CMPE 272 Spring 2022 Project Report

NFT Marketplace Application using Next.js

TEAM 13

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Abstract* - *The NFT marketplace is a place where non-fungible tokens can be bought, sold, and stored. In this market, tokens are typically traded at a fixed price or at a variable price based on market conditions. You'll need a crypto wallet to complete all transactions and store tokens on the marketplace. Users sign up for the NFT market and create one-of-a-kind, sellable assets. In comparison to ordinary NFT marketplaces, niche-based NFT marketplaces are in high demand. Niche-based markets are in high demand because they offer all of the necessary components to meet clients' objectives, such as a focus on selling unique assets online and a specified target audience.

Keywords– *NFTs, non-fungible tokens, cryptocurrency, Ethereum, Metamask, NFT, Smart contract.*

I. INTRODUCTION

Every day, new technology-based applications emerge in response to the expanding scope of technology. Blockchain is a cutting-edge technology that is widely employed in the creation of digital currencies. In addition, digital currency or cryptocurrency blockchain is employed in a variety of areas. The blockchain also includes trading and assets. Every day, more people participate in digital trade; they develop, sell, and purchase digital assets. Digital art is becoming increasingly popular. The non-fungible token, or NFT, has emerged as a new era trend. The NFT marketplace is where buyers and sellers of digital assets can meet.

A. Next js:

Next.js is a react based framework It's a fantastic tool for building online applications, and it's well-known for server-side rendering. Zeit is the creator of Next.js. Developers that are already familiar with HTML, CSS, Java Script, and React can quickly adapt next. js.

B. Features of Next.js:

- A user-friendly page-based routing system (with support for dynamic routes)
- On a per-page basis, pre-rendering is possible, including both static generation (SSG) and server-side rendering (SSR).
- Splitting code automatically for faster page loading
- Client-side routing with prefetching optimization
- Support for CSS and Sass, as well as any CSS-in-JS library
- Fully extendable

C. Features of a NFT:

1. Anything from a piece of furniture, pictures, videos to something ethereal like an animation qualifies as an NFT object.
2. NFTs operate independently of any central or local regulatory authority.
3. NFTs can be a great way for NFT artists, retailers, and others to earn lifetime royalties.

D. Features of a NFT Marketplace:

Below are some of the salient features of Non-Fungible Tokens:

1. **Separate Dashboards for Buyers and Sellers:**
2. **Homepage:**
3. **Crypto Wallet:**
4. **Transaction History:**
5. **Ethereum based NFT Marketplace:** The Ethereum blockchain is used by the crypto platform to mint, exchange, and verify NFTs listed on this marketplace. It enables decentralized apps to function without downtime, fraud, control, or third-party influence.

E. Tech Stack

We have built a full stack application using:

1. Web Application Framework: **Next.js**

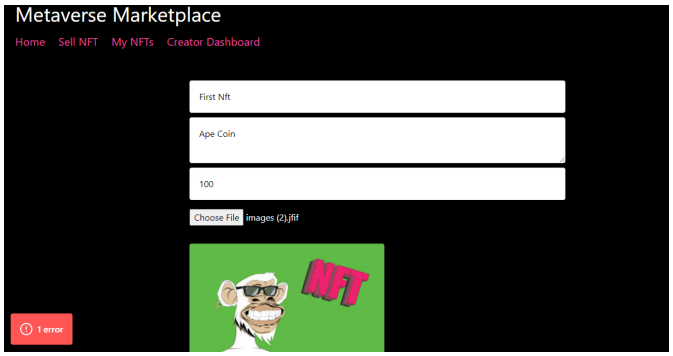
2. Solidity Development Environment: **Hardhat**
3. File storage: **IPFS**
4. Ethereum Web Client Library: **Ethers.js**

II. WORKING MECHANISM

When a user sells an NFT, the item's ownership is transferred from the creator to the marketplace contract.

When a user buys an NFT, the money is transferred from the buyer to the seller, and the item is transferred from the marketplace to the buyer.

A listing charge will be established by the marketplace owner. This charge will be collected from the seller and transferred to the contract owner following the completion of every sale, allowing the marketplace owner to earn recurring money from any sale made on the platform.



III. TECHNICAL COMPONENTS

In this part, we show the technical components that are related to the NFT's activities. These components lay the building foundations of a fully functional NFT scheme. Details are shown as follows.

A. Blockchain.

Blockchain was originally proposed by Nakamoto, where Bitcoin uses the proof of work (PoW) algorithm to reach an agreement on transaction data in a decentralized network. Blockchain is defined as a dis-tributed and attached-only database that maintains a list of data records linked and protected using cryptographic protocols. Blockchain provides a solution to the long-standing Byzantine problem, which has been agreed upon with a large network of untrusted participants. Once the shared data on the blockchain is confirmed in most distributed nodes, it becomes immutable be-cause any changes in the stored data will invalidate all subsequent data. The most prevailing blockchain platform used in NFT schemes is Ethereum, providing a secure environment for executing the smart contracts. In addition, several solutions drop their customized chain-engines or blockchain platforms to support their specialized application.

B. Smart contract.

Smart contracts were originally introduced by Szabo aiming to accelerate, verify or execute digital negotiation. Ethereum further developed smart contracts in the blockchain system. Blockchain-based smart contracts adopt Turing-complete scripting languages to achieve complicated functionalities and execute thorough state transition replication over con-senses algorithms to realize final consistency. Smart contracts enable unfamiliar parties and decentralized participants to conduct fair exchanges without a trusted third party and further propose a unified method to build applications across a wide range of industries. The applications operating on top of smart contracts are based on state-transition mechanisms. The states that contain the instructions and parameters are shared by all the participants, thus guaranteeing transparency of the execution of these instructions. Also, the positions between states must stay the same across distributed nodes. Most NFT solutions rely on smart contract based blockchain platforms to ensure their order-sensitive executions.

C. Protocols, Standards and Properties

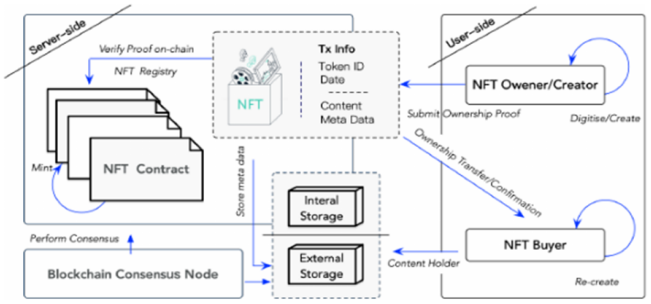
This section presents the basic model of NFT schemes, with emphasis on their protocols, token standards and key properties.

· Protocols

The establishment of NFT requires an underlying distributed ledger for records, together with exchangeable transactions for trading in a peer-to-peer network. This report primarily treats the distributed ledger as a special type of database that stores NFT data. In particular, we assume that the ledger has basic security consistency, completeness and availability characteristics. Beyond that, an NFT system also consists of another two roles: NFT owner and NFT buyer. We provide the detailed protocol as follows.

-NFT Digitize. An NFT owner checks that the file, title, description are completely accurate. Then, s/he digitizes the raw data into a proper format.

-NFT Store. An NFT owner stores the raw data into an external database outside the blockchain. Note that, s/he is also allowed to store the raw data inside a blockchain, despite this operation being gas-consuming



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D. NFTs Desired Properties

NFT schemes are essentially decentralized applications and thus enjoy the benefits/properties from their underlying public ledgers.We summarize the key properties as follows.

-Verifiability. The NFT with its token metadata and its ownership can be publicly verified.

-Transparent Execution. The activities of NFTs include minting, selling and purchasing are publicly accessible

-Availability. The NFT system never goes down. Alternatively, all the tokens and issued NFTs are always available to sell and buy.

-Tamper-resistance. The NFT metadata and its trading records are persistently stored and cannot be manipulated once the transactions are deemed as confirmed.

-Usability. Every NFT has the most up-to-date ownership information, which is user-friendly and information-clear.

-Atomicity. Trading NFTs can be completed in one atomic, consistent, isolated, and durable (ACID) transaction. The NFTs can run in the same shared execution state.

-Tradability. Every NFTs and its corresponding products can be arbitrarily traded and exchanged.

IV. Security Evaluation

STRIDE	Security Issues	Solutions
Spoofing *(Authenticity)*	• An attacker may exploit authentication vulnerabilities • An attacker may steal a user's private key.	• A formal verification on the smart contract. • Using the cold wallet to prevent the private key leakage.
Tampering *(Integrity)*	• The data stored outside the blockchain may be manipulated.	• Sending both the original data and hash data to the NFT buyer when trading NFTs.
Repudiation *(Non-repudiability)*	• The hash data may bind with an attacker's address.	• Using a multi-signature contract partly.
Information disclosure *(Confidentiality)*	• An attacker can easily exploit the hash and transaction to link a particular NFT buyer or seller.	• Using privacy-preserving smart contracts instead of smart contracts to protect the user's privacy.
Denial of service *(Availability)*	• The NFT data may become unavailable if the asset is stored outside the blockchain.	• Using the hybrid blockchain architecture with weak consensus algorithm.
Elevation of privilege *(Authorization)*	• A poorly designed smart contract may make NFTs lose such properties.	• A formal verification on the smart contracts.

Conclusion

The NFT marketplace is a cutting-edge platform for trading, sel's rising popularity and value, it's realistic to predict that NFT marketplaces and the entire blockchain netwling, and purchasing digital works. With cryptocurrency work will remain in demand in the long run, which is why it's so important now and in the future.

Deliverables

https://github.com/sjsucmpe272SP22/NFT-Marketplace/blob/main/README.md

Acknowledgement

We would like to thank Prof. Rakesh Ranjan for his detailed and critical guidance in helping us find this idea and the implementation of it as well. We are also thankful for his clarification of the technical details that required particular attention in the process

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