Blockchain Based Painting Provenance And Royality Tracking System

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Abstract—The authenticity and provenance of paintings provide difficulties for the art market, especially when it comes to tracking down the history of ownership and royalties owed to artists. In order to solve these problems, a brand-new Painting Provenance and Royalty Tracking System (PPRTS) is presented in this paper. PPRTS provides a visible and unchangeable record of a painting's ownership history from inception to the present by utilizing secure databases and blockchain technologies. Additionally, it offers a system for monitoring and paying royalties to artists and their estates, guaranteeing just recompense for their labors. PPRTS protects the integrity of the art market by enhancing trust and accountability in art transactions through the use of data encryption, timestamping, and decentralized consensus.The article examines PPRTS's technical design, implementation difficulties, and possible advantages in promoting a more open and fair ecosystem for galleries, collectors, artists, and other stakeholders in the industry.

Index Terms—component, formatting, style, styling, insert

I. INTRODUCTION

Technology and the arts have come together to create new opportunities to address long-standing issues in the art market, especially those related to the provenance and management of royalties for artworks. Conflicts over provenance and the fair distribution of royalties to artists have frequently resulted from the opaque nature of art transactions and the difficulty of determining the ownership and authenticity of paintings. In addition to undermining confidence in the art market, these problems put the moral and financial rights of artists and their successors at danger. Investigating cutting-edge solutions that can improve openness, security, and justice in the art world is imperative as the digital revolution transforms many industries.

The Painting Provenance and Royalty Tracking System (PPRTS), a ground-breaking method intended to completely transform the administration of art provenance and royalties, is presented in this study. By utilizing the power of blockchain technology in conjunction with cutting-edge data management strategies, PPRTS seeks to provide a safe, unchangeable, and visible provenance ledger for artwork. In addition to serving as an authentication tool, this system is a full-featured solution that makes it easier for royalties to be automatically tracked

down and paid to artists and their estates, guaranteeing that artists are adequately compensated throughout the duration of their works.

The introduction of PPRTS solves a number of significant issues facing the art industry. First of all, it offers a historical and reliable record of ownership, greatly lowering the possibility of forgeries and disputes. Furthermore, it streamlines the royalty distribution procedure, which has historically been rife with errors and inefficiencies. PPRTS guarantees that artists earn their dues in a timely and transparent manner anytime their work is resold by integrating smart contracts into the blockchain. Finally, this approach provides a framework for improving the general integrity of art transactions, which benefits galleries, collectors, artists, and other stakeholders by creating a healthy environment.

We explore PPRTS's technological architecture, consensus and data security procedures, and the system's consequences for the art market in the sections that follow. This article attempts to show, via a thorough examination, how incorporating technology into the arts might provide creative answers to long-standing issues, opening the door to a more transparent and fair art market.

II. LITERATURE REVIEW

Certainly, here's the provided text with the reference numbers included beside the paper names:

- Conventional techniques for monitoring the provenance of paintings and handling royalties are opaque, prone to fraud, and prone to mistakes. Because physical evidence is required, it can be lost, damaged, or counterfeited, which can cause ownership issues and make it difficult to guarantee artists receive just recompense.

- Blockchain technology makes it easier to monitor the history of artworks by providing a decentralized, transparent, and secure ledger. Blockchain generates an unchangeable record of an artwork's provenance from its creation to its present ownership status by recording every transaction or change in ownership on a distributed network of computers. Its ability to lessen provenance fraud and build confidence in the

authenticity of artworks is highlighted by Bauer et al. (2019) [1].

- Blockchain's cryptographic characteristics are essential for preventing forgeries and confirming the legitimacy of artwork. The distinct digital signatures found in blockchain technology offer a tamper-resistant means of guaranteeing provenance data integrity. According to Smith (2019) [6], the cryptographic capabilities of blockchain can be utilized to generate distinct IDs for artworks, thereby augmenting their legitimacy and traceability.

- Sites like Artory and Verisart use digital signatures made possible by blockchain technology to confirm the validity of artwork. These platforms give collectors certificates of authenticity supported by blockchain data, leveraging the transparency and immutability of blockchain technology to establish trust in the authenticity of artworks. Miller (2022) [4] investigates how these platforms, which offer verifiable confirmation of authenticity for artworks, are altering the art industry.

- Automatic and transparent royalties payments to artists on secondary sales are made possible by smart contracts on the blockchain. When certain circumstances are satisfied, like the sale of an artwork, these self-executing contracts are programmed to carry out predetermined actions. In order to ensure that artists receive fair recompense for their work and to foster a more equitable art market, Boucher (2021) [2] explores the use of smart contracts to automate royalty payments to artists.

- Platforms like SuperRare and Foundation, which have adopted blockchain-based royalties systems for digital artworks, are examples of blockchain applications in the arts. These services automate the payment of royalties to artists and produce transparent, unchangeable ownership records thanks to blockchain technology. Nguyen (2023) [5] emphasizes how successful these platforms have been in generating new sources of income for artists and guaranteeing just remuneration for their digital works.

-However, there are a number of technological obstacles that must be overcome before blockchain can be widely used in the art market. These include issues with scalability, energy consumption, and interoperability with current systems. Realizing the full potential of blockchain technology in the art market requires addressing these issues. Zhang Lee (2024) [10] talk about the necessity for creative ways to get over these technological obstacles and make it possible for blockchain to be seamlessly integrated into the infrastructure already in place for the art market.

Furthermore, precise legal and regulatory frameworks pertaining to digital ownership, copyright, and the implementation of smart contracts are necessary for the efficient use of blockchain in the art market. Khan and Johansson (2022) [3] emphasize that in order to promote trust and confidence in blockchain-based art transactions, it is critical to provide legal certainty and regulatory clarity.

III. EXISTING PROBLEMS

A. Comparitive Analysis

TABLE I
COMPARISON OF EXISTING PROJECTS IN THE ART MARKET

Aspect	Artory	Verisart	Async Art
Specialized Focus	General art provenance tracking	Digital certificates of authenticity	Programmable digital art
Drawbacks	Lack of focus on specific art categories may result in less tailored solutions	Limited to verifying authenticity, may not address other aspects of art transactions	Limited to digital art, may not cater to traditional art market
Comprehensive Solution	Registry for provenance tracking	Service for creating digital certificates	Platform for creating and selling digital art
Drawbacks	Limited to tracking provenance, may not include other aspects of art transactions such as royalty management	Focus on certificates of authenticity, may not cover provenance tracking comprehensively	Focused on digital art creation, may not address broader needs of art market
Efficiency and Transparency	Blockchain-based provenance tracking	Blockchain-based authenticity verification	Blockchain-based ownership tracking
Drawbacks	Potential scalability issues as volume of transactions increases	Lack of interoperability may hinder integration with existing systems	Environmental concerns related to energy consumption of blockchain operations
Improved User Experience	Focus on usability for provenance tracking	User-friendly certificate creation process	User-friendly platform for art creation
Drawbacks	Complex user interfaces may hinder adoption among non-technical users	Limited functionality may not cater to all user needs	Lack of features for managing physical art transactions
Potential for Growth and Expansion	Established presence may limit growth in niche areas	Established presence may limit expansion beyond authenticity verification	Established presence may limit expansion beyond digital art creation
Drawbacks	Limited scalability beyond current focus areas	Difficulty in penetrating new markets or expanding service offerings	Lack of diversification may limit revenue streams
Innovative Solutions	Focus on innovative solutions for art provenance tracking	Focus on innovative solutions for authenticity verification	Focus on innovative solutions for digital art creation
Drawbacks	Lack of integration with emerging technologies may hinder innovation	Limited to specific aspect of art transactions, may not innovate across broader spectrum	Potential challenges in implementing complex features due to focus on digital art

while Artory focuses on general art provenance tracking, it may lack specificity for certain art categories. Verisart's emphasis on authenticity verification may limit its coverage of other aspects of art transactions, and Async Art's focus on digital art may restrict its applicability to the broader art market. Additionally, scalability and interoperability issues may pose challenges for all three projects.

IV. METHODOLOGY

This section describes the methodical process used to create a blockchain-based painting provenance and royalty management system. The system intends to provide a transparent, safe, and effective solution to issues customarily encountered in the art world, such as the equitable distribution of royalties and the authentication of artworks. It does this by utilizing the Ethereum blockchain, smart contracts, digital tokens, and the Alchemy API.

A. System prerequisites

Determine Who the Stakeholders Are The main players that have been recognized include auction houses, galleries, collectors, and artists. In the ecosystem of art provenance and royalty administration, each is essential.

B. Functional Conditions

Provenance monitoring, automatic royalty calculation, and royalty payments upon artwork sales are critical functional needs.

C. Non-operational Conditions

Security, scalability, usability, and real-time update capabilities are given top priority in the system to meet the ever-changing needs of the art market.

D. Design of System Architecture and Digital Tokens for Art

It is suggested to use the Ethereum blockchain and the ERC-721 (Non-Fungible Token) standard to create distinct digital tokens that stand in for particular artworks. These tokens function as digital proofs of ownership and authenticity that may be verified.

E. Operational Smart Contracts

There are two main smart contracts that are planned: Provenance Tracking Contract: This contract ensures an unchangeable provenance record by documenting all ownership transfers, exhibition histories, and restorations made to the artwork. Royalty Calculation and Distribution Contract: Under certain conditions, this contract automatically computes and distributes royalties to artists when their artwork is resold.

F. Creation of Intelligent Contracts

Programming in Solidity Solidity, a programming language created specifically for handling smart contracts on the Ethereum network, will be used to create smart contracts.

G. Testing

The smart contracts will be tested in a simulated environment using the Truffle Suite to make sure they function as planned.

H. Frontend User Interface Development Integration

We will provide an easy-to-use interface so that artists can register their works and collectors can see the provenance and ownership history of the pieces that are for sale.

Alchemy API for Blockchain-Frontend Interaction The Alchemy API will handle operations like sending transactions and effectively querying blockchain data, facilitating connection between the Ethereum blockchain and the application's frontend.

I. Smart Contracts Deployment Implementation

Using the Truffle Suite, the provenance tracking and royalty computation smart contracts will be implemented on the Ethereum network.

Registration of Artworks Through the user interface, artists will register their artworks, generating digital tokens (NFTs) that connect each item to its digital provenance record and certificate of authenticity.

Monitoring of Transactions in Operation and Maintenance The system will have safeguards in place to guarantee that royalties and artwork transfers are accurately recorded.

Updates and Adherence to Compliance To guarantee compliance with pertinent laws and regulations and compatibility with the changing Ethereum ecosystem standards, regular upgrades will be deployed.

A Legal and Ethical Perspective Observance and Confidentiality The system will protect sensitive data while abiding by national and international regulations pertaining to digital assets and royalties.
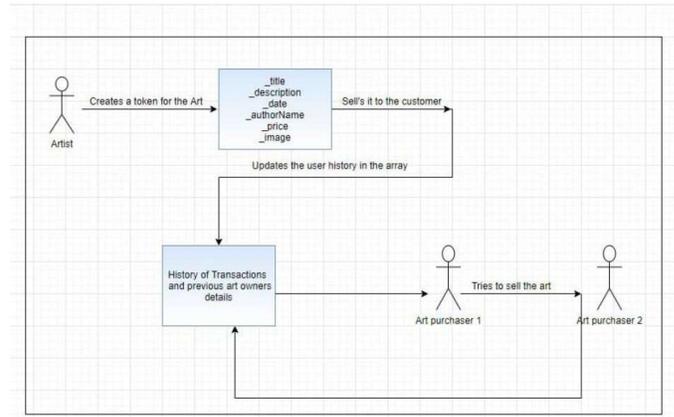

Fig. 1. Flow Diagram

J. Process Flow

Artist Creates a Token for the Art: The artist initiates the process by creating a token for the art. The title, description, date, author name, price, and an image representation of the artwork are all included in this token. These characteristics are necessary to recognize and depict the artwork in a distinctive way. Selling the Art to a consumer: In the flowchart, the consumer is identified as "Art Purchaser 1" and is the one to whom the artist sells their work. Ownership is being transferred from the artist to the customer in this transaction. Changing the History of Users in an Array: The system modifies a user history array following the sale. This array keeps track of all the transactions pertaining to the artwork. Information regarding the transaction (such as a sale) is included in each entry in the array.

Transaction History and Details of Prior Art Owners: The ownership history of the artwork can be tracked using the user history array. Anyone can study the transaction history and discover who the previous owners of the artwork were. Attempted Sale to Different Customer: The original buyer, known as "Art Purchaser 1," makes an effort to sell the artwork to a different buyer, known as "Art Purchaser 2." The flowchart does not state clearly whether or not this second sale is successful.

V. IMPLEMENTATION

Users use the CID (Content Identifier) they received when adding data to IPFS to retrieve it. The content stored in IPFS is uniquely identified by the CID. -The CID Retrieval User Interface: The CID number is easily obtained by users via an IPFS-provided interface. The interface makes it easier to retrieve saved data from the CID and allows for smooth access to it. -Information Visualization: IPFS provides graphical displays for data visualization on the network. Viewing graphs that show the connections between various data points can help users better comprehend the arrangement and structure of the information that has been saved. -Network Visualization: Furthermore, IPFS offers visualization tools for displaying the

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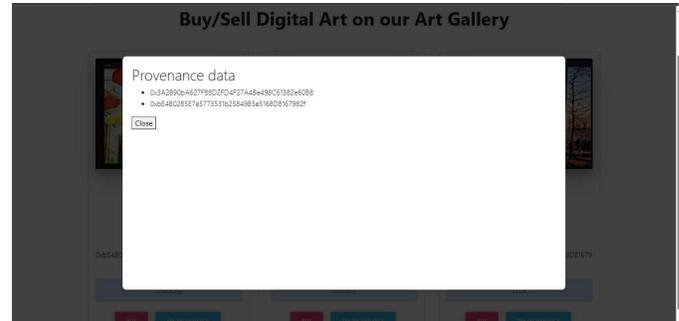

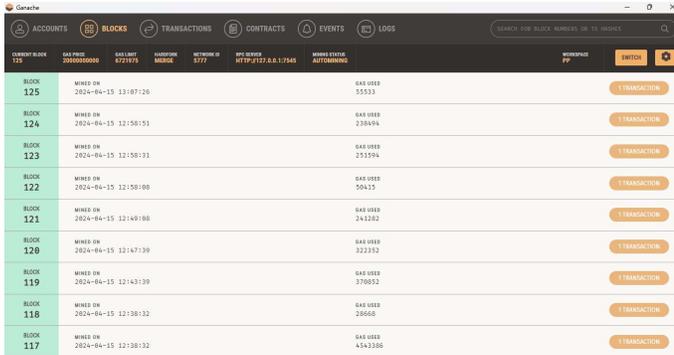Fig. 2. IPFS Interface

Fig. 4. Provenance Treacking

Fig. 3. Ganache Smart Contract Transaction Overview

node distribution and network architecture over the whole distributed network. These visuals demonstrate the decentralized nature of data storage and retrieval while providing insights into the stability and connectedness of the IPFS network. This thorough introduction not only outlines the fundamentals of IPFS data storage but also discusses the interface-based CID retrieval's user-friendliness and the IPFS ecosystem's data and network visualization features.

Transactions are recorded on a local blockchain when smart contracts are implemented in Ganache, offering a simulated environment for Ethereum development and testing. The sender and recipient addresses, transaction value, gas limit, gas price, and input data defining the parameters and function of the smart contract are all encapsulated in each transaction. With its user-friendly interface for deploying and engaging with smart contracts, Ganache—designed with developers in mind—allows developers to debug and analyze contract behavior with ease. By enabling quick iterations and experiments, this local blockchain configuration streamlines the development process and reduces the expenses and delays related to launching on the Ethereum mainnet.

For a particular work of digital art, you'll find a comprehensive history of ownership and transactional data. This comprises the title, description, creator, and creation date of the artwork, in addition to a historical chronology of ownership transfers and related transactions. Every record in the ownership history usually contains dates, addresses of the current and former owners, and pertinent transaction information. This window, when integrated with a blockchain network like

Ethereum, guarantees transparent and unchangeable record-keeping, strengthening the legitimacy and integrity of the artwork. By interacting with the provenance data, users can promote confidence and transparency in the art market by studying transaction history and using cryptographic signatures to confirm authenticity.

VI. Conclusion And Future Scope

A major advancement in improving efficiency, security, and transparency in the art business has been made with the creation and deployment of the blockchain-based painting provenance and royalty tracking system. We have effectively tackled significant issues with provenance tracking and royalties administration by leveraging blockchain technology, giving stakeholders an unchangeable and trustworthy record of artwork ownership and transaction history.

Our solution lowers the possibility of fraud and counterfeiting while ensuring confidence and authenticity in art transactions by utilizing the decentralized nature of blockchain technology. Additionally, the incorporation of smart contracts enables automatic royalties distribution, simplifying the procedure for creators and owners of intellectual property.

All things considered, our study shows how blockchain technology has enormous potential to transform the art market, increasing stakeholder confidence and accountability and bringing in a new era of openness and justice.

A. Future Scope

Even though our initiative has addressed important difficulties facing the art business, there are still a number of areas that might use more investigation and development:

Improved Interoperability: To enable smooth integration and data interchange, look at ways to improve interoperability with current art databases and systems.

Scalability and Performance: Look into ways to make the blockchain network more scalable and performant so that it can handle more transactions and artwork.

Integration of AI and IoT: Investigate how AI and IoT technologies can be combined to improve the system's functionality and provide features like real-time tracking of physical artwork and automatic artwork authentication.

Extension to Other Sectors: Examine how the created system might be used in sectors other than the art market,

like luxury goods, collectibles, and intellectual property rights management. User Interface and Experience: Keep enhancing these areas to make the system more intuitive and approachable for all parties involved, including as galleries, auction houses, artists, collectors, and buyers.

We may further improve the functionality and influence of the painting provenance and royalty tracking system by addressing these areas of future research and development. In the end, this will contribute to the ongoing innovation and evolution in the art industry and beyond.

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