# Research and application of digital Collection smart Contract Method based on Block-Chain

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**Abstract.** There are still some problems in the traditional art market, such as piracy, copyright and market narrowing. How to use block-chain technology to convert specific words, pictures, music and other items into digital credentials is an urgent problem to be solved. Compared with traditional works of art, digital collections are digital goods that are uniquely identified by block-chain technology, which have a wide range of values such as social value, science popularization value, commercial value, and artistic value. This paper studies block-chain technology and smart contract technology, develops an NFT communication and management platform based on block-chain technology, realizes information transparency and cannot be tampered with, and promotes the development of digital art industry.

**Keywords:** Block-chain technology;Digital collection;smart contract

## 1    Introduction

In order to thoroughly implement the spirit of the Party and the state to promote innovative industries and seize the strategic opportunities for intensive innovation and rapid growth of the digital economy industry, in May 2022, the State Office of the China National Cultural Digitization Office issued the Opinions on Promoting the implementation of the National Cultural Digitization Strategy, which clearly stated: By the end of the 14th Five-Year Plan period, digital cultural infrastructure and service platforms will be basically built , data centers will be basically connected with all kinds of cultural institutions, digital layout of cultural industries will be basically completed, digital construction of public culture will leap to a new level, and a cultural service supply system with online and offline integration and three-dimensional coverage will be formed[1]. In the future, China has made a deployment in the development and application of artificial intelligence,  block-chain and other aspects. We have a large number of cultural accumulation, which can be reflected through digital collections.

Digital collections can carry forward and protect traditional culture, and provide digital support for intangible cultural heritage and other cultures and customs.

This study designed a block-chain-based smart contract platform, which stored key data such as digital resources such as art works of young artists and intangible cultural heritage music on the block-chain to realize information transparency and non-tampering. The  block-chain-based smart contract promotes the creation of artworks, provides digital transformation for national intangible cultural heritage, museums, cultural tourism, and young artists, and enriches the expression forms of artworks. In addition, this method also provides a new mechanism for information sharing , risk management and cooperative relationships of digital collections, promotes digital credit construction, and helps to improve the trust and regulatory capacity of the whole industry.

## 2      The application of smart contracts based on block-chain technology in digital collections

Digital collection is the use of Block-chain technology to convert specific words, pictures, music and other items into digital credentials.Emerging digital art collections cannot   be separated from the physical value of art collections in the traditional market (the collection value of the collection itself), but at the same time, there are still some unavoidable problems in the traditional art market: piracy, rampant co pyright problems, difficult links between artists and the industry chain, etc., and the traditional market space is shrinking under the background of digital transformation. In the face of the problems existing in traditional art, the digital art market has begun to actively transform[2]. Based on the pillar of the own value of traditional art, Block-chain technology has brought values such as scarcity and easy circulation to art, which is welcomed by more and more users. At present, major collection platforms display and trade through this form. This is the most widely used field at home and abroad. Whether it is to determine copyright, or to facilitate transmission and transaction, it has brought great convenience and is extremely valuable for creators and lovers.

This digital certificate has the following benefits:

1)Social attributes

It can be displayed on social platforms after purchase, and may be displayed in individual homes in the future. This social value is not just the possession of a digital collection, but also a kind of admission ticket and entrance ticket to certain circles or clubs. Digital collections are rare, highly consensual, and symbolic of status.

2)Ownership value

The use of  block-chain technology, which cannot be copied, can also trace provenance and transaction records, cannot be replaced. The owned digital collection has the ownership value of the "real thing" .

3)Facilitate people's learning and understanding of cultural heritage

Digital collection can realize the "digitization" of cultural heritage, without the limitation of time and space, so that more people can understand and appreciate it. The

application of digital technology in the future will make it more widely used and promoted.

4)Brand image

The digital collection image can set the brand IP and digitize the brand IP. Digital collections can be used as away to promote brand IP, combining brand and NFT to issue related products to the brand.

A smart contract is a program that runs on the Block-chain and aims to provide, verify and enforce contracts. Specifically, smart contracts are an important reason why Block-chain is called "decentralized". They can record the behavior of all parties to a transaction, achieve irreversible and traceable, and ensure the security of transactions. Smart contracts can run automatically according to the design of the code, and no human intervention is required during the operation. With the support of Block-chain technology, smart contracts are introduced to make natural contracts into smart contracts. Once the conditions are met, the contract can be executed, realizing automation and non-repudiation. When the bank is connected to the Block-chain and the smart contract is executed to the payment stage, the payment certificate can be directly generated, and even the payment can be made directly. The data security mechanism provided by Block-chain technology can not only prevent digital collection data from being tampered with, but also ensure the security of data interaction.

## 3     The principle of smart contract method based on   block-chain technology

### 3.1     Principles of information security

block-chain technology is based on the established mathematical algorithm model, forming a network between each node, establishing trust through technical endorsement, without the need for information transmission through a   central credit agency.   Each block contains a certain number of transaction records and a hash value, which are connected in order to form a block-chain. Each node is a computer on the network. They are connected through the Internet and jointly maintain the entire block-chain.

The most important feature of block-chain is decentralization, which does not rely on any central authority or third party trust. Each node has a complete copy of the ledger and communicates and collaborates with each other on the network[4]. Any transaction or record is added to the block-chain only if it is verified by other nodes. This decentralized structure ensures the security and credibility of data, and also avoids a single point of failure and review by a centralized authority.

 block-chain uses a data structure called Merkle tree to store transaction records and hash values. Each block contains a certain number of transaction records and a hash of the previous block, which connects all the previous blocks to form the   block-chain. Merkle tree is a binary tree structure that divides all transaction records into two groups and computes a hash value for each group. These hashes are then merged into a new hash value, and the process is repeated recursively until eventually only one root hash

is left. This root hash contains a summary of all transaction records, which ensures the integrity and verifiability of the data.

Each transaction on the block-chain needs to be verified by multiple nodes before it can be added to the block-chain. Specifically, transactions are broadcast to all nodes in the network, and after certain verification and screening, they are packaged into blocks and added to the block-chain.

## 3.2    Smart Contract technology

Smart contract technology is a computer protocol designed to disseminate,verify or enforce contracts in an information-based manner. Smart contracts allow for trusted transactions without a third party that are traceable and irreversible. When do parties to a smart contract come to an agreement? The answer depends on the particular smart contract implementation. In general, a contract is discovered when a party commits to its execution by installing it on the contract hosting platform[3]. What the contract execution really means depends on the enforcement. Generally speaking, enforcement means active enforcement through technical means.

Smart contracts are based on computer code, which minimizes linguistic ambiguity and is represented by tight logical structures. The content and its execution process are transparent to all nodes, which can observe, record and verify the status of the contract through the user interface.

Once the conditions are met, the contract automatically executes the expected plan. Under the given fact input , the smart contract must output the correct result and be visualized in the display horizon. The transaction information on the block-chain is open and transparent. Each node can trace the transaction process recorded on the block-chain, and the probability of default behavior is extremely low. According to the cryptographic principle of asymmetric encryption, zero-knowledge proof, ring signature, blind signature and other technologies, on the block-chain, although the transaction process is public, the transaction parties are anonymous[5].

In order to write smart contracts, this application u block-chinases Smart Contract Language (SCL). Solidity is a programming language for writing smart contracts, and it runs on the Ethereum virtual machine. It is a high-level contract-oriented language with a syntax similar to JavaScript that is primarily targeted at Ethereum EVM.

The Ethereum Virtual Machine (EVM) is the runtime environment for smart contracts on Ethereum. It is effectively completely isolated, meaning that code running on the EVM does not have access to the network, file system, and other processes. Smart contracts also have limited access to other smart contracts, operating separately on the block-chain network[6]. Ethereum is by far the most notable smart contract framework, as it was specifically created to support the use of smart contracts. Programmed in the Solidity language, the Ethereum smart contract framework helps facilitate a decentralized network that facilitates the processing of transactions with smart contracts.

There are three main steps to writing a smart contract on the Ethereum network:

(1)Write it in the Ethereum high-level language

(2)Compile to bytecode with EVM compiler

(3)Upload to the   block-chain network with an Ethereum client

## 4    Application of smart contract method based on   block-chain technology

The block-chain-based NFT aggregation platform for digital collections is an NFT communication and management platform developed based on   block-chain technology. It can promote art creation; Active art trade market; Accelerate the exchange of artworks and improve their liquidity; Strengthen copyright protection of works of art; Promote art derivatives trading; And expand the popularity and influence of art integrated trading platforms[7].

### 4.1    Architecture diagram of the system

The system consists of five parts, customers can access the platform page through the browser and mobile phone, API library running on Ethereum and BSN Wuhan chain, can interact with the Web background data, through WebSocket technology between the Web browser and the server for any bidirectional data transmission, and Fig.1 shows a typical system architecture.
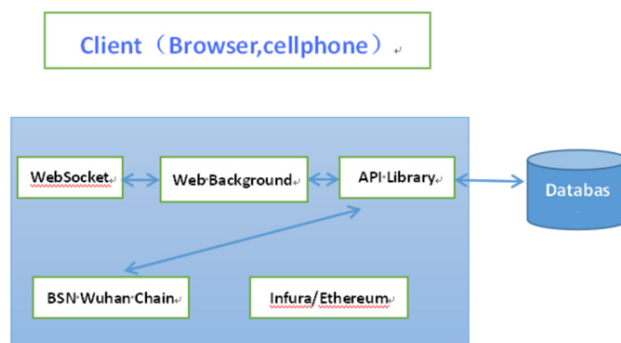


**Fig. 1.** The diagram of system architecture

### 4.2    Functional Description

The whole application system is divided into 10 modules.The mobile terminal develops Android H5 interface and background data joint login and registration, while the wechat mini program terminal develops H5 interface and background data joint login and registration. The API routing library includes login/registration API, NFT casting API, NFT purchase API, NFT transfer API,Follow API, My collection API and cross-domain access processing. Account   management includes account registration, login and account information management. NFT foundry uploads the digital information provided by the user, plays the game, casts NFT on the Wuhan chain, and returns the

contract address and transaction number. Block-chain interaction sends transactions to the Block-chain through the Web3 library. NFT related functions include NFT up/down, NFT follow/unfollow, NFT bookmark/unbookmark, NFT purchase, NFT giveaway, etc. The database involves data table design, user table, system table, NFT table, wallet history table, wallet table, etc. The database operation covers accessing/reading NFT related database tables. IPFS includes reading and writing decentralized IPFS library, Web background can realize   wallet display, recharge/withdrawal management, account management functions, Web socket server can subscribe to events, announcements and other information. At present, the payment function supports wechat Pay, and Alipay, UnionPay and other third-party payment interfaces may be provided in the future. Fig.2 shows the specific functional modules.
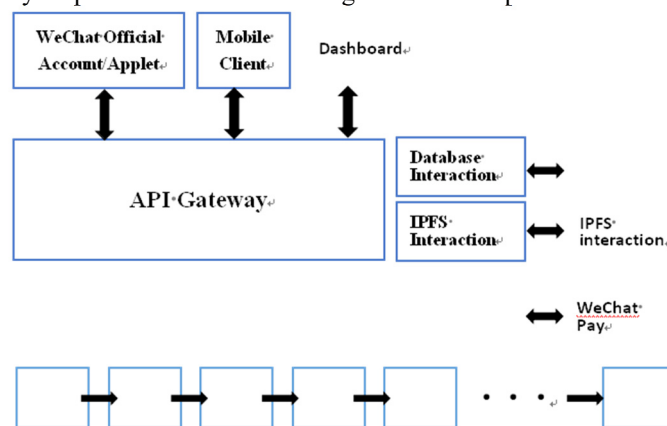


**Fig. 2.** The diagram specific functional module diagram

## 4.3    Development language and system software Settings

The decentralized application uses Solidity language, GOlang and Rust languages are used in the system background, Gin Framework is used in the back-end framework, and Vue.js is used in the front-end page. The mobile terminal is oriented to IOS system and Android system. The operating system of the platform is Linux system and Ubuntu 14. The platform is a typical DApp (Decentralized Application). The server runs on Aliyun and adopts the firewall service provided by Aliyun. The server-side program runs behind a firewall and interacts with users through a designated open port, while also protecting the server from attacks.

## 4.4    Interface Presentation

The project adopts the block block technology of high performance writing and real-time visual tracking of transaction sequences. It has completely state-owned intellectual property rights and does not rely on foreign supply chain technology. It supports the chain family and cross-chain bridge in the BSN open alliance chain.
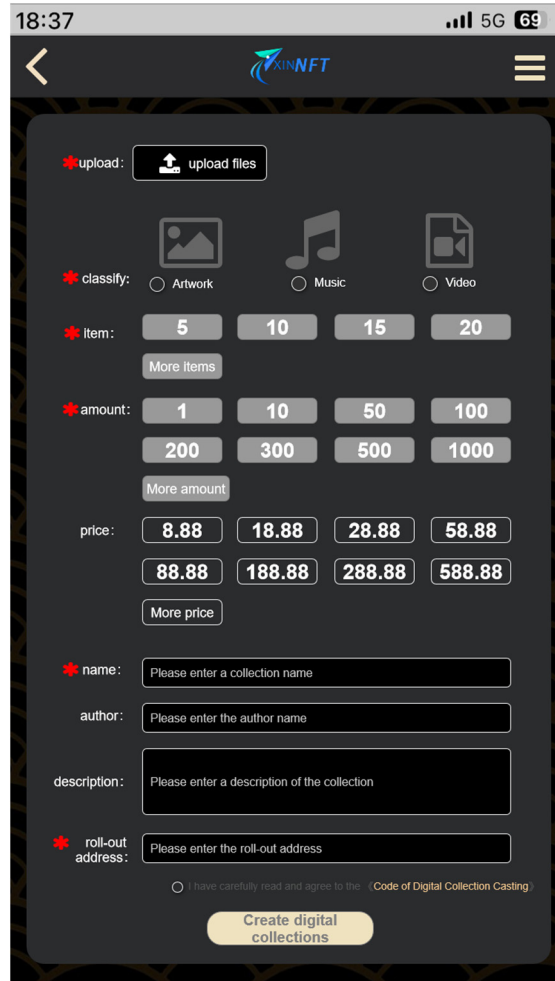
**Fig. 3.** The diagram of Casting page diagram

This platform is developed based on the BSN development alliance chain, but for the promotion and inheritance of digital culture and art, this platform also supports cross-chain, that is, the NFT cast on BSN can be transferred to other chains through cross-chain operation, so as to facilitate the promotion and sales of digital art NFT.

The platform provides a variety of stylish gameplay, and is user-defined, self-operated, one-click completion. First of all, cooperate with popular IP, museums, and Internet celebrity attractions to negotiate, followed by a lower unit price (such as 19.9 yuan), and then limited sales of 10,000 copies (the number can be selected, a small amount is recommended), and finally purchased by the buyer directly, while supporting the transfer model after 30 days. In other words, the underlying logic of NFT is scarcity, or creating an atmosphere of scarcity. So we have to have a small, limited release. The price should be low, such as 19.9 yuan, almost a cup of milk tea is less than the money,

which can attract users to quickly decide to buy.Fig. 3 shows the concrete casting interface of the digital collection.

The second way is through blind box sales. The main reason why young people buy blind boxes is that in addition to the pleasing satisfaction that collecting can bring them, they can also get spiritual companionship. Compared with the offline blind box, the biggest feature of the NFT blind box is that it is written on the smart contract to ensure that the content of all the blind boxes is open and transparent. Once the conditions are met and the user clicks on the draw, the result is already generated and cannot be altered. Moreover, the NFT blind box limits the output through the blockchain code before starting production and selling, which can completely avoid the blind box cheating in the production, sales, and transportation process.

Digital collections are digital goods that are uniquely identified by  block-chain technology, which have a wide range of values such as social value, science popularization value, commercial value, and artistic value. The digital form of digital collections is in line with the aesthetic interest of the digital media era, and the positioning of high quality and low price is in line with the consumption habits of the public, which can stimulate the consumption interest of the public, especially the young audience who like to "taste new" .

NFT technology can play a huge role in various cultural types,not only protecting, inheriting, recording, communicating and spreading, but also contributing to the generation of new knowledge and the transfer of experience. Intangible cultural heritage is diverse and complex, and the demand for information technology and NFT technology is more urgent. Digitalization and informatization are of great help to the inheritance, innovation and development of intangible cultural heritage.

The digital application in the protection and development of intangible cultural heritage can help the protection, display and inheritance of intangible cultural heritage, and explore the creative transformation and innovative development of traditional culture through the role of NFT technology in data acquisition, data storage, data transmission, data processing, data analysis and data application of intangible cultural heritage. Accelerating the process of digital development is an inherent demand for the dissemination of intangible cultural heritage, and is als an inevitable trend of social development and scientific and technological progress. The integration of modern science and technology into traditional art will create new sparks and rejuvenate intangible cultural heritage.

The platform cooperated with Gu Limin, the third generation direct descendant of Gu's "single-string Pull Opera" and the sixth batch of provincial representative inherits of intangible cultural heritage in Hubei Province. As an important carrier and expression of Chinese outstanding traditional culture, intangible cultural heritage is actively building a digital industry chain of "intangible cultural heritage digital collection", driven by the Block-chain-based NFT aggregation platform for digital collections, in order to break the real space restrictions, extend the market to the virtual space, and meet the social needs of the new era as much as possible. It is helpful to develop the creator economy and open up a new income generation channel for the non-genetic inheritors.

## 5       Conclusions

In this paper, the smart contract method based on   block-chain technology is studied and applied, and a digital collection aggregation platform based on   block-chain is developed. The platform   is based on the application of   block-chain technology in the field of intellectual property and the development of digital art industry, in order to promote the art creation of young artists, and provide digital transformation for national intangible cultural heritage, museums, cultural tourism and young artists. All the historical information of the whole life cycle of digital collections is recorded on the block-chain, which can realize the whole process traceability of data and cannot be tampered with. The research results of this paper provide an innovative solution for the smart contract of digital collections. The   block-chain-based smart contract platform can improve the singleness of the current digital collection, and can provide more types of works to be traded and displayed on the   block-chain platform. It provides a new mechanism for information sharing , risk management and cooperative relationship of digital collections, promotes the construction of digital credit, promotes the deep integration of digital technology and cultural industry, empowers the transformation and upgrading of cultural and creative products, and strengthens the digital economy. This method has a wide range of application prospects and social significance, and provides a useful reference for related research and practice.

## Acknowledgment

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