts of the Ethereum platform as the basic framework. In terms of security, we store the business ledger data on the Ethereum network, without centralized servers, which enhances data security. In terms of operating model design, our system can better coordinate the interests of all parties and promote the further development of the industry. For example, copyright owners can provide music copyright resources on the Ethereum network for a fee through smart contracts. Operators can earn profits from the sale of music rights over the Ethereum network. Under this model, operators do not have to compete for the rights but can enhance their competitive advantage by improving their music services, such as sound effects, to provide a better listening experience to their users. Creators can register and release their music on the Ethereum network. Users can purchase music rights and enjoy music services on different platforms through Ethereum.

The main contributions of this paper are as follows.

- Proposes an innovative solution to the current problems in the online music industry, which can better coordinate the interests of all parties and promote the further development of the music industry.
- A decentralized music copyright operation management system based on Blockchain technology is proposed, which uses the shared ledger mechanism of Blockchain to improve data security, and uses smart contracts to realize automatic generation and processing of transactions according to agreements; it improves work efficiency.

2. Blockchain-based Music Copyright Operation Management System Design

The interaction between the various parts of our system is shown in Fig.1.

2.1. Business Design of the Operation Management System

The music copyright operation management system creates an identity for the user: the consumer, an identity for the operator: the copyright distributor, an identity for the author: the music creator, and an identity for the copyright owner: the copyright manager.

As a consumer, the user can purchase music rights with smart contracts on an application provided by an operator, and the user who purchases the rights can enjoy the services provided by different operators.

Operators, as copyright distributors, can help users record relevant purchase information on the blockchain through smart contracts and verify whether the user has the right to use the music. In addition, the operator will receive a certain amount of dividends when the conditions set by the copyright distributor are met.

The copyright owner, as the copyright manager, is responsible for the management of copyright information on the Blockchain and the setting of rewards in smart contracts.

Creators are the main contributors to the content of the online music system and can upload their works and receive rewards based on the sales of their works.

2.2. Architecture Design of Operations Management System

The system architecture is shown in the Fig.2 and explained in detail below.

2.2.1. Data Layer

The data layer of the music rights operation management system consists of the Ethereum network and music data, with the Ethereum platform as the basic framework for the data layer. As a public Blockchain platform, Ethereum provides a decentralized accounting mechanism through its dedicated cryptocurrency and supports smart contract interaction and information storage, making it highly scalable and easily expandable to large-scale nodes.

2.2.2. Middle Layer

The middle layer uses smart contracts to standardize transactions and other operations. The middle layer of the system consists of smart contracts and web APIs. Smart contracts are deployed as a protocol on the Ethereum and once deployed, contracts cannot be modified. The use of contracts ensures the standardization of operations between different roles in the system. When different roles operate following the content of contracts and rewards after reaching the agreed goals. The web API is mainly used for interaction between different modules of the system.

2.2.3. Application Layer

The application layer provides a visual operating service for copyright owners, operators, and authors. Different roles can use the application layer to perform various operations on the data layer, such as copyright creation and sales, and so on. To ensure the robustness of the system, the application layer is divided into two subsystems based on different business scenarios: the copyright management system and the operator-copyright owner system. The former is a music copyright management system designed for users and creators and provides content related to copyright management, while the latter is an operation management system that connects operators and copyright owners.

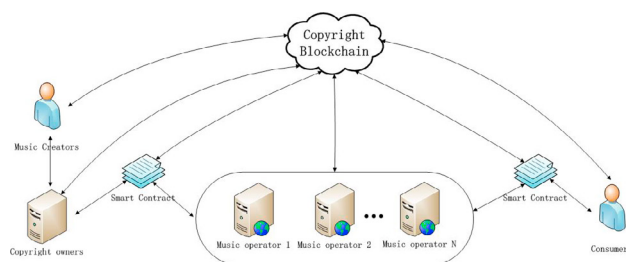


Fig. 1: Diagram of system components

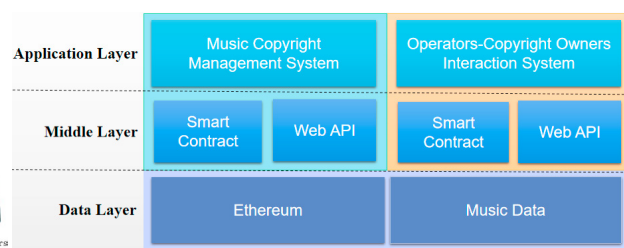


Fig. 2: System Architecture Diagram

3. Smart Contract Design

3.1. System Flow Design

The system process design is shown in Fig.3 and Fig.4 .

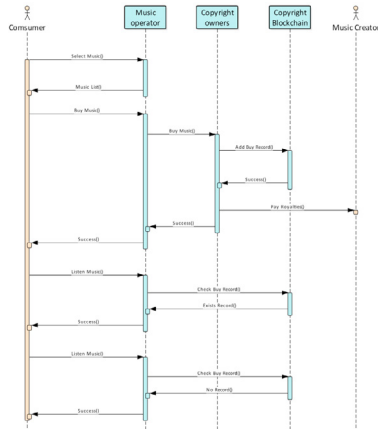


Fig. 3: Sequence diagram of user interactions

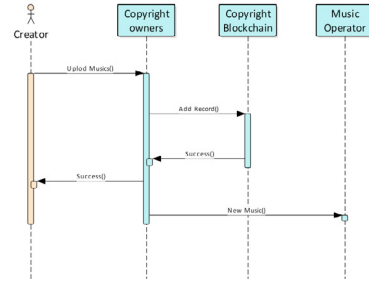


Fig. 4: Sequence diagram of creator interactions

3.2. Smart Contract Security Analysis

3.2.1. Platform Security

Since the emergence of Blockchain, many Blockchain platforms have been developed, among which the Ethereum network-based Blockchain system can be said to be the most widely used platform, also because it has a mandatory protocol such as smart contracts, which is supported by a large number of community developers. As a result, we can get faster feedback on issues and version iterations and updates on a multi-developer platform, and thus ensure that security issues at the platform level can be resolved promptly. In terms of owned smart contracts and platform conventions, when there is a problem with a smart contract, the only way to restart the Blockchain is to terminate the contract and redevelop it; otherwise, the Blockchain will not be recognized and there will be no subsequent development path.

3.2.2. Business Process Security

In the business process design, we take into account the problem of operators falsifying their flow to obtain rewards by recording all their key information on the Blockchain and executing smart contracts compulsorily for every transaction to check whether the requirements are met and the status is correct. Smart contracts are set up to scan periodically and every once in a while to check if the users' current data and the operators' data match. Only when the data is matched will operators be able to receive the reward. The above strict verification conditions ensure the logical correctness, execution security, and data authenticity of the system's business process.

3.3. Smart Contracts Functional Module Design

3.3.1. Copyright Creation

The creation of music copyright means that the copyright owner provides a book-entry transaction to the Ethereum system with information about the music copyright. As shown in Fig.5, smart contracts then follow the logic of the bookkeeping process to create a trading book for the music copyright.

3.3.2. Copyright Search

As shown in Fig.5, according to the copyright number and music ID provided when creating the music copyright, you can query the music copyright through the copyright number and music ID. Furthermore, to facilitate the search of music copyrights, we use a database to store the details of music copyrights and retrieve the information directly from the search.

3.3.3. Copyright Sales

This feature serves as the primary function of the system. As shown in Fig.5, generally, users purchase music through the operator's application. When the user selects the music, the operator sends a purchase request to the copyright owner based on the music ID. When the transaction is successful, the user recording purchase information will be recorded on the Blockchain.

3.3.4. Copyright Periodic Dividend Guarantee

The rules are negotiated between the copyright owner and the operator, and the existence of smart contracts, due to their nature, guarantees fairness, authenticity, and punctuality when it comes to dividends.

Algorithm 1 SETCOPYRIGHT	Algorithm 2 SEARCHCOPYRIGHT	Algorithm 3 SALECOPYRIGHT
Input: ID, copyrightNum, name, creator, royalty, publisher, buyerAddress, date, supplement 1. if (SetterisCopyrightOwner) then 2. Copyright.musicID \leftarrow ID 3. Copyright.copyrightNum \leftarrow copyrightNum 4. Copyright.copyrightName \leftarrow name 5. Copyright.copyrightCreator \leftarrow creator 6. Copyright.copyrightRoyalty \leftarrow royalty 7. Copyright.copyrightPublisher \leftarrow publisher 8. Copyright.copyrightBuyerAddress \leftarrow buyerAddress 9. Copyright.copyrightDate \leftarrow date 10. Copyright.copyrightSupplement \leftarrow supplement 11. else 12. alert permission incorrect 13. end if =0	Input: musicID, CopyrightNum 1. if (musicIDandCopyrightNumExists) then 2. Output: Copyright.musicID, Copyright.copyrightNum, Copyright.copyrightName, Copyright.copyrightCreator, Copyright.copyrightRoyalty, Copyright.copyrightPublisher, Copyright.copyrightBuyerAddress, Copyright.copyrightDate, Copyright.copyrightSupplement 3. else 4. alert not exists 5. end if =0	Input: musicID 1. if (musicIDExists) then 2. Choose and Buy 3. Record purchase information 4. else 5. alert not exists 6. end if =0

Fig. 5: Our Algorithms

4. Implementation of a Music Copyright Management System

4.1. Operator Page

The page displays (see Fig.6) the recent music copyright purchase status, the number of new purchases, user consumption, and flow statistics, etc. This function helps operators better analyze copyright sales and user purchases to better specify marketing strategies. Moreover, it also includes the details of copyright sales, user management, and copyright.

4.2. Copyright Owner Page

The home page shows (see Fig.7) the number of partners of copyright owners and operators and the number of their copyrights. Besides, there are functions to add or delete partners and to manage copyrights.

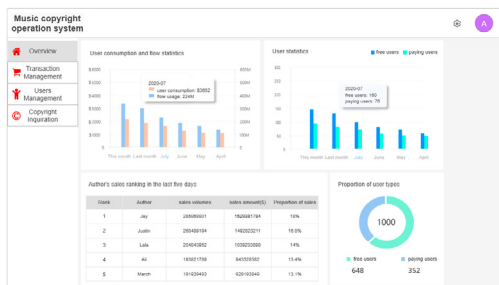


Fig. 6: Operator System Overview Page

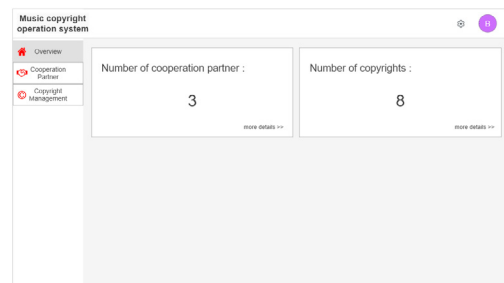


Fig. 7: Copyright Owner Overview Page

4.3. User Page

As shown in Fig.8, if you are a regular user, the main function is to buy copyrights, etc. When a regular user is upgraded to an author through authentication, the system will enable the copyright management function for the author.

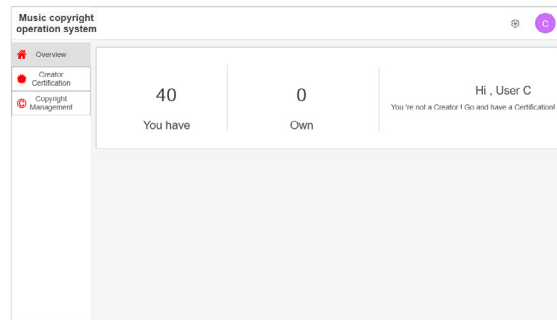


Fig. 8: User System Overview Page

5. Conclusion

This paper proposes a decentralized music copyright management system based on Ethernet that decouples the relationship between operations and copyright. This will help operators to focus on improving music service experience and copyright owners to focus on improving music quality, and users will have more choices and a better experience.

More importantly, our system can be a good solution to the current problem of serious internal depletion of operating companies due to copyright issues, which is conducive to the further development of the music industry.

At present, the platform is still in the development and improvement stage. Smart contracts function in the system needs to be improved to solve the possible problem of cheating when incentivizing dividends. Further, we will also improve the incentive mechanism to encourage all parties to focus on their fields, promote the development of the industry, create value for users, bring a better experience, and achieve a win-win situation for all parties.

Acknowledgements

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