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## Decentralizing Digital Ownership: Exploring NFT Marketplaces And Blockchain Integration

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### Abstract

**Background:** The face of digital assets has been revolutionized with the advent of NFTs, and they offer simply amazing options to both investors and creators. The constant need for the stable and easy utilizing of the NFT marketplace platforms is permanently growing with the increasing enthusiasm about NFTs. This research paper is aimed to bridge the gap by creating an NFT marketplace with Motoko backend, and React frontend technologies on the Internet Computer network using the blockchain technology.

**Methodology:** The research covers all processes in detail including, how to make an application of decentralized type for the purposes of creation of the NFTs and the purchase of them as well as their ownership transformation. Developers should get to know how to set up the project environment, build interfaces required to ensure convenience, include vital features, and eventually launch the program using a detailed method. In the context of coding the blockchain programmed, programmers work on code integrity, testing procedures and problem solving in order to guarantee reliability and security of the market

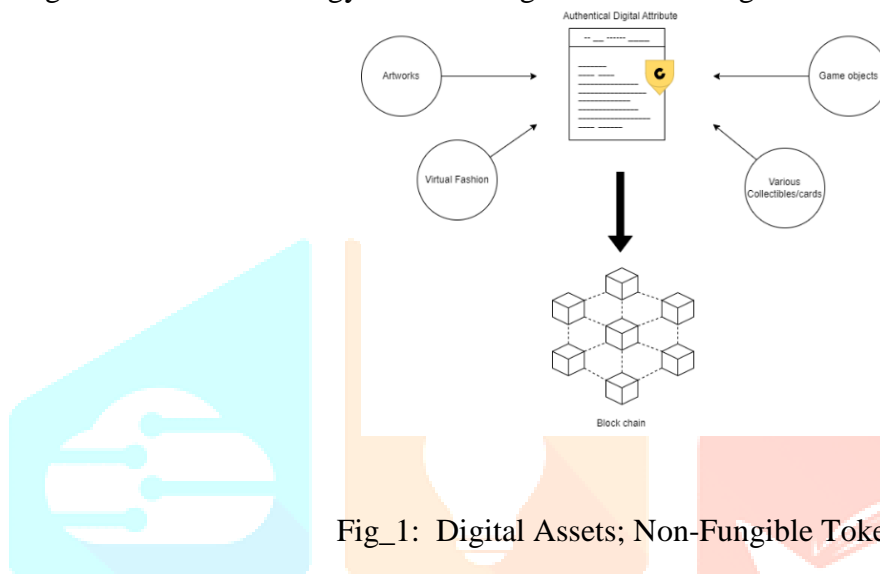
**Result:** The research covers all processes in detail including, how to make an application of decentralized type for the purposes of creation of the NFTs and the purchase of them as well as their ownership transformation. Developers should get to know how to set up the project environment, build interfaces required to ensure convenience, include vital features, and eventually launch the program using a detailed method. In the context of coding the blockchain programme, programmers work on code integrity, testing procedures and problem solving in order to guarantee reliability and security of the market.

**Conclusion:** The study presented has a great importance for developers who are the ones responsible for the development of IC smart contracts for instance. During creation of a NFT market using React frontend and Motoko backend both robustness as scalability are maintained to adopt any dynamism in the digital asset market. The project collates and evaluates a development model so the developers can strengthen their skill, join the project with fresh ideas, and contribute to the development of blockchain technology. This article serves as a guide about how to craft advanced and user-friendly ICP NFT markets. ICP NFT market is crucial for NFT market because of its growth.

**Keywords:** Digital Assets, Decentralized application, Blockchain technology, NFT marketplace, Internet Computer network, Smart Contracts

## I. Introduction

Non-Fungible Tokens (NFTs) have emerged as a transformative force within the digital assets market, introducing novel paradigms for ownership and value representation [1][2]. In this paper, we delve into the development of NFT marketplaces on the Internet Computer (IC) platform, leveraging Motoko and React technologies [15]. We provide an in-depth exploration of platform functionality, offering insights into canister development using Motoko and frontend design with React [15]. The discussion encompasses various facets of the NFT management lifecycle, emphasizing code integrity and collaboration within the DFINITY ecosystem [15]. By navigating blockchain complexities, developers are empowered to participate in the burgeoning NFT market ecosystem [3][12][15]. As the Internet Computer sector continues to evolve, driven by innovation and collaboration, it is poised to shape the decentralized finance landscape [3][11]. This article serves as a roadmap for developers, facilitating their journey towards advancing blockchain technology and fostering the continuous growth of the NFT environment [15].



Fig\_1: Digital Assets; Non-Fungible Tokens

*Overview of Research Paper:* The research paper focuses on the development of an NFT marketplace on the Internet Computer platform, integrating Motoko backend and React frontend technologies. The study provides a detailed exploration of the process involved in creating a decentralized application for minting, listing, buying, and transferring ownership of NFTs. By dissecting the project methodology, developers are guided through setting up the project environment, designing user interfaces, testing functionalities, and deploying the application on the Internet Computer platform.

## II. Literature Survey

This section represents a literature survey on non-fungible tokens (NFTs) and existing NFT marketplaces. The survey aims to provide a comprehensive overview of the current state of NFT technology and its applications in various industries.

### A. NFTs

NFTs, as elucidated by Wang et al. [1], are digital tokens representing ownership of specific items or content, distinct from fungible cryptocurrencies like Bitcoin or Ethereum [1][9]. They are underpinned by blockchain technology, ensuring authenticity and scarcity through unique identifiers [1][9]. NFTs offer transformative potential across industries, facilitating new forms of digital ownership and monetization [1][10].

### B. Internet Computer

The Internet Computer platform, as described by "NFT Marketplaces: The Future of Digital Asset Trading" [4], revolutionizes blockchain by enabling hosting of smart contracts at web speed and scale [4]. Its capabilities include infrastructure for building internet services, scalability, and interoperability [4][15]. Sustainability and security are core missions [4].

### C. Motoko

Motoko, as detailed by the literature [15], is a programming language optimized for the Internet Computer platform, offering developers tools to author canisters [15]. Its JavaScript or Rust-like syntax enhances accessibility, aiding rapid development of complex decentralized applications [15].

### D. React

React.js, as highlighted by industry sources [6], facilitates the creation of dynamic user interfaces with features like component-based architecture and virtual DOM [6]. Its use in single-page applications enhances modularity, performance, and workflow control [6].

### E. Existing NFT Marketplace React

Existing NFT marketplaces, such as OpenSea, Rarible, and Foundation, cater to diverse digital asset trading needs [8]. OpenSea, for instance, offers a wide range of digital collectibles [8]. Rarible enables users to create and sell NFTs [8]. Foundation supports emerging digital artists through an invite-only model [8].

### F. Challenges and Opportunities

Challenges include ensuring robust security protocols to prevent fraud, managing the environmental impact of blockchain operations, and navigating the complex legal landscape of digital asset ownership. Additionally, creating a user-friendly interface with React while ensuring seamless integration with the backend Motoko canisters requires careful design and testing.

On the other hand, opportunities abound. The Internet Computer platform offers a scalable and cost-effective solution for NFT transactions, potentially reducing gas fees. React's flexibility allows for creating dynamic and engaging user interfaces, enhancing user experience. Motoko's design for the Internet Computer ensures efficient backend processing, facilitating a smooth marketplace operation. Together, these technologies can create a marketplace that empowers artists and collectors with true digital ownership and global accessibility.

Table\_1: Literature Review

S.No.	Research Paper	Author	Description
1.	What is non- fungible token (NFT):A short discussion about NFT Terms used in NFT	Diptiben Ghelani	The paper delves into the surge of NFTs, their influence on brands and artists, and the integration of machine learning for market analysis, showcasing the fusion of technology and art.
2.	Non-fungible token (NFT): Overview, evaluation, opportunities, and challenges	Qin Wang, Rujia Li, Qi Wang, Shiping Chen	The paper delves into the NFT market's growth driven by Ethereum standards, emphasizing its opportunities and challenges, while advocating for systematic development.
3.	NFTs: Applications and challenges	Wajiha Rehman, Hijab e Zainab, Jaweria Imran, Narmeen Zakaria Bawany	The paper discusses NFT applications in education, fashion, sports, and digital art, emphasizing benefits and addressing challenges for broader adoption.
4.	Survey on NFT Mint, Buy and sell web app	Piyush Shitole, Aditya Bansode, Yash Prasad, Aparna Meshram	The research highlights the surge in NFT marketplaces and proposes a decentralized exchange to address centralized storage issues. The project aligns with blockchain's

			transformative potential, focusing on secure NFT trading and exploring IPFS for digital asset storage.
5.	Non-Fungible Tokens (NFT) - A Primer	Prof. Himanshi Agrawal, Abhay Bodhe, Ananta Sontakke, Aniket Shahane, Rushi Bihade	The research paper delves into the technologies surrounding NFTs, the growth of NFT marketplaces, and the challenges related to NFT implementation. It also discusses the various applications of NFTs in reshaping the future of digital assets.
6.	The Future of Non-fungible Tokens: PNFTs as a Medium for Programmatic Art Enabling a Fully Realized AI-Driven Art Ecosystem	Jeffrey T. K. V. Koh	The chapter explores the potential of smart contracts and blockchain to revolutionize art through NFTs, enabling AI-driven programmatic art creation and challenging traditional art paradigms.

*Objectives:* The main goals of the project included developing of a fully-fledged decentralized NFT marketplace based on the ICP blockchain system. In the first place, we began by developing the DCT token based on Motoko smart contracts, and eventually the building of the functional construct of the ecosystem commenced. Then, our attention was turned to user-friendly frontend development with React capable to bring much smoothness when it comes to moving around and conduction operations aimed at buying and selling NFT products. Supporting features that make it possible to discover, buy, sell or mint NFTs were well considered in terms of increasing the platform efficiency. Last but not least, DCT token as a principal means of purchase allowed for all securities, as it were, which were the key concerns for us while developing a marketplace away from centralized institutions.

*Motivation for Backend:* The reason we decided to use IC blockchain network and Motoko smart contracts involves its special technical advantages. It stands out due to the uniqueness in scalability and decentralization that results in an increased level of robustness and durability in handling big transactions. Motoko, which with its languages design sits on the IC and has an easy development experience, makes complexities to be available and efficiency to be peak in smart contract deployment. A synergy between IC and Motoko helps to build a reliable and scalable decentralized NFT marketplace in accordance with the project's aims of promoting integrity, clearness, and user power in the world of digital assets.

### III. Methods Employed in NFT Platform Development

#### A. Token Creation

The token was developed from scratch using Motoko smart contracts on the ICP blockchain network. The process began with the design phase, where the initial token specifications were defined, including its name, symbol, total supply, and functionalities. Smart contracts were then written in Motoko to implement these functionalities, such as token minting, transferring, and the token faucet for users to claim free tokens. Once the smart contracts were developed and tested locally, they were deployed onto the ICP blockchain network using the Internet Computer Interface Specification (IC-IS) and the DFINITY Canister SDK.

#### B. Frontend Development

The frontend of the decentralized NFT marketplace was developed using a combination of HTML, CSS, ES6, JavaScript, React, React Router, and React Hooks. The development process involved creating user-friendly interfaces/pages to enable various functionalities, such as browsing NFT collections, buying/selling NFTs, and minting NFTs. Seamless integration between the frontend and backend was ensured by establishing

communication channels with the Motoko smart contracts using HTTP requests and JSON-RPC calls.

### C. Frontend Development NFT Marketplace and Functionality

Integration of Motoko smart contracts with the frontend enabled users to interact with the NFT marketplace seamlessly. Users could browse and discover NFT collections listed by other users, buy NFTs using their DCT token wallet as the payment method, list their NFTs for sale, and track their owned/self-minted NFTs. Development of each functionality involved writing and deploying additional smart contracts to handle specific actions, such as listing NFTs for sale and transferring ownership.

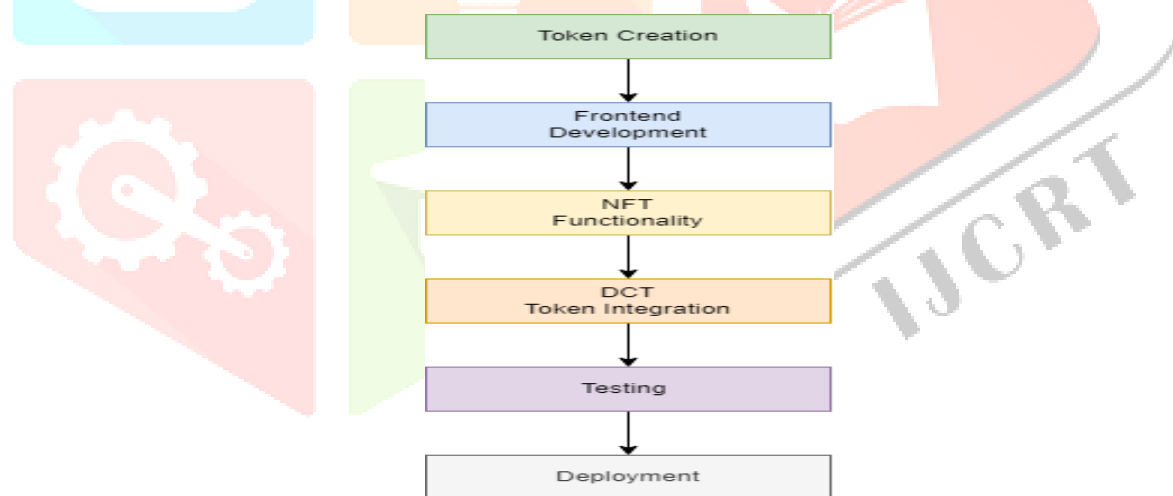
### D. DCT Token Integration

Integration of the DCT token wallet as the primary payment method for all transactions within the marketplace was achieved by connecting users' DCT wallets to their marketplace accounts. This integration allowed users to complete transactions conveniently, with DCT tokens deducted from the buyer's wallet and transferred to the seller's wallet upon successful purchase. The integration process required implementing secure authentication mechanisms and ensuring compatibility between the DCT wallet and the marketplace platform.

### E. Testing and Deployment

To ensure the functionality, security, and performance of the decentralized NFT marketplace, rigorous testing methodologies were employed throughout the development lifecycle. This included unit testing of smart contracts, integration testing of frontend and backend components, and end-to-end testing of the entire platform. Deployment of the marketplace onto the ICP blockchain network was carried out using standard deployment tools and protocols, with considerations given to scalability, reliability, and maintainability post-deployment.

By following this methodology, the project successfully achieved its objectives of developing a decentralized NFT marketplace with DCT token integration, providing users with a seamless and secure platform for discovering, buying, and selling NFTs on the ICP blockchain.

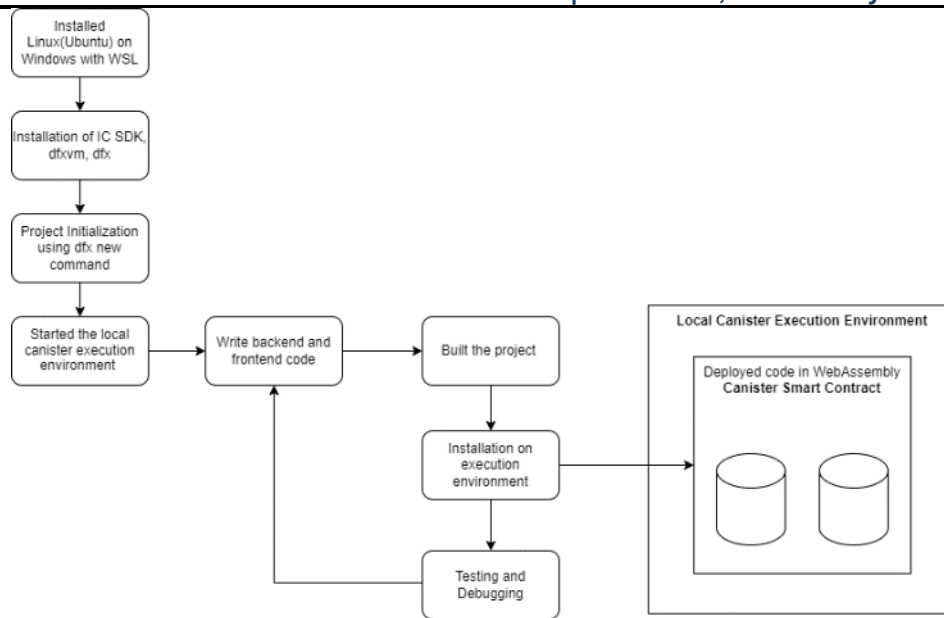


Fig\_2: Methods Employed

## IV. Methodology

This methodology outlines the steps for setting up and developing a non-fungible token (NFT) marketplace on the Internet Computer blockchain using dfx and WSL on a Windows machine. It covers backend and frontend development, inter-canister communication, and testing and deployment procedures.





Fig\_3: Development Workflow of NFTMKT

### A. Setting Up the Project

The project setup involves utilizing dfx (0.19.0) and WSL (Windows Subsystem for Linux) on a Windows machine to create a non-fungible token (NFT) marketplace on the Internet Computer blockchain. The process includes the following steps:

Installing the DFINITY SDK (dfx) to set up the development environment for building and deploying canisters on the Internet Computer blockchain. Created a new project using dfx new command, selected Motoko for frontend, React for backend.

### B. Backend Development

The backend development process includes creating a new canister file for the NFT within the src folder. Methods for minting NFTs, listing them for sale, and transferring tokens are defined. Cycles are allocated for the canister's creation and deployment using the "dfx deploy" command.

### C. Frontend Development

The frontend development phase involved the creation of essential files such as App.jsx, Button.jsx, Footer.jsx, Gallery.jsx, Header.jsx, index.scss, Item.jsx, main.jsx, Minter.jsx, and PriceLabel.jsx. These files were crucial components in building the user interface and functionality of the NFT marketplace, enabling the management of user input, display of NFTs, handling of routing, and providing a seamless user experience.

Additionally, React Hook Form was utilized to manage user input for minting NFTs, and the minted NFTs were integrated with the frontend to display them on the website. The testing of the frontend was conducted by running "npm start" and accessing it on localhost, ensuring the proper functionality and appearance of the NFT marketplace.

### D. Inter-Canister Communication

To ensure seamless communication between canisters, the declaration file for the token canister is copied and pasted into the project. Query functions are tested to verify inter-canister communication.

### E. Testing and Deployment

The project functionalities, including minting NFTs, listing them for sale, and transferring tokens, are thoroughly tested. The canisters are deployed using the "dfx deploy" command to make the project available on the Internet Computer blockchain.

## V. Result and Discussion

The project successfully delivered a fully operational decentralized NFT marketplace on the Internet Computer (ICP) blockchain network. The integration of various features resulted in a comprehensive system capable of catering to users interested in creating, buying, and selling NFTs.

*Seamless Wallet Integration:* The seamless integration of the DCT digital wallet with the marketplace eliminated cumbersome processes, facilitating easy and straightforward purchasing. This streamlined user experience and simplified token management.

*Discover Page Functionality:* The Discover page curated a diverse range of NFTs available for purchase by other users, offering users the opportunity for exploration and informed buying by browsing listings based on price and owner.

*NFT Purchase and Ownership Transfer:* Direct purchases from the Discover page instantly transferred ownership to the user and automatically deducted the purchase price from the user's DCT wallet.

*My-NFT Section Management:* Users could monitor both owned and self-minted NFTs through the My-NFT section, enhancing transparency and accountability in their digital asset portfolio management.

*NFT Listing and Marketplace Ownership:* Participants could list their NFTs for sale on the platform, with listed NFTs displayed in the Discover section. The marketplace's ownership structure ensured fair and transparent transactions by denying users the opportunity to purchase their own listed NFTs.

*NFT Minting:* The interface facilitated the creation of NFTs by users through trial periods, allowing individuals to diversify their digital asset collections and engage in art creation.

*Third-Party Minting:* Users had the capability to mint NFTs from external sources through dfx command line function calls, promoting flow and ease of transactions for creators and collectors alike.

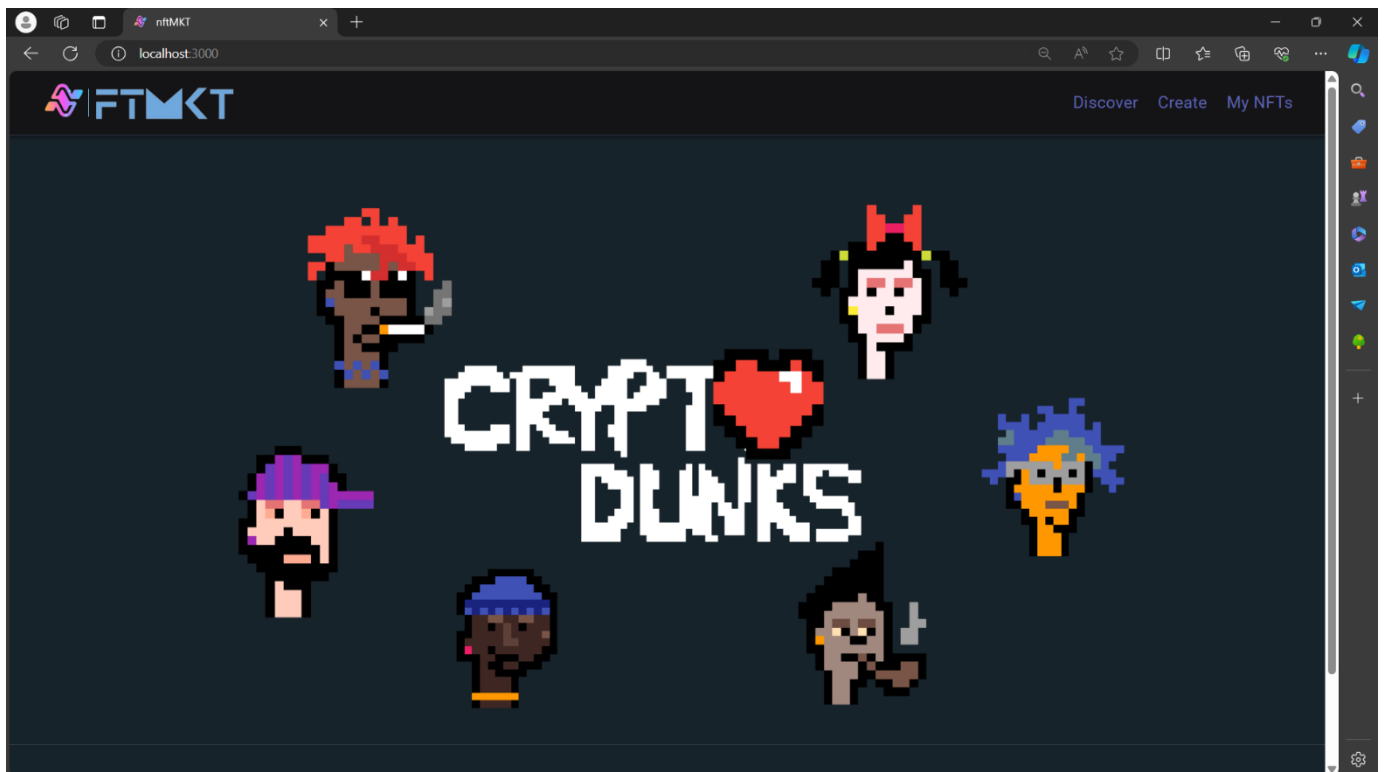
Table\_2: Achievements in NFT Marketplace Development

Result	Description	Outcome
Minting and Listing NFTs	Through the marketplace, people will be able to mint, list, and buy NFTs, thus production and administration of distinctive one-of-a-kind digital assets would be enabled.	Successful implementation of minting and listing NFTs.
Frontend Development	The interface of the NFT marketplace is written, allowing users to interact with the platform, see all minted NFTs, and which provide features like the gallery and My NFTs options.	Responsive and user-friendly frontend interface.
Backend Deployment	Canisters are deployed, and backend functionality is integrated with the frontend, ensuring the seamless operation of the NFT marketplace.	Stable and reliable backend infrastructure.
Inter-Canister Communication	Communication between canisters is established, enabling the transfer of tokens and interaction between different components of the marketplace.	Smooth transfer of tokens and seamless interaction.
Testing and Debugging	Through rigorous testing and debugging processes, different bugs are detected and the smooth	Identified and resolved bugs, ensuring robustness.

	functioning of the NFT marketplace gets accomplished.	
User Interface and User Experience	The main focus is given to the designing of an interface that is friendly to use, the incorporation of features like loaders, image rendering, and NFTs is included to improve the users' experience.	Enhanced user engagement and satisfaction

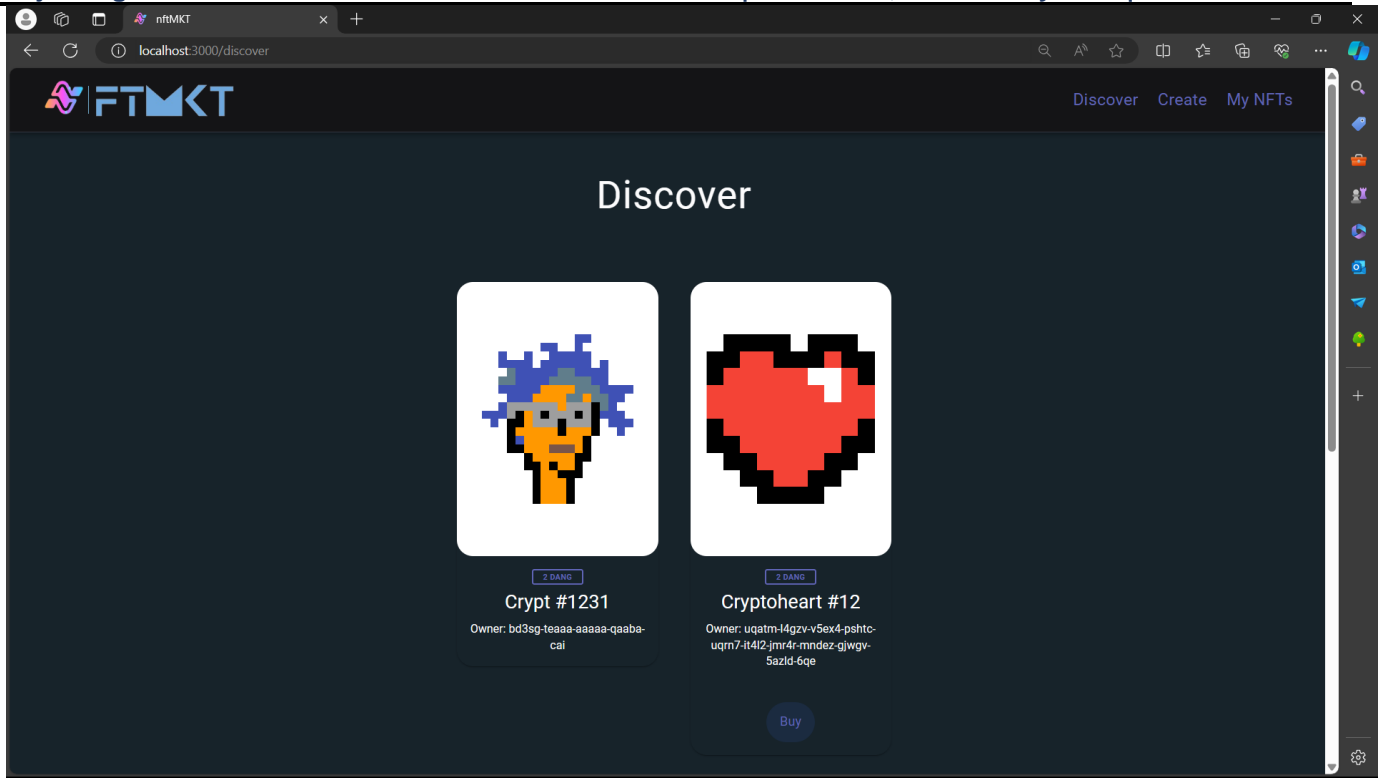
Ultimately, the culmination of these features resulted in the establishment of a fast, secure, responsive, and decentralized NFT marketplace that utilizes blockchain technology as its foundation for digital asset trading. Through its decentralized marketplace, NFTMKT showcases the transformative potential of such a structure in revolutionizing the way users interact with digital objects on the blockchain.

#### *The Project snapshots:*

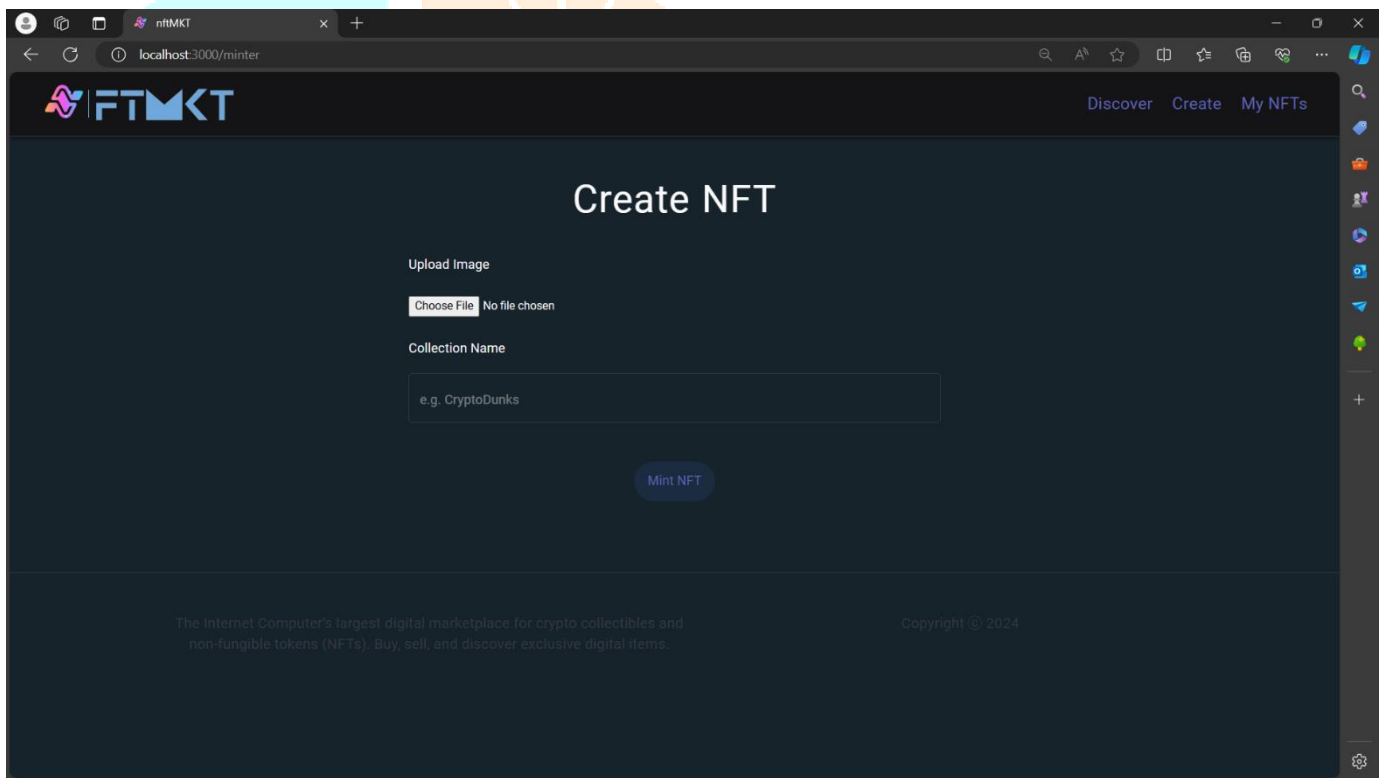


Fig\_4: Main View of the application

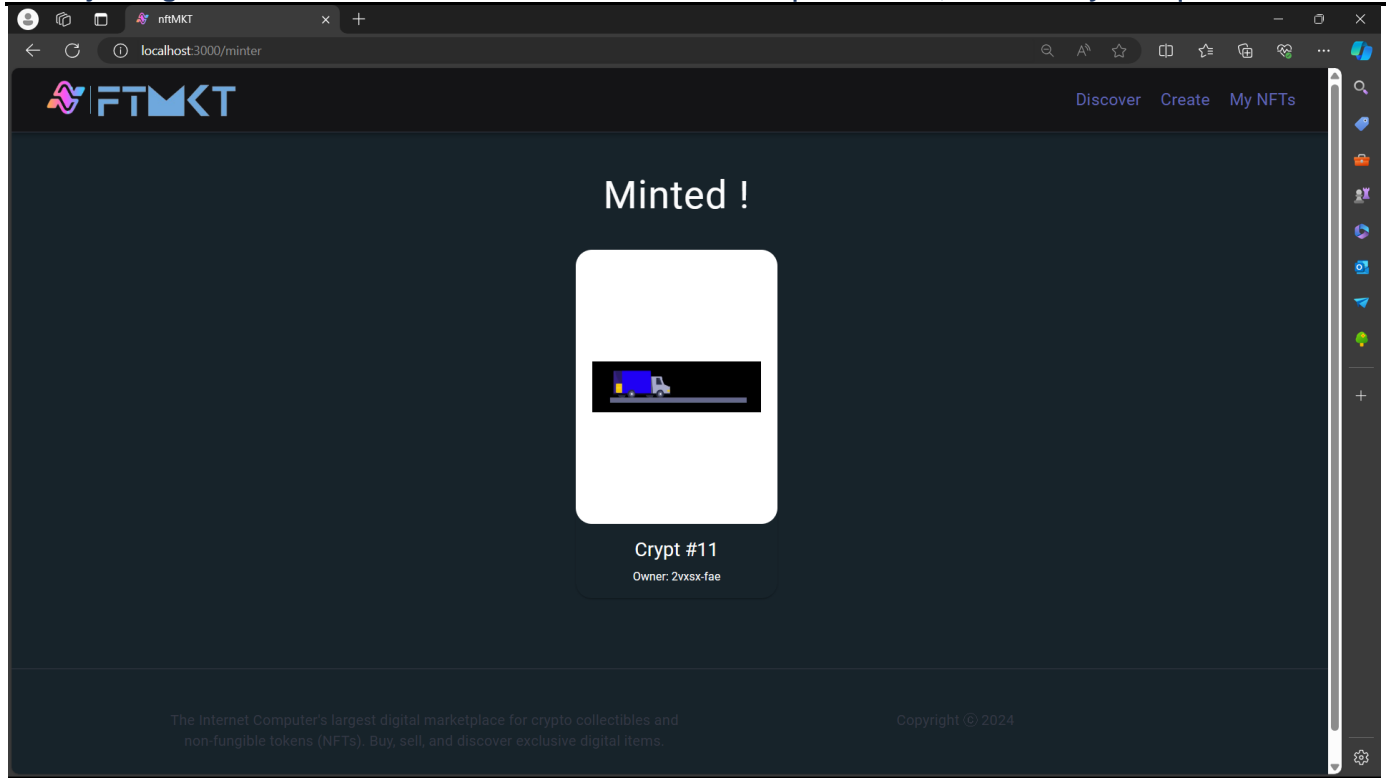




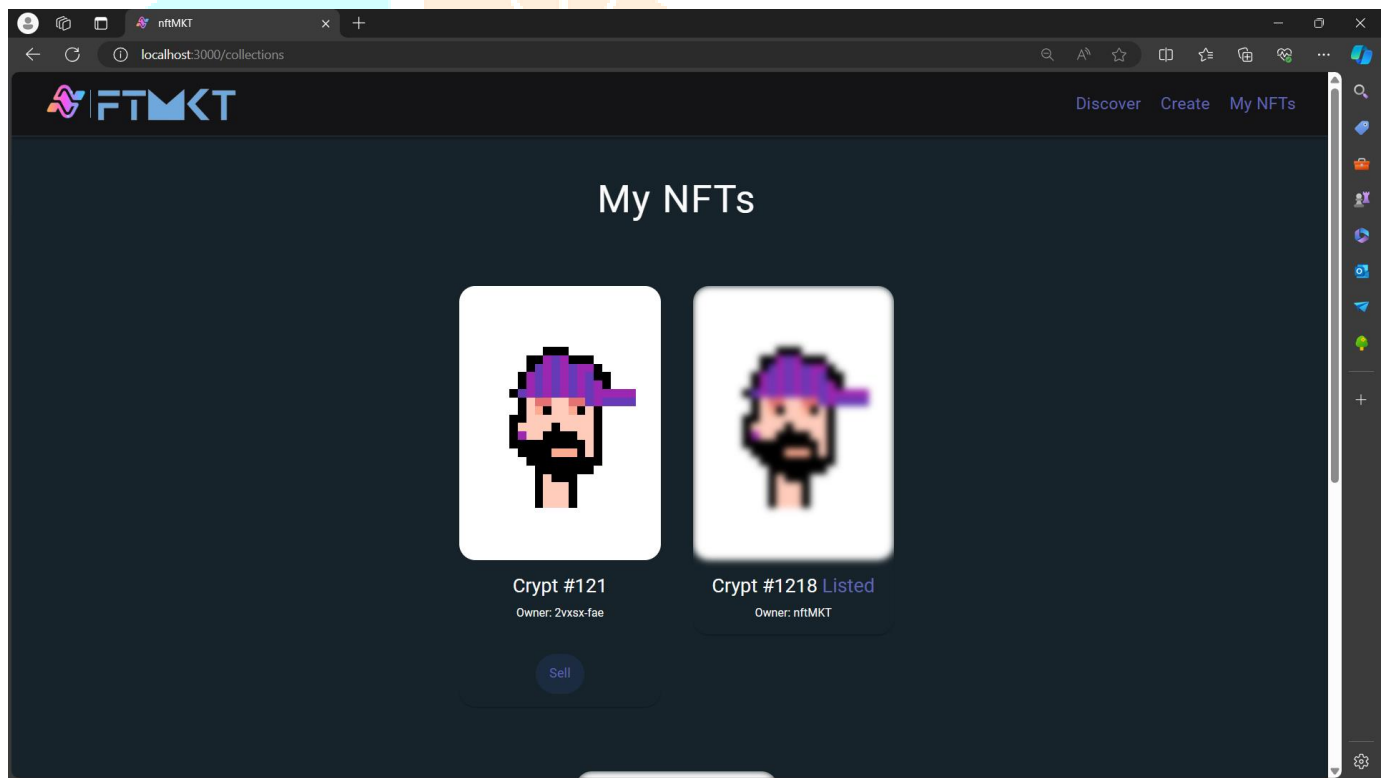
Fig\_5: Discover to Buy NFTs



Fig\_6: Minter to mint NFTs



Fig\_7: Minting NFTs



Fig\_8: Gallery for My NFTs

### VI. Comparative Results

The variety of NFT venues are unfolded to the viewers in a full range which comprises of different functionalities and characteristics. The ensuing comparison examines main features of these platforms, among others, bringing to light how they differ from one another and what could be the impact of this on the users and developers.

Table\_3: NFT Marketplace Dynamics: Diverse Platforms Unveiled

Feature	NFTMKT	Other Platforms (e.g. Open Sea, NBA Top Shot, Binance NFT)
Blockchain	Internet Computer Protocol (ICP)	Ethereum, Flow Blockchain, Binance Smart Chain
Transaction Fees	Zero gas/minting fees for users.	Variable fees
Scalability	Infinite scalability through seamless generation of new subnets without network interruption	Limited scalability, Scalable
Interoperability	Native interoperability with other blockchains	Limited interoperability
Decentralization	100% decentralization	Centralized or Semi-decentralized
Security	Built-in security features of ICP	Security reliant on Ethereum's network and smart contract audits
Minting Process	Simple minting process with Motoko smart contracts	Minting process typically involves writing and deploying Solidity smart contracts

This table provides a comparison between the NFTMKT (NFT Marketplace) platform and other platforms such as OpenSea, NBA Top Shot, and Binance NFT. It highlights key differences in their blockchain technology, transaction fees, scalability, interoperability, decentralization, security, and minting process.

## VII. Future Work

One advancement that shall be added to the platform is incorporating sophisticated AI/ML technologies so as to arrive at a secure and unique NFT buy and sell platform as compared to current existing marketplaces. An integral part of this exercise includes the design of a user-adaptable site with simple procedures of obtaining and selling NFT tokens. The site will also ensure that navigation is easy as possible with a smooth flow of transactions by users to improve satisfaction.

On top of that, we are also going to use comprehensive authenticity mechanisms in order to guarantee the safety of transactions and user information. By implementing AI/ML algorithms, personalized NFT suggestions will be given according to users' historical data, preferences and other similar factors. AI algorithms will be put in place to ensure that all NFTs are original and genuine which will increase trust and confidence among users.

In addition, the platform will be unique by providing the fullest range of NFT trading functions with distinctive features, provided that the features will be developed based on the changing realities of the NFT space. The platform intends to improve the level of user interaction and confidence by achieving it, hence, the marketplace aims to be the instrument of growth and evolution leading to the advancement of the NFT field, and thus, worth and experience of both buyers and sellers increase. By persistently coming up with new ideas and bringing in all the advanced technologies there are, the platform intends to be one of the key players that are currently active in the market of non-fungible tokens.

## VIII. Declaration

**Funding:** For the research paper titled "Decentralizing Digital Ownership: Exploring NFT Marketplaces and Blockchain Integration": The authors would like to declare that this research was conducted without the assistance of any external funding bodies. All expenses and resources used for this research were self-funded.

**Competing Interests:** The authors state that they do not have any competing interests. The research presented in these papers was carried out in the absence of any commercial or financial ties that could be interpreted as potential conflicts of interest.

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