

NFT Marketplace

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Abstract—The rapid evolution of the blockchain technology has introduced a novel digital economy, in which Non-Fungible Tokens (NFTs) have the center-stage. The NFTs are non-fungible, digital, art, music, collectibles or other goods. The objective of the project is to develop a secure, transparent, and user-friendly platform between the creators and buyers of the NFT. It enables the issuance, trading, selling and purchasing of NFTs and guarantees the ownership integrity through smart contracts on the blockchain. The system architecture of the blockchain system integrates blockchain and IPFS storage with a web-based interface (written in HTML, CSS, and Bootstrap5) to create an efficient interface. The marketplace is also scalability oriented, affordable and accessible and useful to artists, collectors and investors. This project demonstrates that blockchain based market places are a viable and they will help transform the ownership and trade of digital asset in the future.

Index Terms—Blockchain, Non-Fungible Tokens (NFTs), Marketplace, Smart Contracts, IPFS, Web Development, Digital Assets, Decentralization, Ethereum, Bootstrap 5, etc.

I. INTRODUCTION

In the past few years blockchain technology has gotten past the cryptocurrencies and has created a pathway into other applications that emphasize on transparency, decentralization and digital ownership. One of the biggest final products of this development is the Non-Fungible Tokens (NFTs). Unlike the traditional cryptocurrencies, such as Bitcoin or Ethereum, NFTs are tradeable and that have the same amount of money, but unlike their counterparts are non-replicable, unique digital certificates ones, that identify a specific good. These assets may be in the form of artwork, music and the virtual locations and catchments/property on the internet. With the possibility to confirm the ownership and authenticity, NFTs are becoming increasingly popular among creators and collectors around the world.

Despite the movement, NFT ecosystem has been facing some complexities such as lack of easy applications, expensive transactional costs, and technical complexity which renders them less user-friendly by masses of people in the internet. NFTs are often perceived to be overly complex which is why they tend to scare away artists and people who want to venture into NFTs as it seems overly complicated. That is why the need to possess convenient, safe, and easy to use platform that would bring together creators, collectors and investors into one place is great.

To address this gap, the NFT Marketplace project will establish a system that will allow making the world seem more accessible to minting and listing and trading NFTs. The front end of the system is developed with a friendly interface in HTML, CSS, and Bootstrap 5 but the background end is based on blockchain and IPFS that make the information stored securely and capable of demonstrating the ownership only. Smart contracts are transparent with transactions and chances of fraud or manipulations have been eliminated to a minimum.

The given marketplace project will not only provide the realization of the outcomes of the decentralization process; it will enable the digital economy to grow significantly by creating a substantial number of benefits via the convenience. It is one of the examples of how blockchain may empower artists and collectors and what more advanced uses are possible in the future.

II. METHODOLOGY

The methodology of the research report is directed at researching, analysing and understanding the functioning of Non-Fungible Token (NFT) marketplaces, the blockchain technology behind them, and the changing influence on the ownership of digital content they produce. This approach will

include the synthesis of theoretical research study and the case study analysis to ensure a complete understanding of what NFT ecosystem is.

This section describes the different strategies in the gathering, evaluation, and expressing of facts at all via the report.

Research Design

The research largely differs in qualitative and descriptive studies. It laments on the cognition of the NFT marketplace operations and the manner in which blockchain fosters security, openness, and integrity. The similarities between NFT systems and the traditional marketplace have also been made in the paper in the manner of determining the differences between the technological and the operational aspect. The research design does not focus on numerical data but must provide a description of the process of creation, trading, and management of NFTs in decentralized regimes in detail.

Data Collection

Some of the sources used in gathering secondary data that has been utilized in this study include:

- Publications and academic journals in blockchain.
- Such large blockchain projects as Ethereum and Polygon white papers.
- Online NFT marketplace Documentation Online NFT marketplace (OpenSea, Rarible, Foundation).

Articles and reports concerning the industry, interviews with one of the known blockchain professionals.

The sources had the right and up-to-date information about the construction of NFTs, the market processes, and the implementation questions.

Case Study Approach

The report presents a case study analysis as a demonstration of real operations of NFT markets. The popular, useful and share to the market are three platforms that were selected:

- OpenSea is a decentralized non-fungible marketplace which is connected to other blockchains.
- Rarible - is an artist NFT market with community and royalty-oriented companies.

- NBA Top Shot is a branded platform selling cryptographic sports items as non-fungible tokens based on blockchain.

Both platforms had been measured against the following criteria:

- Smart contract integration
- Minting process
- User experience
- Fee structure
- IDENTITY: security and authentication.

The strategy helps to show how the concept of blockchain will work in the context of NFT in reality.

Technical Analysis

Technical exploration was conducted to get to know:

- Cryptocurrency Minting in smart contracts on Ethereum and other blockchains.
- How metadata and digital files are stored is stored in the decentralized storage systems (like IPFS (InterPlanetary File System)).
- The communication between the users and the blockchain via the crypto wallets like Metamask.
- Procedures of computing and payment of gas charges towards confirming transaction.

In the analysis simplified blockchain models have been used to simplify the concepts of technology such that people would not need to be programmers in order to easily grasp the concepts of the technology.

Forecast Analysis and Anticipatory Analysis.

As per the current trend of blockchain, a preemptive study was done to deduce the future scope of the NFTs and blockchain advancements.

This includes:

- The development of Layer-2 solutions(Polygon, Arbitrum, Optimism).
- Energy conservation through the use of Proof-of-Stake (PoS).
- Cross-chain interoperability: The introduction of a smooth movement of assets.
- Use of AI and use of metaverse in NFTs.

Ethical and Environmental Problems.

The paper also addresses the discussion of ethical, social and environmental impacts of NFTs such as: Mining of blockchain as source of energy.

The issues of the intellectual property and copyright.

Market and new user financial risk and speculation. In an attempt to highlight how the NFT ecosystem is on track to become sustainable, eco-friendly blockchain networks (e.g. Ethereum 2.0 and Tezos) are also explored.

III. WORKING OF NFT

NFTs are blockchain-based, meaning that the digital property ownership is registered and verified in a non-fungible way in chains, i.e., recording the owners. Each NFT is a one-only token and can not be replaced with another token of the same price. The complete life-cycle, their creation and resale is a process which elaborates as explained below.

Tokenization

Any digital or physical asset is transformed into a one of a kind cryptographic token in the blockchain via the process of tokenization.

Every NFT includes:

- the chain identification of it as a token ID,
- Collected address of the creator wallet [human]>Address of the creator wallet
- metadata a hash that refers to descriptive information on the asset.

This combination will present originality and authenticity.

Minting Process

Making an NFT is a process that is known as minting. Ready Asset an image, a video, a 3-D model or a music file.

Save Metadata - name, description and media link data are stored in a decentralized storage (usually IPFS).

Deploy Smart Contract - is a program, which as executed in the blockchain, creates ownership royalty and transfer policies.

Confirm on-Chain - this is where the artist pays a gas fee to make the token permanent among the validators.

Award Ownership - the newly made token will be perceived in the crypto wallet of the creator and will be traded.

Smart Contracts

The explanation of the NFTs is known as smart contracts.

They automatically do transfers, charge royalties and check authenticity.

Key properties:

- Automation: The middle-men should not exist.
- Transparency: Inspeckable code.
- Unchangeability: Like any finance agreement, contracts are unchangeable.

ERC-721 (one-of-a-kind tokens) and ERC-1155 (semi-fungible batches) are some of the widely used stands.

Storage and Metadata

Nothing more than the address to the real digital file is stored in the blockchain; significant media files are stored off-chain on:

- IPFS- interplanetary file system (IPFS).
- Arweave, or
- Filecoin.

The NFT metadata items usually contain the title of the work, its creator, description and the IPFS address that ensures that the art is provable when the place of the hosted data changes.

Wallet Integration

Cryptocurrency wallets (MetaMask or Trust Wallet or Coinbase Wallet) are used to access marketplaces.

They store:

- cryptocurrencies (so as to pay gas fees),
- NFTs themselves, and
- cryptographic keys of transactions.

Each wallet has a public address where the wallets receive tokens and a secret key blocks that are used to authorize actions.

Transactions and Gas Fees

Each blockchain operation will be associated with costs in terms of gas that the video validators in the network will pay.

This is depending on the network congestion and the type of the contract.

Polygon and Arbitrum are cheaper and quicker to utilize layer-2 networks.

There are other sites that mint slowly, and do not create until the first sale which saves artists the set-up costs.

Buying and Selling NFTs

Creator presents the auctioning or the NFT selling (fixed price).

Buyer puts on a wallet and payment verification.

Smart redeems NFT and pays out money.

Royalties are automatically identified on the original creator on each resale.

The entire deals are made within a peer-to-peer environment without the participation of banks and brokers.

Ownership Verification

It is also open-source, and someone is able to view the blockchain to get the entire history of ownership of an NFT.

Each transaction includes:

- wallet addresses
- timestamps
- transaction hashes

These internet services like Etherscan make sure that this is done without difficulties.

Security and Authenticity

NFTs rely on cryptography.

Evidence that is documented cannot be ended up or copied and titles of ownership cannot be counterfeited and imitation.

Even though the media behind it can be copied, it is impossible to duplicate the blockchain record (which parks the truth that it is real ownership).

IV. CORE COMPONENTS OF NFT

The NFT ecosystem is comprised of a number of key components that complement each other to make the system secure, transparent and decentralized. Each of the layers - blockchain to wallets has its portion to play in order to make authentic, traceable, and tradeable NFT. These core aspects may be applied to explain how NFTs are working in the digital economy.

Blockchain Network

Any NFT system is developed around the blockchain. It is a decentralized online registry where all transactions will be stored permanently.

They are mostly built on Ethereum, but (and arguably because of their success) NFT standards may also be

hosted on other chains, such as Polygon, Binance Smart Chain (BSC), Solana and Avalanche.

When NFTs is applied to Blockchain, it operates as follows:

- Stores ownership and history of transaction.
- Transactions of inertia (records are forever).
- It Offers confidentiality and liberty along with visibility and safety.
- Allows the use of smart Contracts.

Smart Contracts

Smart contracts refer to computerized internet contracts amongst other internet contracts, which would be stored in the blockchain.

They impose the rules of the formation of NFTs, payments of transfer and royalty on an automated basis.

Roles of Smart Contracts:

- Maotai NFTs of award-winning-wine, create and own.
- Automate sales and auctions.
- Royalty payments to the original creators every time it is resold.

Common Standards of NFT Smart Contracts:

- In one-of-a-kind and unique NFTs, ERC-721 is utilized.
- ERC-1155: Supports all the unique and semi-fungible objects (optimal game assets).
- BEP-721 BEP-1155 Ethereum equivalents at Binance.

NFTs rely on smart contracts to be trustless because regular users can communicate with one another without any form of a middleman.

Token Standards

Keynotes in the standards of NFT behavior and interaction with wallets or marketplaces, the specifications are also known as the token standards. They give interoperability of platforms.

Key NFT Token Standards:

- ERC-721: Counterfeit token and representation.
- ERC-1155: The standard of a multi-token and multi-asset type (used in the sphere of games and collectibles).
- ERC-998 Partial NTFs NTFs containing NTFs.
- EIP-2981, Standard access to royalty payment to creators.

Every NFT created must comply with a token standard in order to be rightly identified and be listed on the appropriate market with the ability of tools like open seas or meta mask.

Decentralized Storage

The files (images, videos, music or documents) are too massive to be directly saved in the blockchain.

Instead, the information is kept off-chain, and with the assistance of decentralized file systems the information is kept only in the blockchain as the hash of the file or in its IPFS address.

Main Storage Options:

1. IPFS (InterPlanetary File System): This approach is grounded on content addressing and permanently storing files in a peer-to-peer node.
2. Arweave: was a permanent storage solution which was provided on a single payment.
3. Filecoin: It provides long term, economical incentivized 300 plus storage which is economical.

This can be ensured by decentralized storage so that a media stored in an NFT is not lost or suppressed by a single power.

Metadata

Metadata attributes whatever NFT description is. It is a small XML file, which is linked to the token ID of the NFT and contains:

Purpose of Metadata:

- Raises the issue of what is the NFT.
- Stores have features, which define something as unique or rare.
- It determines the asset represented by a visual representation.

According to the metadata, the NFT may be on a digital form but the information on it, as well as its uniqueness, can be verified and retrieved.

Crypto Wallets

Crypto wallets are included in the interface of the user with NFTs and blockchain apps.

Common Wallets:

This app is considered to support both Polygon and Ethereum.

- MetaMask (Ether and Polygon)
- Trust Wallet (BSC, Ethereum)
- Coinbase Wallet

- Phantom (Solana)

V. COMPARISON OF NFT MARKETPLACES VS TRADITIONAL MARKETPLACES

Both NFT marketplaces and traditional marketplaces can allow buyers and sellers to sell and buy assets but they differ completely in the way they transfer ownership, verifiable ownership, and transfer of value. The traditional ecosystem is centralized and NFTs market is decentralized infrastructure with blockchain and smart contracts.

The current section reviews their structure, processes, weaknesses, and their strengths.

Nature of Ownership

In traditional marketplace, the ownership is informed on a centralized basis. In reference, when individuals make purchases of online digital art in digital store, they will have access to the art work, but not the ownership of the real file. The firm controls licenses, distribution and permissions.

NFT ownership within a marketplace is verified by using blockchain records. The buyer receives a token once, which represent the electronic record of genuineness and absolute property proprietorship that is made on a common register.

Aspect	Traditional Marketplace	NFT Marketplace
Ownership Type	Centralized (platform-controlled)	Decentralized (blockchain-based)
Proof of Ownership	Company records or receipts	Smart contract on blockchain
Transferability	Limited, often restricted	Instant and verifiable globally
Risk of Loss	Possible if database is hacked	Low due to blockchain immutability

Challenges and Limitations

In spite of the fact that an NFT marketplace allows transparency and automation, it also has issues:

- Outrageous gas fee during serious blockchain congestion.
- Environmental concerns (consumption of power).

- Cryptocurrencies speculative prices, crypto volatility.
- Intellectual property issues which include the minting of art by those who do not own the art.

Traditional markets on the other have suffered:

- Lack of transparency,
- Intermediary costs, and
- Restrictions on payments that are geometric.

VI. CONCLUSION

The NFT market places will become unprecedented in defining ownership, creativity as well as value in the digital world. They empower creators to directly make a living out of what they have created, purchasers to verify ownership in an authentic manner and also the management by the community through greater ownership of the ecosystems. This innovation is ensured by the key which is the blockchain technology that ensures transparency, security, and autonomy. As interoperability advances and the creation of new consensus mechanisms that use less energy is created, NFTs will continue to maintain second-mover approaches to real estate, education, healthcare, and entertainment. The second-generation marketplace NFT will not only be an area in which to buy and sell digital art, it will inherit the foundations of the entire digital economy, including all forms of ownership converting them into tokenized assets sold and bought on-chain.

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