Decentralized Marketplace for Digital Art Creativity using Blockchain

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Abstract: Blockchain technology and digital art collided to give rise to Non-Fungible Tokens (NFTs), the new era for digital assets creation, valuation, and trading. NFTs serve like the unique digital certificate of ownership over a new piece of art making it possible for an artist to prevent their creation from being pirated or copied without due permissions. In this work we present NFT ArtHub, a decentralised platform that uses the immutability of blockchains and the decentralised storage capabilities of InterPlanetary File System (IPFS) and Pinata. This integration creates an additional layer of security and a de-centralised database to provide a secure marketplace for artists to tokenise their work and showcase it on a global scale.

One of the things that makes NFT ArtHub so special is that artists are paid by way of smart contracts automatically, whenever their artwork sells or gets sold. This mechanism provides the benefits of traditional systems without their inefficiencies and enhances trust and transparency. It also highlights the platform's solutions for scalability, gas high fees that users on Ethereum are facing and more importantly user adoption emphasizing its position as an enabler of creators while redefining ownership in the creative economy.

Keywords: Blockchain, NFTs, Digital Art, Smart Contracts, IPFS, Decentralization, Ethereum.

I. INTRODUCTION

Along with a virtual revolution that transformed from how and where artists create and sell their arts, It affected access issues regarding ownership, sharing space, and payment; however, it brought about a virtual revolution concerning the way and where artists create and sell their art. The gallery-established methods are slow and very expensive in comparison; meanwhile, they face speed bumps such as piracy and late payments, putting artists at a disadvantage regarding making workable profits from their works of art.

The advent of blockchain and especially Non-Fungible Tokens partly offers an answer for the artists. It permits tokenisation of virtual artworks into unique, verifiable entities for secure trade. This decentralised approach ensures a high degree of freedom for artists over the use of their works and secures them just payments.

NFT ArtHub addresses those demanding situations by providing a stable, decentralised market where artists can tokenise their artworks, giving proof of ownership and protection from piracy. Ethereum-primarily based totally clever contracts automate royalty bills, while decentralised garage answers like Pinata and IPFS make sure artistic endeavours stay stable and completely accessible.

This paper considers the architecture, design methodology, and key issues of the platform, focusing on how blockchain technology and decentralized warehouses can transform the digital art market. By examining the larger impact of NFTs and the potential benefits of decentralised marketplaces, this research asserts that NFT ArtHub could potentially influence the future of digital creativity.

II. LITERATURE REVIEW

A. Background

The features of smart contracts are also used at the NFT ArtHub to pay royalties and copyright/title holders, thus ensuring fairness for artists as well as an effective way of profiting from their works. Therefore, the main purpose of the NFT ArtHub is the enhancement of the digital creators and the presentation of a real and sustainable program that aims to enhance, protect, and share the revenue associated with digital arts.

The world of art has been altered by blockchain technology and NFTs in that artists can now have authentication, receive royalties, and protect their works from being copied. All of these possibilities are

considered maliciously contrasted against the traditional markets and galleries, which attain the status of monopolies in the eyes of the critics. Essentially an NFT is just an added level of protection for a digital asset stored on a blockchain but can be tokenized; it is not just an image or a digital file.

Today many NFT marketplaces, eg. OpenSea, have some major disadvantages especially when it comes to their dependence on centralized servers and off-chain storage that put data availability and integrity into question. NFT ArtHub addresses these problems by marrying the Ethereum blockchain with the InterPlanetary File System and Pinata, creating a marketplace that is fully decentralized and secure.

Royalty distribution, copyright, and title holder compensation for NFT ArtHub are anchored in smart contracts, which means artists always have a trustworthy way to earn from their work. In general, the key goal behind NFT ArtHub is to consider empowering the digital creator and to form a genuine and sustainable program that proper rewards and shares revenue from digital art.

Market Decipher highlights several trends in the rapidly growing global NFT market. Digital art NFTs are gaining significant value, while NFTs in digital Art are reshaping asset ownership. Additionally, collectible NFTs are thriving in sectors like sports, entertainment, and digital art, reflecting the diverse expansion of the NFT ecosystem (Market Decipher, n.d.).

Figure1 showing Market Decipher. (Year). Global NFT Market by Type. Retrieved from www.marketdecipher.com

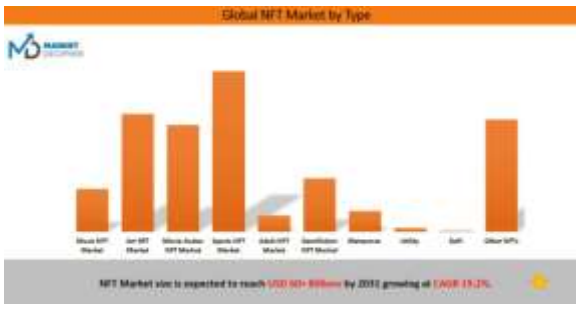

FIGURE 1

Existing literature on blockchain development and its applications to the virtual art field offers credible insights for platforms like NFT ArtHub. NFT, standing for non-fungible token, is the blockchain-backed combination of digital and virtual art that assures secure and transparent transactions with corresponding ownership records.

B. Blockchain Fundamentals

Zheng et al. (2017) highlight the three key features of blockchain: transparency, immutability, and decentralisation. Blockchain is the ideal solution for tamper-resistant transaction recording because of these features. Its immutability prohibits unwanted alterations, and its decentralised structure ensures that no unmarried entity holds the data, effectively resolving issues with piracy and ownership conflicts in virtual artwork.

C. NFTs and Digital Art

Secondly, the rise of NFTs has revolutionised the world of digital art. More directly, NFTs give more power to artists that can now charge directly for the use of their songs (Lee and Kim, 2021) When artists tokenise their art by converting it into NFTs, they are creating unique and verifiable digital certificates of ownership, which bypasses the need for an intermediary such as a gallery. Next up, they can provide attractive features such as automation of royalties by NFTs, which leads to a long-term business model for musicians.

D. Storage solutions that utilise decentralisation

Narayanan et al. IPFS (2016). highlights the importance of decentralised storage solutions such as IPFS, providing evidence for the preservation of digital content. With IPFS, NFT ArtHub distributes ARTworks, protecting them from being deleted and distorted while keeping them accessible for a long time.

E.Smart Contracts for Royalty Payments

According to Wood (2014), smart contracts can facilitate transactions between strangers without the need of a third party. When using NFT ArtHub, all artists are automatically paid royalties when the work comes up for resale.

An interweaving of blockchain, NFT, decentralised storage, and smart contracts showed potential as a great solution to meet the existing digital artist issues, and this unveils sturdy ground for building up our 2nd home, NFT ArtHub.

There are multiple platforms that have risen as NFT and digital art marketplaces like OpenSea, Rarible, and SuperRare. While every one of those platforms has its own advantages, allowing artists to get paid

for their work, they seem to have illegal challenges that NFT ArtHub wants to beat against.

- **OpenSea**

OpenSea, one of the biggest NFT marketplaces, supports different types of digital assets. But it is completely dependent on centralised infrastructure and offchain storage, exposing vulnerabilities with security risks for high Ethereum gas fees, thus making it non-accessible to smaller artists as well. By comparison, NFT ArtHub provides storage on IPFS, which is decentralised and free from the risk of loss or interference with artworks.

- **Rarible**

Rarible is Rarible's native token that allows community oversight on platform policies and incorporates a decentralised governance model. It provides more decentralisation than the other contenders but still struggles with gas fees and scalability. NFT ArtHub takes this a step further by providing smart contracts that allow artists to set up automated royalties and decentralised storage, enabling greater control in the hands of artists with permanent access to their work.

- **SuperRare**

SuperRare is a marketplace for exclusively high-end digital art curated by its own team, which, while limiting access to only top-tier works, also precludes emerging artists from participation. While it also raises real issues around decentralisation because it uses a centralised infrastructure for storage. NFT ArtHub strikes the right mix of decentralised ownership, IPFS storage, and Ethereum smart contracts to allow artists to maintain their own assets.

III. METHODOLOGY

A. NFT ArtHub vision

NFT art hub methodology comes with many key technologies that will help design and build a decentralized marketplace for digital art. For this, the proceedings of the platform itself, such as making NFT and executing the smart contract for automated paying of royalties, fall under its operational possibilities. The NFT ArtHub methodology is an amalgamation of different technologies that will build their decentralised marketplace, which will revolve around these overarching technologies. It basically depends on the architecture of the platform, on how NFTs are minted in the architecture framework, and what part smart contracts will play in assisting with automatically paying out royalties.

A. Design and Architecture of the Platform

NFT art hub is an Ethereum-based platform that provides the core infrastructure for NFTs. The platform has a decentralized storage model based on Pinata and the IPFS (InterPlanetary File System). This locks up artworks from getting lost or left behind, and all done in an immutable way.NFT ArtHub basically consists of three major areas:

Layer for blockchain: NFT minting is on Ethereum; ownership is traceable, and the execution of smart contracts happens.

Smart Contract Layer—automated royalty payments and secure transparent transactions through contracts based on Solidity.

Storage Layer: Digital artwork files are stored on Pinata and IPFS, providing an immutable storage solution.

A.1 System architecture and operation flow

Figure 2 shows the architecture of the proposed system.

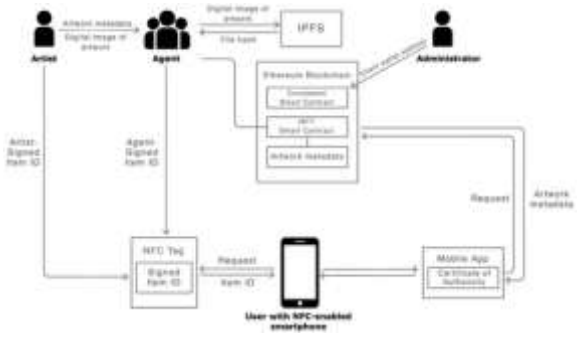

FIGURE 2

B. NFT Creation and Tokenisation Process

This process starts with an artist who uploads the digital artwork to the platform. The art has been uploaded to IPFS using Pinata, and you get a hash specifically for that file. When the NFT is minted out to the Ethereum blockchain by using an ERC-721 standard, it will be connected with this hash. The NFT

can then be listed for sale on the platform and bought, sold, or traded.

Going by the numbers in Figure 3, the minting process is described below:

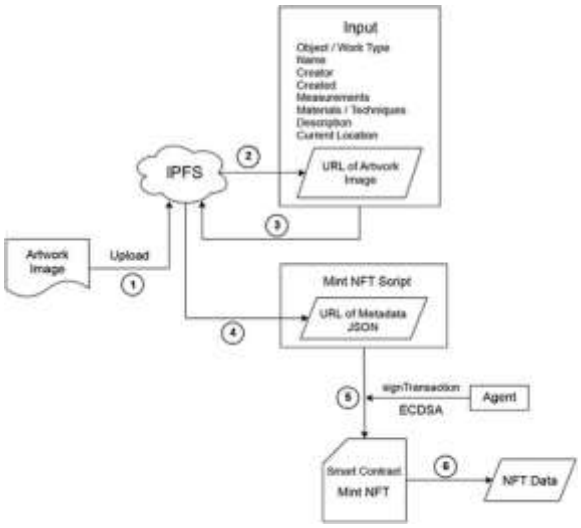

FIGURE 3

C. Payments of Royalties and Smart Contracts

A smart contract associated with the NFT automatically rewards a percentage of resales to the artist behind the token. It removes the effort of tracking royalty manually, thus ensuring fair and transparent payment to artists.

in Figure 4, the nft transaction process is mentioned

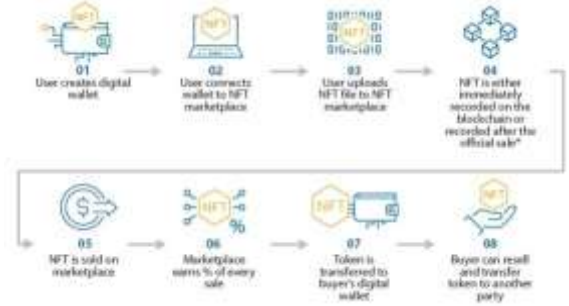

FIGURE 4

IV. TECHNOLOGY STACK

- **Blockchain:**

  NFT ArtHub acts as a market place based on the Ethereum blockchain, which employs the ERC-721 protocol to create distinct non-fungible tokens. Such a standard must also distinguish each NFT from one another, making them records that cannot be duplicated, especially in NFA for digital art. Making use of the Ethereum blockchain, NFT ArtHub enables secure, transparent, and immutable transactions, which add value and assurance to both types of users of the digital assets—sellers and buyers. On top of that, the addition of smart contracts and the decentralised characteristic of the Ethereum blockchain provide greater security since all transactions take place without intermediaries or trust and will be completed as per the agreed terms. This establishes a reliable platform for conducting transactions involving digital art.

- **Decentralised Storage:**

  NFT ArtHub engages Pin'ata for safeguarding its digital and tangible assets on IPFS. IPFS, which stands for Interplanetary File System, is a distributed storage network whose primary goal is to make data more durable. By having replicas of digital files on different nodes in a network, IPFS is able to eliminate or reduce both the risk of data loss and the risk of unauthorised modification. Pinata helps manage and upload files on IPFS with ease and makes it possible to offer a reasonable way to ensure always available access to uploaded files. Such a system makes it practically impossible for the digital content affiliated with the NFTs to change, enabling their value and integrity to be maintained easily within the blockchain ecosystem. Because of the distributed aspect of IPFS and the decent management abilities of the Pinata platform, it is reasonable to store the files that are intimately connected in the context of NFTs, providing adequate protection and permanence properties.

- **Smart Contracts:**

  Automated processes of creation, trading, and royalty payments of the NFTs are performed in NFT ArtHub with the help of smart contracts. These contracts, which are self-executing and based on conditions written in Solidity, are created and fused on the blockchain for easier control without the use of middlemen. In the event that an NFT is transferred and the artist is compensated in fixed proportion from the primary price in all transactions, the smart contract modifies itself to that. This process eliminates middlemen, which leads to time waste and costs, with more safety and transparency at work. Thanks to the use of blockchain

technologies, it is impossible to breach the conditions of the transaction, and the execution of the transaction is seamless, which in turn benefits artists. The value and the role of the digital art are further consolidated with the process automation in the NFT ecosystem.

- **User Interface**:

  React is used to build the front-end of the platform. So, the front-end is developed with js, which is a JavaScript library for creating user interfaces, and the back-end will be Node.js. Such an architecture allows for the front-end to communicate with Ethereum, and both can utilise IPFS as the storage medium, creating a solution that is responsive for artists to sell their NFTs and buyers to buy objects from said artists.

VI. RESULTS AND EVALUATION

- **Functionality**

The functionalities of NFT ArtHub are the ability to mint artworks smoothly as NFTs and programme ownership and revenue shares through smart contracts. While its reliability is contingent upon seamless Ethereum-based transactions. Specific to user testing, backend efficiency is compulsory, making sure every transaction works fine with emergent dumps and handling any existing bugs or inconsistencies.

- **Scalability**

Users also believe that as the platform expands scalability is important. L2 zk-rollup solutions can enhance the throughput of transactions and slashing the gas fees at the same time at Layer 2 (L2). Here, load testing is important in order to determine problem areas when the platform is under high load as well as to check its capability of to scale up. It helps to ready for a scalability that keeps user experience uniform while maintaining organisational efficiency.

- **User Adoption**

Adoption success can be measured by the levels of utility that users will show towards the platform. From questionnaires and other evaluations of the usability of the platform, one may estimate how secure and comprehensible the latter is. Other forms of user engagement include the number of actively using users, retention levels, and completed sales. Affirmative comments will confirm that created PSs design and functions are appropriate.

- **Security and Compliance**

The execution of the solution requires a high security level, for which smart contract verification and data encryption are necessary. To encourage people using it for the long term, compliance with blockchain standards helps prevent numerous frauds and protect user data.

- **Community Building**

Increased community engagement can be achieved through the use of edutaining webinars and user contributed content. A vast community is useful for response and development.

D. NFT ArtHub Differentiation ·

Though OpenSea, Rarible, SuperRare, and the like have paved their way into NFT philosophy, NFT ArtHub operates on the merit of increased decentralisation for both security as well as peace of mind for artists. NFT ArtHub takes advantage of IPFS for completely decentralised storage and automates royalty payments via Ethereum smart contracts to allow artists to find, mint, sell, and transfer their work with as little dependence on centralised infrastructure as possible. It helps artists regain a modicum of control over their work as well as more transparency and fairness in transactions.

In summary, while OpenSea, Rarible, and SuperRare provide valuable marketplaces for NFTs, NFT ArtHub's emphasis on decentralisation, security, and artist control sets it apart, offering a robust solution that addresses key challenges faced by digital creators today.

VII. DISCUSSION

NFT ArtHub appears to be an excellent prospect, yet they do face problems:

- **Effects on the Environment**:

  The environment is perhaps one of the biggest challenges posed by blockchain technologies, in particular proof-of-work (PoW) systems, due to their energy greediness. With this in mind, NFT ArtHub should, as a scaling solution to mitigate its carbon footprint, begin the transition to proof-of-stake (PoS) or other environmentally sustainable alternatives. This change would align with sustainability goals and may even draw interest from artists and collectors focused on environmental values.

- **Laws and Regulations**

Enforcing copyrights on a cross-jurisdictional basis is an uphill battle for NFT platforms. Because blockchain is a decentralised tool, we ensure that intellectual property protection sanctions are much more difficult to determine where and what law applies in an era where cross-border transactions are not only extremely common but also lie into major international complexity. NFT ArtHub will have to formulate clear legal frameworks and work with copyright authorities in helping users navigate through these nuances so they know their rights and obligations as a way of making non-fungible tokens mature.

- **Ethical Concerns**

NFT Minting and purchasing of NFTs is costly, excluding up-and-coming artists and medial or ethnic groups from the equation, in contrast to its promise of making digital art more democratic. NFT ArtHub has a responsibility to promote tiered pricing and education for all types of creators to participate in the digital art marketplace.

VIII. CONCLUSION

NFT ArtHub assists in the digital art market picking up a revolutionary change as it leverages blockchain and decentralised storage to address major pain points such as piracy, artist compensation, and provenance. The ERC-721 format availings option allows artists to tokenise their works on Ethereum blockchain without having worries because every piece(s) are methodologically differentiated and ensured. This way, you maintain control of your IP and can be paid automatically in royalties.

In addition, digital assets are impossible to lose due to decentralised storage through IPFS (InterPlanetary File System), thus adding a layer of security and redundancy as well. But this worry about the safety of the musician and so too that of the collector only helps to grow an authentic pose for digital art.

In the coming days we are going to support scalability solutions and cross-chain interoperability; this will enable NFT ArtHub to scale up its capability and reach. The platform guarantees a much more fair, sustainable digital art transaction ecosystem by eliminating intermediaries that directly connect creators and purchasing agents. Such direct engagement creates audiences for the artists and gives a medium for collectors to interact on a much deeper level with creators.

NFT ArtHub, altogether, is a stellar showcase of what this technology can do with our digital art forever. A robust and community-orientated artistic ecosystem layering new models for how we make, buy, show, and value digital art on top of an accessible, safe, and revolutionary ground in which artists flourish. NFT ArtHub combines the values of decentralisation, security, and artist empowerment—a pretty good answer to the problems of the current digital art landscape but also another way for a new generation of creatives to be empowered with alternative avenues for expression.

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