IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

AN NFT MARKETPLACE'S DEVELOPMENT AND SCOPE IN THE FUTURE OF E-COMMERCE

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Abstract: A brand-new class of blockchain-based tokens that is exclusive and indivisible is called a non-fungible token (NFT). They first made their debut in late 2017. NFTs are a particular class of blockchain-based digital assets that have recently attracted a lot of investor attention. The phenomenon and its markets have grown significantly since early 2021. Developers struggle to create such marketplaces since blockchain technologies are yet underutilized. This paper outlines the essential procedures that readers may adhere to as they engage in NFT marketplace creation through the example of a web application named RareBuy. The development process involves choosing the base blockchain, writing relevant contracts, deploying and testing them, UI designing, frontend creation, and its interaction with the contracts. Relevant options for the same have been presented in terms of workflow, architecture, and tech stack. It has been investigated how IPFS is an adept file storage system for NFTs. The study also discusses the difficulties NFT marketplaces face, such as blockchain selection tradeoffs and NFT-related legal concerns. It also highlights the advantages of NFT marketplaces, which are directly related to the security and transparency features of blockchain technology. As a result, we set the way for future research paths on a number of crucial yet unresolved areas pertaining to NFTs, NFT markets, and their role in future e-commerce.

Index Terms **- Blockchain, NFT, Smart Contract, ERC721, Ethereum, IPFS.**

I. INTRODUCTION

Unlike Bitcoin and banknotes, which all have the same value and are interchangeable, NFTs or non-fungible tokens are a specific type of crypto asset in which each token is distinctive. Since each NFT is distinct, they may be used to verify who owns digital assets including artwork, music, videos, etc. Using a special identification number that is recorded on a blockchain, NFTs offer secure storage.

Igor Barinov bidding $140,000 worth of Ether on a Crytokitty NFT [1] is an example of the craze for NFTs headlined by The New York Times. As per CoinTelgraph [2], by 2030, the NFT market may be valued at $231 billion. Various fields and industries ranging from culture, gaming, fine arts, luxury goods, and real estate have seen a surge in NFT employment within their traditional systems. Interest in blockchain-related technologies has risen among investors and consumers. A decentralized platform to acquire and sell virtual digital assets (NFTs) has therefore become a trending requirement.

Built on the blockchain, an NFT marketplace is a digital platform that allows the creation (minting), featuring, storing, auctioning, and trading of NFTs using cryptocurrencies. Every time an NFT is bought through their platform, the marketplace charges a transaction fee. After paying for the NFT, the buyer receives a special ID that includes evidence of ownership as well as details about the author, source, and legitimacy. NFT marketplaces are broadly categorized into universal and niche marketplaces [3].

Since NFT marketplaces are the drivers of the NFT's market growth and they are based on blockchain which is still in the infant stages of its development, finding the necessary frameworks/ tools/ solutions has been cumbersome which makes developing them a challenging and intricate task. Despite the popularity of various NFT marketplaces, there is still huge scope for developers in this field in terms of providing a better user experience and a larger pool of features.

This paper presents the various steps that go into the development of a decentralized universal NFT marketplace based on Ethereum. It discusses various challenges encountered during the project's SDLC along with the benefits and limitations of an NFT marketplace as opposed to those of traditional E-commerce marketplaces like Amazon. Finally, it paves the way to answer the question of NFT marketplaces as the future of E-commerce and sets the course for future study on the same.

II. LITERATURE SURVEY

Any item that may be replaced with a like or identical item is referred to as "fungible". Fungible assets include things like goods, shares of common stock, and currency bills. Saffan [4] uses the example of a car whose loan can only be cleared by none other than its owner to explain non-fungibility. Features of NFTs like public verifiability, transparency in related activities, availability, failure-resistance, non-alterable nature, atomic nature, and tradability make the NFT system efficient to represent both digital and non-digital items. This promotes the NFT space and related marketplaces to hold a strong chance as a futuristic technology in various industries.

Saffan [4] remarks that NFT creators hold the copyright to their digital assets and buying NFT does not make its buyer hold unrestricted access to the actual asset. He further states that the owner must confirm that they have the necessary private key to transfer NFTs, and they must use a legitimate digital signature to send the NFTs to the other address(es). Someone who asserts ownership of NFT-based intellectual property rights is essentially asserting possession of the creator's original hex hash value. NFT marketplaces still have to acknowledge that the NFTs stand in for their rarity in order for the monopolistic tendencies of NFT systems to work.

Yash [5] and coauthors examine a number of obstacles to creating an NFT marketplace. ERC721 is used to create contracts for an NFT marketplace and has various constraints, like, as it does not support multiple copies of the token to be created, it doesn't provide a facility to get token IDs of created NFTs, and inability to send multiple tokens at a moment, which makes transaction take longer to execute. Blockchains like Ethereum which form the basis of NFT marketplaces charge very high transaction fees. The end user suffers a significant loss as a result while using the platform to conduct transactions. Blockchain layer 2 networks are a fantastic way to reduce increased gas costs. The choice of blockchain to build marketplaces has various tradeoffs in terms of transaction throughput, block time, and base consensus algorithm followed. Block sizes are restricted by Proof of Work consensus methods, and building a block takes a fixed amount of time. Each transaction also needs to wait for a lot of block confirmations. In order to get past these restrictions, the consensus system Proof of Stake uses a staking approach, which increases throughput but decreases decentralization. Smart contracts also have their own setbacks. A smart contract contains features that enable a special status to arbitrarily and unilaterally alter the functioning of an asset. Any flaw in the smart contract code, no matter how little, might cause major problems and end in the customer losing the entirety of their money. The smart contract may function in ways that are not intended by the user due to innate faults. Implementation hazards could include improper signature implementation and unlawful asset transfers. The smart contract allows for asynchronous transaction processing using mempool transaction reordering, which may be utilized for profiteering or protocol correctness.

Buki [6] summarizes the work of authors of [7] through Figure 1 and found 13 flaws in the NFTMs as security, confidentiality, and user experience issues. Wajiha [8] and coauthors point out that future solutions to these problems may include emerging technologies like zero-knowledge proofs (ZKP), which are currently being explored.

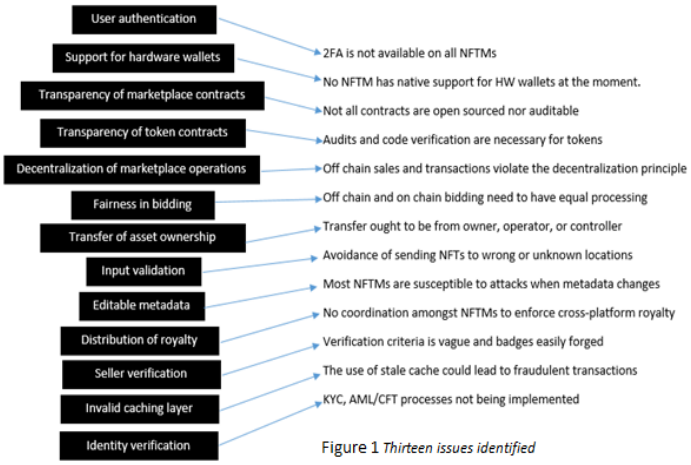

Fig. 1 Security Flaws

Pavel [9] implies that NFT listing and sale prices will rise when bidding becomes simpler due to bidding bots or changes in UX design. An upsurge in NFT prices could not only be ascribed to increases in the "value" of NFTs but also to advancements in marketplace design. Hence topnotch marketplace development is crucial to expect exponential growth in the NFT ecosystem.

III. METHODOLOGY

An NFT marketplace in the form of a web application named "RareBuy" was developed to aid the agenda of this paper.

The development process of the project was divided into the following steps:

3.1. Workflow Setup

The workflow of the application was organized as shown in Figure 2.

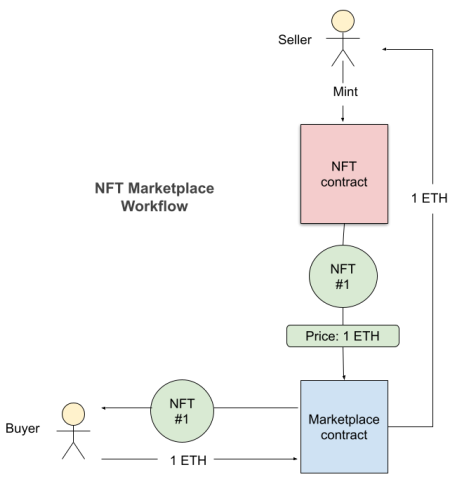

Fig. 2 RareBuy Workflow

3.2. Architecture Designing

The project was finalized to be layed out through the following elements in its architecture:

- Ethereum Blockchain: Stores data pertaining to NFT transactions.
- Functional Smart Contracts: Makes use of ERC721 to mint and create listings of NFTs on our marketplace by providing a unique ID for every NFT.
- IPFS: Stores NFT content and its metadata via a distributed file storage network.
- Metamask Wallet: Allows users to store, exchange and transfer cryptocurrencies or digital assets. Also acts as an interface to the Ethereum network.
- NFT Metadata: Defines information about NFTs like their description, name, date of minting, creator address, etc.
- Web app: Consists of frontend and backend which together provide the facility to trade NFTs.

3.3. Tech Stack Selection and Setup

Upon analysis of project requirements, the project was decided to be built using React, Chakra UI, Node.js, Solidity, OpenZepplin, Ether.js, Waffle, Chai.js, React Router Dom, and a few other useful development packages.

Hardhat specifically helped in building, deploying, and testing the smart contracts and also provided a local Ethereum development blockchain.

3.4. UI Designing

Used Figma to develop mockups of the web application. One such mockup is shown in Figure 3.

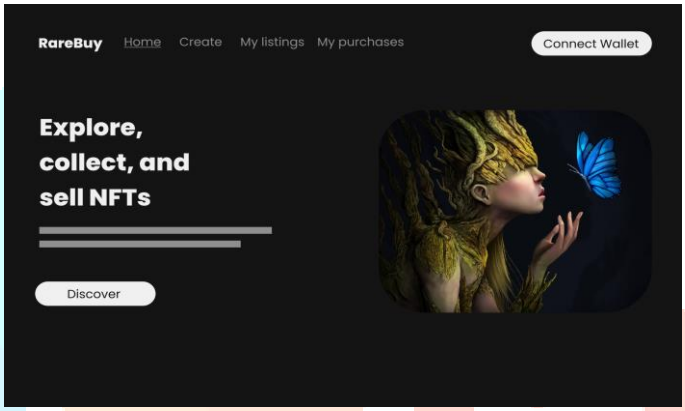

Fig. 3 RareBuy Homepage Mockup

3.5. Smart Contract Creation

The following smart contracts were written.

1) *NFT Contract:* Describes a function that mints an NFT with its data in the form of a token URI.
2) *Marketplace Contract:*
   - Sets the fee percent and fee account to receive the price margin (in ETH) cut by the marketplace on each NFT bought through it.
   - Describes a function to list an item on the marketplace by transferring NFT ownership from the seller to the marketplace while keeping track of the selling price, the seller's information, and the NFT's information.
   - Describes a function to purchase an item from the marketplace. The function pays the seller and marketplace, transfers NFT ownership from the marketplace to the buyer, and updates the NFT as sold.
   - Describes a function to calculate the total listing price of the NFT by adding the selling price and marketplace's margin.

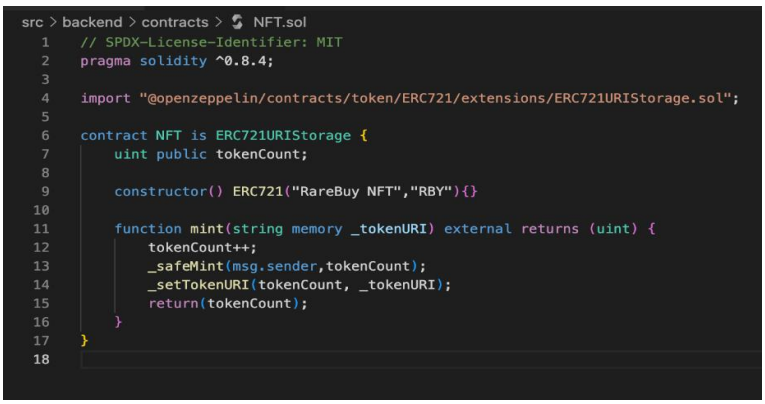

Fig. 4 NFT Contract Code Screenshot

3.6. Deploy Script Development

A deploy script as shown in Figure 5 was written to deploy both contracts on the Ethereum blockchain and for each contract, save a copy of the contract ABI and address to the front end.

Fig. 5 Deploy Script Code Screenshot

3.7. Smart Contract Unit Testing

Seven tests were written using Waffle and Chai libraries to test the deployment of each contract, minting of NFTs, listing NFTs on the marketplace, and purchasing of the NFTs from the marketplace for both success and failure conditions.

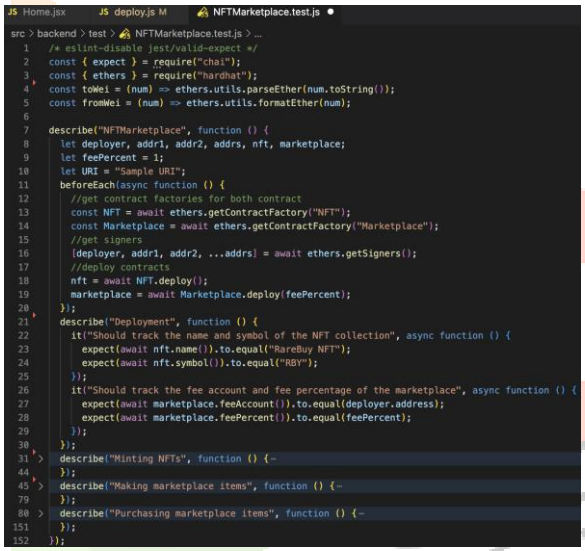

Fig. 6 Test File Code Screenshot

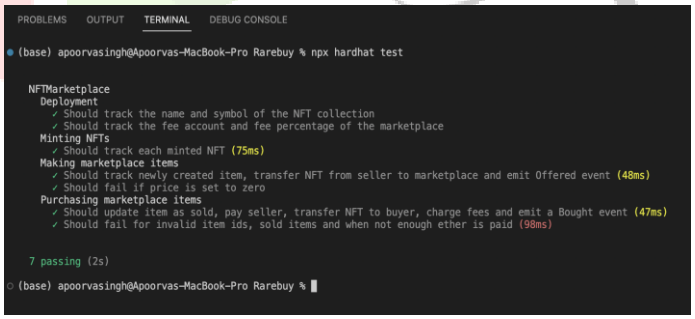

Fig. 7 Unit Test Screenshot

3.8. IPFS Setup

Set up an account on Pinata to upload NFT content and metadata on its IPFS pinning service. Used Axios to interact with it from the frontend.

3.9. Frontend Integration

- Used React and Chakra UI library to build pages (Landing Page, Create NFT Page, My Listings Page, and My Purchases Page) and various components (Navigation Bar, form to mint and list NFT, card representing NTF up for sale, etc) making up these 4 pages.
- Set up navigation routes for all the pages using react-router-dom.
- Set up a connection between the web application, Web3 provider, and the MetaMask wallet.
- Used ethers.js library and saved contract ABIs to get deployed copies of the contracts which are needed to establish interaction between the front end and the contracts.

Summary of the working of RareBuy Marketplace:

- The buyer uses the Create Page to mint and lists their NFTs to the RareBuy marketplace. Internally the data gets uploaded on Pinata and the URI goes as a parameter to the triggered NFT contract. He/She gets prompted to confirm the transaction through the Metamask wallet.
- Marketplace contract takes ownership of the NFT, keeps a track of seller details to receive ETH if his/her NFT gets sold, and also adds their price margin before listing.
- Once a buyer presses the Buy NFT button on any listed NFT and confirms the transaction, the NFT ownership is transferred to him/her. The buyer and marketplace get paid and some amount of gas fees are incurred on everyone's end.
- The application users can see their listed, sold, and purchased NFTs using the My listings and My purchases Pages.

IV. RESULTS AND DISCUSSION

The RareBuy application was successfully developed with the working explained in the methodology section. The workflow described in this paper is common to all the marketplaces already in the market and is the bare minimum for any NFT marketplace developer to follow.

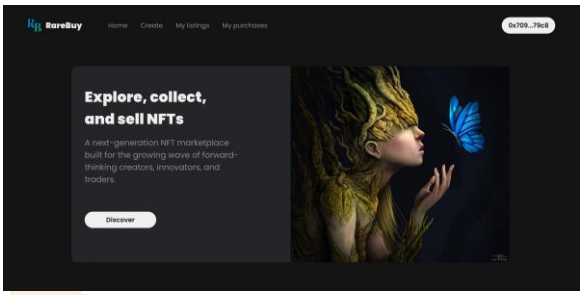

Fig. 8 RareBuy Home Page

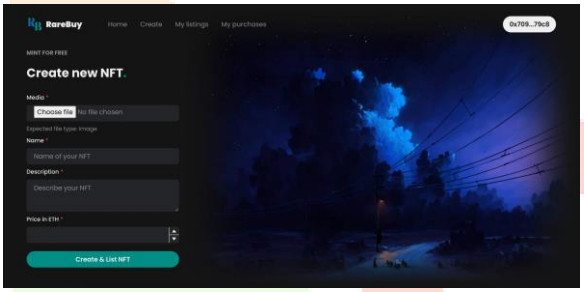

Fig. 9 Create NFT Form

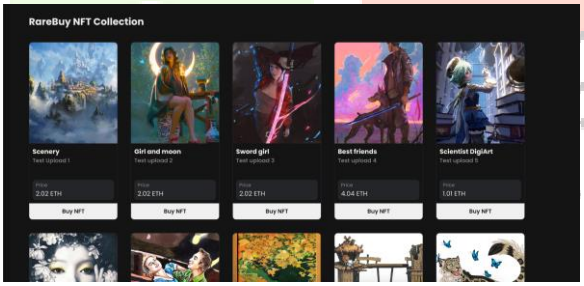

Fig. 10 RareBuy Collection to Buy NFTs

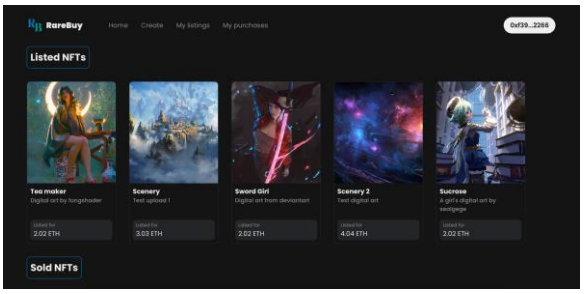

Fig. 11 My Listings Page

The project's development leads to the realization of some challenging loopholes in the NFT marketplace space:

- Complex UX: Knowledge of blockchain and cryptocurrencies is a must to understand and develop such platforms. This is yet a largely uncommon field.
- Originality tracking issue: Despite the decentralized nature of NFT marketplaces, copyfraud remains an issue making it difficult to confirm the originality of NFT work. Cyber-security incorporation in NFT marketplace development is a challenging research topic.
- Absence of legal defense mechanism: In scenarios of fraud and due to the non-supportive attitude of governments towards the crypto world, non-accountability is prominent.
- Choice of blockchain: For marketplaces based on Ethereum, high gas costs might result in low client retention.

Despite the aforementioned flaws, NFT marketplaces provide a number of advantages:

- Transactions are completely transparent due to blockchain technology, which provides excellent security.
- Decentralization eliminates unauthorized interference. Therefore, traders, creators, and investors will have greater room for growth.
- NFT marketplaces will be the future of e-commerce since Defi is the financial technology of the future.
- Offers more freedom from prevailing laws and restrictions.
- It may support a variety of sectors, including the arts, music, real estate, and journalism.

V. CONCLUSION

A new technology called Non-Fungible Token (NFT) is gaining popularity in the blockchain industry. In this report, we examine NFT systems that have the potential to transform the market for digital and virtual assets in the future. Following a technical component analysis, we offer design models and attributes. Next, we evaluate the security of the present NFT systems and discuss the prospects and future NFT applications. We conclude by outlining the present research obstacles that must be overcome before widespread commercial acceptance. It is anticipated that this report will help newcomers keep up to date by providing timely analyses and descriptions of initiatives and solutions that have already been offered.

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