Full Stack NFT Marketplace

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Final Approval

This is to certify that we have read the report submitted by *Muhammad Afzaal Hameed (23733), Usman Ayyub (27952), Mussab Saeed (27660)*for the partial fulfillment of the requirements for the degree of the Bachelors of Science in Computer Science (BSCS). It is our judgment that this report is of sufficient standard to warrant its acceptance by Riphah International University, Islamabad for the degree of Bachelors of Science in Computer Science (BSCS).

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Declaration

We hereby declare that this document "**Full Stack NFT Marketplace**" neither as a whole nor as a part has been copied out from any source. It is further declared that we have done this project with the accompanied report entirely on the basis of our personal efforts, under the proficient guidance of our teachers especially our supervisor **Mr. Tajamul Shahzad**.

If any part of the system is proved to be copied out from any source or found to be reproduction of any project from anywhere else, we shall stand by the consequences.

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Dedication

Insert dedication Our final year project is dedicated to our parents, friends and teachers, whose love and support have been our pillars of strength. To our professors and especially supervisor"**Mr. Tajamul Shahzad**", your guidance has shaped our academic journey.

Acknowledgement

First of all we are obliged to Allah Almighty the Merciful, the Beneficent and the source of all Knowledge, for granting us the courage and knowledge to complete this Project.We extend our heartfelt gratitude to our project supervisor "**Mr. Tajamul Shahzad"**, whose unwavering support, invaluable guidance, and continuous mentorship were indispensable to the successful completion of this project. Their dedication and commitment have been a driving force behind our work.Furthermore, we want to say a big thank you to our family and friends. They have been our constant source of support and motivation, always encouraging us to do our best and be honest and hardworking.

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Abstract

The project, titled **"The Full Stack NFT (Non-Fungible Token) Marketplace"** aims to create a comprehensive platform for trading digital assets, offering a seamless experience for creators and collectors alike. Built on a foundation of **Next.js, Solidity, Hardhat, Node.js, and MetaMask,** the marketplace provides a robust ecosystem for minting, buying, and selling NFTs. The platform prioritizes security, scalability, and user-friendliness, ensuring that users can confidently engage with the marketplace. Through innovative features and a focus on emerging blockchain technologies, the project seeks to revolutionize the way digital assets are traded, opening up new avenues for creators to monetize their work and for collectors to discover and acquire unique pieces. With a commitment to excellence and a vision for the future of digital asset trading, the Full Stack NFT Marketplace project represents a significant step forward in the evolution of blockchain-based marketplaces.

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Chapter 1

1.1 Introduction

Non-fungible tokens (NFTs), a product of blockchain technology, have totally changed the way that ownership was predicted in the digital realm. NFTs are clear digital assets that substitute for the ownership of a specific device or work of material, along with music, art, collectibles, and more. As they are kept on a blockchain, their ownership history, scarcity, and legitimacy are insured.

We are designing a "Full Stack NFT Marketplace" include in our Final Year Project (FYP) which will further utilize in blockchain technology to make it simple to create, purchase, and sell NFTs. With the help of this marketplace, artists will be able to mint their digital works as NFTs and market and sell their masterpieces to a worldwide audience of collectors and enthusiasts.Various kinds of technologies, including Next.js for the front end, Solidity for building smart settelments, Hardhat for Ethereum development, Node.js for backend development, and MetaMask for wallet integration, will be used in the building of the marketplace. With the use of these technologies, we will be able to develop an NFT platform that is secured, inflatable, and simple to use for both manufacturer and purchaser. With the help

of this project, we desired to examine how NFTs might convert digital ownership and give a platform that facilitate workers to review their work in advanced and modern ways.

1.2 Goals and Objectives

1.2.1 Goals

1.2.1.1 Build a customer friendly platforms for selling and purchasing NFTs

1.2.1.2 Confirm the safe transactions by using blockchain technology

1.2.1.3 Issue a broad area of NFT group for the customers to explore

1.2.1.4 Apply a filter system and strong search for comfortable browsing

1.2.1.5 Build coordination with creators and experts to encourage the platform

1.2.1.6 Allow customers to design and organize the contributions of NFT

1.2.1.7 Must give the access to retailers for checking their NFTs performance

1.1.1.8 Provide a smooth incorporation with famous wallets of cryptocurrency

1.2.1.9 Apply a receptive draft for greatest customer experience over devices

1.2.1.10 Make sure the acceptance with official and regulatory demands linked with NFTs

1.2.2 Objectives

1.2.2.1 Build a front end interface for buying and browsing NFTs

1.2.2.2 Apply unique agreements on the blockchain to control the transactions of NFTs

1.2.2.3 Develop a customer verification system for accurate registration and login

1.2.2.4 Integrate payment channels for cryptocurrencies to purchase NFTs

1.2.2.5 Develop a back end system to control customer account and transactions

1.2.2.6 Apply the filter and search utility for NFTs postings

1.2.2.7 Provide a dashboard where consumers may oversee their transactions and NFT collections.

1.2.2.8 Conduct extensive testing on the platform to guarantee security and functionality.

1.2.2.9 Improve the platform for better performance and scalability. Develop a marketing initiative to publicize the platform and engage the users

1.3 Scope of the Project

The goal of full-stack NFT marketplace project is to create a complete and user-friendly platform by incorporating a wide range of features and functionalities. In addition to NFT creation and minting through smart contract integration for smooth asset development, it also provides user administration and authentication, enabling safe registration and profile management. Users can browse, search, and filter NFTs using the marketplace feature, and detailed NFT pages offer in-depth details. Features for buying and selling include interaction with well-known crypto currency wallets, secure payment processing, set price listings, and auctions. Transparency and status reporting for transactions are guaranteed by transaction management. Securing and optimizing contracts for sales, auctions, and minting is the main goal of smart contract development. With mobile-friendly features and user on boarding training, responsive and intuitive UI/UX design improves the user experience. Interaction is encouraged by community tools including commenting, following creators, and forums. Prioritizing security and compliance means putting best practices into effect and conducting frequent audits. The database administration and scalability of the backend infrastructure are supported, along with APIs for blockchain interactions. Functionality and security are guaranteed by thorough testing and deployment, with CI/CD pipelines enabling continuous updates. Future improvements will include support for a variety of digital assets, multi-blockchain interoperability, and sophisticated features like fractional ownership and royalties. This wide range guarantees a strong and flexible NFT market.

Chapter 2

Literature Review

2.1 Introduction

Non-fungible tokens (NFTs) are a revolutionary development in the quickly developing field of blockchain technology. They allow for the digital depiction of distinctive assets and completely alter ideas about provenance and ownership. A examination of the literature indicates that NFTs are becoming more and more popular in a variety of industries, such as art, gaming, and collectibles. Talks about how these technologies may affect copyright, authenticity verification, and applications related to decentralized finance (DeFi) are particularly noteworthy. Developing a full-stack NFT marketplace requires a thorough understanding of critical technologies, which must come first. A dynamic and user-friendly interface is ensured by using frontend frameworks like Next.js and React.js, while the backend is powered by Node.js for scalability and reliable operation. Solidity makes it easier to create smart contracts, while resources like Hardhat offer a more efficient Ethereum development environment. While using libraries like OpenZeppelin guarantees the dependability and security of smart contracts, integration with cryptocurrency wallets like MetaMask improves user accessibility and security. This technological synthesis makes it possible to build a unified and effective platform for the smooth exchange of digital assets within the developing NFT ecosystem.

2.2 Background and Problem Elaboration

2.2.1 Background

The notion of non-fungible tokens (NFTs) has become a game-changing innovation in the digital asset industry with the explosive growth of blockchain technology. NFTs are distinct digital assets, such as virtual real estate, music, artwork, collectibles, or even pieces of material, that signify ownership or provide evidence of their validity. Because blockchain technology is decentralized and guarantees immutability, transparency, and security, NFTs are a great option for both creators and collectors. A reliable and user-friendly platform that makes it easier to create, purchase, sell and trade these digital assets is desperately needed as NFTs' popularity grows.

2.2.2 Problem Elaboration

NFTs have a lot of promise, but the industry is now fragmented and doesn't have a comprehensive solution that meets the various interests of investors, collectors, and producers. Current NFT marketplaces frequently have problems with high transaction costs, restricted scalability, unintuitive user interfaces, and challenges with intellectual property rights and copyright infringement. Furthermore, the lack of a single platform hinders NFTs' discoverability and accessibility, making it difficult for producers to exhibit their work and for consumers to find distinctive and worthwhile digital goods. Furthermore, the ecosystem's credibility is weakened by the frequency of fake NFTs and fraudulent activity, which puts producers and consumers at serious danger. The building of a full-stack NFT marketplace that makes use of blockchain technology to offer a safe, open, and effective platform for the creation, exchange, and ownership of digital assets is necessary to address these issues. This marketplace aims to revolutionize the creation, purchase, and sale of digital assets by providing features like low transaction fees, strong copyright protection mechanisms, seamless integration with well-known blockchain networks, and user-friendly interfaces. This will enable users to take part in the rapidly growing NFT economy and open up new opportunities for creators.

2.3 Detailed Literature Review

Non-fungible tokens (NFTs) are a novel way to represent ownership and validity of digital assets, and their introduction into the blockchain ecosystem has generated a lot of interest from a variety of businesses. NFTs, which are based on blockchain technology, offer a decentralized, unchangeable record that guarantees transaction security and transparency. Due to this technology, a variety of markets for the purchase, sale, and exchange of digital assets— such as artwork, collectibles, and virtual real estate—have been developed. On the other hand, extant NFT marketplaces have obstacles like exorbitant transaction costs, problems with scalability, and worries about copyright violations. In order to promote broad adoption and guarantee the NFT ecosystem's viability, these issues must be resolved. Key factors to take into account are scalability and interoperability. Layer 2 scaling and compatible standards, for example, allow for smooth transactions between various blockchain networks. Future prospects for NFTs include chances for innovation in fields including supply chain management, digital identity, and decentralized finance (DeFi). This literature review offers important insights for the creation of a full-stack NFT marketplace that meets the changing needs of creators,

collectors, and investors in the digital asset space by combining the body of knowledge on NFTs, blockchain technology, copyright, scalability, and future prospects.

2.4 Literature Review Summary Table

No.	Title	Author	Year	Source	Summary	Reference
.	NFT MARKET PLACE	Chirag Chaudhari, Kunal Girme	023	IRJ METS	The paper explains how NFT marketplaces use blockchain to ensure the authenticity and ownership of digital assets, offering secure transactions and monetization opportunities for creators, while also noting challenges like fraud and scalability.	https://www.irjmets.com/uploadedfiles/paper/issue_10_october_2023/45692/final/fin_irjmets1698589914.pdf
	NFT Marketplace Design and Market Intelligence	Pavel Kireyev	022	Papers SSRN	This paper likely examines the strategic design and market analysis essential for NFT marketplace success. It probably delves into user-friendly interfaces, blockchain integration, and market trends, offering valuable insights for developers and analysts.	https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4002303
	Non-fungible Token(NFT) Markets on the Ethereum Blockchain	Lennart Ante	021	Tandfonline	This study looks at the NFT market from 2017 to 2021, focusing on 14 major submarkets on Ethereum. It finds that while transaction numbers have dropped, traded value has risen. The research shows interconnectedness among submarkets, indicating ongoing evolution and potential inefficiencies in NFT markets.	https://www.tandfonline.com/doi/abs/10.1080/10438599.2022.2119564
	NFT Marketplace	Piyush Batra	023	Arvix	This project creates a dApp for secure NFT management, combining blockchain and deep learning for features like wallet connections, NFT generation, and marketplace, showcasing their potential in digital asset management.	https://arxiv.org/abs/2304.10632

2.5 Research Gap

Examine how NFT marketplaces might benefit from the application of user experience design concepts to increase accessibility, usability, and user engagement. Examine ways to improve NFT transaction security and foster user confidence while taking fraud prevention, data privacy, and safe smart contract development into account. Investigate ways to make NFT marketplaces more performant and scalable, particularly when managing heavy network congestion and a high volume of transactions. Examine the difficulties in achieving interoperability that NFT marketplaces encounter, and suggest guidelines or conventions that can facilitate smooth communication across various marketplaces and blockchain networks. Examine the legal and regulatory environment surrounding NFTs, taking into account issues with intellectual property rights, tax consequences, and adherence to the law. Examine tactics to support a thriving environment and community surrounding NFT marketplaces, such as rewards for developers, collectors, and artists.

2.6 Problem Statement

2.6.1 Security Breaches:

- Unapproved access to customer accounts results of stealing the NFTs or particular information

- Smart agreements susceptibility results of manipulation of loopholes.

2.6.2 Scalability Issues:
- The incapacity to manage a substantial amount of transactions during peak hours, leading to sluggish system performance or failures.
- Difficulty in expanding the platform's user base and meeting the rising demand for NFTs.

2.6.3 User Experience Challenges:
- Complex transactions and confusing customer interface results of discouragement and perplexing among users
- Unavailability of mobile upgradation, makes the customer unsuitable to approach the platforms on tablets and smart phones

2.6.4 Legal and Regulatory Compliance:

- Unreliability and uncertainty with regard to NFTs legal status and the essential management for controlling an NFT marketplace
- Valid legal argument from ownership disputes, copyright infringement, and non compliance with financial rules

2.6.5 Market Manipulation and Fraud:

- Scheme to tackle NFT prices with the help of artificially inflating demand and fake bids
- Faked or copied NFTs being vending on the marketplace, cheat the customer and weaken the trust in platforms

2.6.6 Payment and Transaction Problems:

- Delaying and failures in payments leads to ineffective transactions and funds loss
- Insufficient support for various payment process or currencies, difficulty for users to approach in different regions.

Chapter 3

Requirements and Design

3.1 Requirements

For an NFT marketplace, requirement engineering is a thorough process of determining, recording, verifying, and overseeing the requirements that specify the capabilities, limitations, and performance of the system. The first step in this process is to interact with stakeholders—such as artists, collectors, investors, and platform operators—to learn about their requirements and expectations. A wide range of elements, including the development of NFTs, token standards, smart contract functionality, marketplace user interfaces, search and discovery systems, payment gateways, and security measures, may be included in these requirements. Scalability, compatibility with other blockchains, regulatory compliance, and data protection concerns must also be taken into account. Flexibility and adaptability are critical in the continuously evolving NFT arena, necessitating a detailed examination of market trends and user input. To provide as the basis for the development process, needs must be obtained, prioritized, verified, and clearly and concisely documented. An NFT marketplace's requirement engineering is an iterative process that makes sure the finished solution satisfies stakeholders' expectations and fits into the dynamic NFT ecosystem.

Functional Requirements

3.1.1.1 User

ID	Requirements
3.1.1.1.1	User shall be able to Sign Up.
3.1.1.1.2	User shall be able to login to their account.
3.1.1.1.3	User shall be able to view his profile.
3.1.1.1.4	Securely connect their cryptocurrency wallet (e.g.,MetaMask) to the platform.
3.1.1.1.5	Browse NFTs by category, keyword, or popularity.
3.1.1.1.6	Search for specific NFTs based on their properties or creator.
3.1.1.1.7	Like, comment on, and add NFTs to their favorites list.
3.1.1.1.8	Place bids on NFTs in auctions.
3.1.1.1.9	Purchase NFTs using their connected cryptocurrency wallet.
3.1.1.1.10	Follow other users and creators to see their activity and NFT collections.
3.1.1.1.11	Contact platform support with questions or concerns.
3.1.1.1.12	Receive notifications about bids, purchases, and other relevant activities.

3.1.1.2 Admin

ID	Requirements
3.1.1.2.1	Admin shall be able to login into the system.
3.1.1.2.2	Admin shall be able to manage user profiles.
3.1.1.2.3	Admin shall be able to monitor and manage NFT sales and auctions.
3.1.1.2.4	Admin shall be able to track ownership history of NFT.
3.1.1.2.5	Admin shall be able to configure platform settings like fees and security parameters.
3.1.1.2.6	Admin shall be able to manage content and categories on the marketplace.
3.1.1.2.7	Admin shall be able to analyze market trends and user behavior.
3.1.1.2.8	Admin shall be able to implement and maintain robust security measures to protect user data and assets.

3.1.2 Non-Functional Requirement

3.1.2.1 Performance:

- **Response Time:** The system must check the actions of user (e.g., loading a page, searching for NFTs, placing a bid) within 2 seconds.

- **Transaction Throughput:** The marketplace should control at least 100 transactions per second during peak times.

- **Scalability:** The system should scale to maintain up to 1 million users simultaneously

3.1.2.2 Security:

- **Data Encryption:** All sensitive data (e.g., user credentials, transaction details) must be cracked in transit (using SSL/TLS) and at rest.

- **Authentication:** Apply multi- factor attestation (MFA) for user login to increase the security.

- **Authorization:** Ensure role-based access control (RBAC) to stop the access of various parts of the system based on roles of user (e.g., admin, user, seller).

- **Smart Contract Security:** Confirm that all the short contracts are audited for exposure and attend best practices to avoid attacks such as reentrancy, underflow, and unapproved access.

3.1.3   Hardware and Software Requirements

3.1.3.1 Hardware:

- **Server:** A cloud-based virtual server instance from providers like AWS or Azure. This offers scalability (adjust resources as needed) and avoids upfront hardware costs.
- **Secure Storage:** Utilize a cloud storage solution like Amazon S3 or Google Cloud Storage. This ensures redundancy and easy access to NFT metadata and potentially media files.
- **Reliable Internet Connection:** Invest in a high-bandwidth and stable internet connection to handle user traffic and ensure smooth platform operation.

3.1.3.2 Software:

- **Front-End Development Framework:** Choose a popular framework like React or Vue.js. They offer pre-built components, faster development, and easier maintenance compared to building everything from scratch.
- **Back-End Development Framework:** Select a framework like Django (Python) or Spring (Java) based on your team's expertise. Frameworks provide structure and tools for efficient development and API creation.
- **Blockchain SDK Integration:** Integrate the Software Development Kit (SDK) provided by your chosen blockchain platform (e.g., Ethereum, Solana). This allows your application to interact with the blockchain for NFT minting, transfers, and ownership verification.
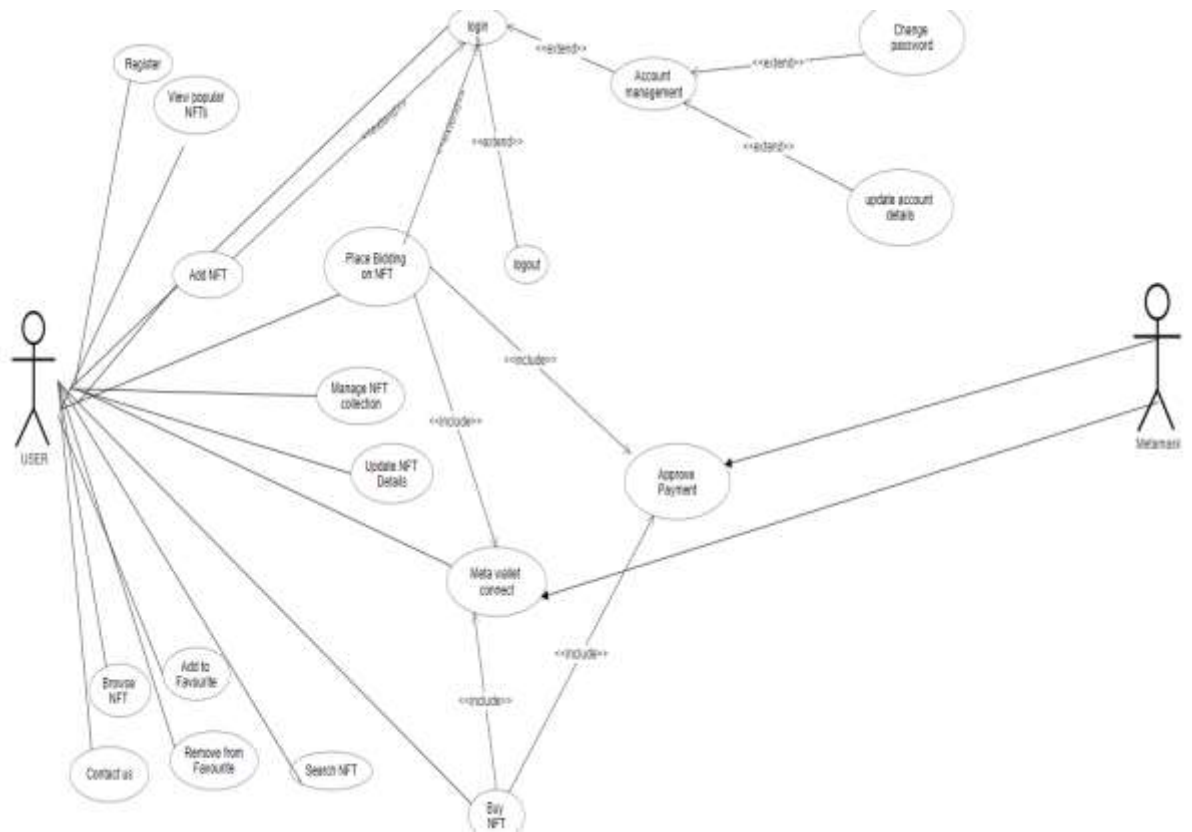
3.2   Proposed Methodology

A suggested methodology of full-stack NFT marketplace project can include a few crucial components. Firstly, in order to comprehend the market and pinpoint unique selling propositions, you would start with in-depth competitor and market research. This would entail researching user preferences, identifying new NFT trends, and looking for best practices in the successful NFT marketplaces. The next step would be to draft a thorough project plan that would outline each development phase, including frontend development for user interface design and optimization, backend development for managing user accounts, transactions, and data storage, and smart contract development to enable NFT creation, buying, and selling. The development process would also include the integration of the required APIs for NFT minting, blockchain interface, and payment processing. The platform would be continuously tested to make sure it is error-free and satisfies user expectations using both manual QA procedures and automated testing frameworks. User feedback loops obtained via early access releases or beta testing would offer insightful information for improving usability and feature refinement. Ultimately, scalability and reliability would be ensured by a strong deployment strategy that leverages cloud infrastructure and containerization technologies. To keep the marketplace safe and operational after launch, regular updates, security patches, and support would be provided by an ongoing maintenance plan.

3.3 System Architecture

3.4 Use case

3.5 Fully Dressed use cases

3.5.1   UC ID: UC001

UC Name:	Registration of User
Primary Actor:	New User
Stakeholders and Interests:	Users (who wants to connect with marketplace), Admin (involved in controlling new registrations)
Pre-condition:	User has approach to the registration page.
Post condition:	Successfully created User account.
Success Guarantee:	A confirmation mail must send to User for login account.
Main Flow:	i. User cover the registration Page ii. User enter all the required information or data iii. User consent the registration form iv. System support the information v. If required, system make a new user account vi. User secure a verification mail
Alternative Flow:	The system shows an error message, if the given email is already registered.

3.5.2   UC ID: UC002

UC Name:	User Login

Primary Actor:	Registered User
Stakeholders and Interests:	Users (want to access their account), Admin (Security concerns)
Pre-condition:	registered account of User.
Post-condition:	User is logged into the system.
Success Guarantee:	User is assigned to the dashboard leads to successful login
Main Flow:	i. User move to the login page. ii. User gives their email and password. iii. User presents the login form. iv. System supports the credentials. v. If correct, user is logged in and turns over to the dashboard.
Alternative Flow:	System shows an error message, if credentials are invalid.

3.5.3   UC ID: UC003

UC Name:	Generate NFT listing
Primary Actor:	Seller
Stakeholders and Interests:	Sellers, Buyers, Platform Administrators
Pre-condition:	Seller is validated and has digital resources for listing.
Post-condition:	Create NFT listing which is in view on the marketplace.
Success Guarantee:	NFT is successfully listed with correct metadata.
Main Flow:	i. Retailer logs into the platform.

	ii. Seller starts the process to make a new NFT listing. iii. Seller uploads digital resources and Seller uploads digital asset and fill up in metadata details. iv. Seller fixes prices and other listing guidelines. v. Seller finds out and submits the listing.
Alternative Flow:	None.

3.5.4   UC ID: UC004

UC Name	: Search NFTs
Primary Actor:	User
Stakeholders and Interests:	Users (need to search the particular NFT), Artists (Want their NFTs to be discoverable)
Pre-condition:	User is on the NFT marketplace page.
Post-condition	Specific search results are presented to User.
Success Guarantee	User observed the specific NFTs
Main Flow:	i. User enters a search query. ii. System filters NFTs based on the query. iii. System shows the filtered results to the User.
Alternative Flow:	None.

3.5.5   UC ID: UC005

UC Name:	Add to Favorites
Primary Actor:	User
Stakeholders and Interests:	Users (need a bookmark NFTs), Artists (Want their NFTs to be favorite)
Pre-condition:	User is logged in and looking an NFT.
Success Guarantee:	User gets a verification of successful addition.
Post-condition:	NFT is added to the favorite list of User.
Main Flow:	a. User clicks on the "Add to Favorites" button. b. System adds the NFT to the user's favorites list.
Alternative Flow:	a. If the NFT is already added in user's favorite list, the system shows a message specifying the same.

3.5.6   UC ID: UC006

UC Name	Remove from Favorites
Primary Actor:	User
Stakeholders and Interests	Users (need to hide the NFT from favorites), Artists (convert their NFT into un-favorite).
Pre-condition:	User is logged in and looking their favorites list.
Post-condition:	NFT is hiding from the favorite list of User.
Success Guarantee:	User receives a confirmation of successful removal.
Main Flow:	User taps on the "Remove from Favorites" button next to an NFT. System removes the NFT from the user's favorites list.

Alternative Flow:	a. If the NFT is not in the user's favorites, the system displays a message indicating the same.

3.5.7 UC ID: UC007

UC Name:	Purchase NFT
Primary Actor:	Buyer
Stakeholders and Interests:	Buyers, Sellers, Platform Administrators, Payment Processor.
Pre-condition:	Buyer is validated and has enough balance.
Post-condition:	Buyer keeps the purchased NFT.
Success Guarantee:	Buyer successfully completes the purchase transaction.
Main Flow:	i. Buyer searching the marketplace and select NFT for purchase. ii. Buyer analyzes the listing details and settled the purchase. iii. Buyer chooses the payment method and finished the transactions. iv. The ownership of NFT is shifted to the buyer.
Alternative Flow:	Failure in payment, NFT already sold out.

3.5.8 UC ID: UC008

UC Name:	Browse NFT Listings
Primary Actor:	User (Buyer/Seller)

Stakeholders and Interests:	Buyers, Sellers, Platform Administrators
Pre-condition:	User is validated and on the marketplace homepage.
Post-condition:	User has looked all the available NFT listings.
Success Guarantee	User successfully cut across through listings.
Main Flow:	i. User accesses the NFT marketplace. ii. User exploring through present NFT listing. iii. User look details of specific selected listings.
Alternative Flow:	None

3.5.9   UC ID: UC009

UC Name:	Manage NFT Collection
Primary Actor:	User (Buyer/Seller)
Stakeholders and Interests:	Buyers, Sellers
Pre-condition:	User is validated and has uploaded NFTs.
Post-condition:	User well ordered and control their NFT collection.
Success Guarantee:	User successfully fulfills activity on their NFTs.
Main Flow:	i. User accesses their profile/dashboard. ii. User covers the collection section of NFT. iii. User arranges, improve metadata, or remove the NFT as desired.

Alternative Flow:	None.

3.5.10 UC ID: UC010

UC Name:	Update NFT Details
Primary Actor:	Artist
Stakeholders and Interests:	Artists (need to improve their NFT information), Buyers (Want correct information)
Pre-condition:	Artist is logged in and owns the NFT.
Post-condition:	NFT details are modernized
Success Guarantee:	Updated details are displayed to users
Main Flow:	i. Artist covers the improved NFT page. ii. Artist selects the NFT to update. iii. Artist improves the details (name, description, and price). iv. Artist submits the update form. v. System upgrades the NFT details.
Alternative Flow:	i. The system rejects the updates, if the artists no longer maintain the NFT.

3.5.11 UC ID: UC011

UC Name:	Contact Us
Primary Actor:	User
Stakeholders and Interests	Users (Want to contact the supporter), Admin (Want to direct the support requests)
Pre-condition:	User is on the "Contact Us" page.
Post-condition	User's message is submitted to the support team.

Success Guarantee:	User get a verification email with a support ticket number.
Main Flow:	i. User navigates to the "Contact Us" page. ii. User fills in the contact form with their name, email, and message. iii. User submits the contact form. iv. System validates the form data. v. If valid, system sends a confirmation email to the user and assigns a support ticket.
Alternative Flow:	If the form data is invalid, the system displays an error message and prompts the user to correct it.

3.5.12 UC ID: UC012

UC Name:	Meta Wallet Connect
Primary Actor:	User
Stakeholders and Interests:	Users (Need to join their Meta Wallet), Admin (Want to control wallet connections)
Pre-condition	User is logged in and wants to link their Meta Wallet.
Post-condition:	User's Meta Wallet is successfully linked.
Success Guarantee:	User can access Meta Wallet features on the marketplace.
Main Flow:	i. User negotiates to the Meta Wallet connection page. ii. User taps on the "Connect Meta Wallet" button. iii. System produces the user access to select their Meta Wallet provider.

	iv. User selects their Meta Wallet provider and accepts the connection.
	v. System linked with Meta Wallet of User to their marketplace account.
Alternative Flow:	i. The system must show a message of cancellation, if the user cancels the link task.

3.5.13 UC ID: UC013

Use Case Name:	Viewing Popular NFTs
Primary Actor:	User/Collector
Stakeholders and Interests:	User/Collector: Interested in viewing and discovering famous NFTs. NFT Creators: Great concern in their NFTs being featured as famous, attaining more clearness and developing sales.
Pre-condition:	The user is logged into the NFT marketplace.
Post-condition:	The user has checked famous NFTs and may select to connect with or buy them.
Success Guarantee:	The user can access a list of famous NFTs and check their details and media.
Main Flow	i. User negotiates to the "Popular NFTs" section of the marketplace. ii. System recovers a list of famous NFTs based on criteria such as views, likes, or sales volume. iii. System shows the list of famous NFTs to the user. iv. User selects a specific NFT to view its details. v. System shows the details of specific NFT, such as title, description, media, creator, and present price.

	vi. User can linked with the NFT, such as view it, liking it, add it into favorite list, or buying it.
Alternative Flow	If there is no famous NFT available at that moment, the system tell the user and suggest searching other NFTs group.

3.5.14 UC ID: UC014

Use Case Name:	Placing a Bid on an NFT
Primary Actor:	Collector/Buyer
Stakeholders and Interests:	Collector/Buyer: Concerned in buying NFT through bidding. NFT Creator/Artist: Interested in accepting bids and selling their NFTs. Marketplace Platform: Interested in fostering the bidding process.
Pre-condition	The purchaser must register on the platform and logged in.
Post-condition:	The bid is successfully set on the NFT, and the purchaser receives a verification of bid.
Success Guarantee:	The bid is successfully put on the NFT, and the buyer can track the level of their bid.
Main Flow	i. Purchaser navigates to the specific NFT listing and selects the option to place a bid. ii. System moves the buyer to enter their bid amount. iii. Collector/Purchaser enters the bid amount and decides the bid. iv. System records the bid and updates the bid status for the NFT listing. NFT artist/creator is informed for the new bid.
Alternative Flow	If the amount of bid is less than that of present highest bid, the system informed the collector/purchaser that their bid

	was not successful and produces them to place a greater bid if needed.

3.5.15 UC ID: UC015

Use Case Name:	Buying an NFT with MetaMask
Primary Actor:	Buyer/Collector
Stakeholders and Interests:	Buyer/Collector: By using MetaMask, interesting in buying NFTs safely. Seller: Interested in selling their NFTs to buyers. Marketplace Platform: Interested in fostering safe transactions between purchaser and sellers.
Pre-condition:	Buyer/Collector has a MetaMask wallet set up and linked to the marketplace. The preferred NFT is listed for sale on the marketplace.
Post-condition:	The MetaMask wallet of buyer is removed with the purchase amount, and NFT is shifted to the buyer's wallet.
Success Guarantee:	By using MetaMask, the buyer successfully buys the NFT, and the NFT is shifted to their wallet.
Main Flow	i. Collector/Buyer chooses the preferred NFT for purchase. ii. System shows the buy details, including seller information and price. iii. Collector/Buyer chooses the option to purchase and confirms the purchase. iv. System makes the buyer to link their MetaMask wallet if no already linked. v. Collector/Buyer linked their MetaMask wallet and confirms the transaction. vi. System checks the amount of purchase from the buyer's MetaMask wallet and shifted the NFT to the buyer's wallet.

	System improves the record of owner for the NFT.
Alternative Flow	If the MetaMask wallet of purchaser is not sufficient, the system mentions the buyer to refill their wallet before go on to the purchase.

Chapter 4

Implementation and Test Cases

4.1 Test Cases and Descriptions

4.1.1 Test Cases

Test Case	TC-1
Form:	Registration Form
Stakeholder:	User
Field:	All fields
Technique:	Boundary Testing, Equivalence Partitioning
Valid:	- Username: "testuser" (alphanumeric, 5-20 characters) - Email: "test@example.com" (valid email format) - Password: "Password123!" (8-20 characters, includes uppercase, lowercase, digit, special character) - Confirm Password: "Password123!" (matches Password) - Wallet Address: "0x1234567890abcdef1234567890abcdef12345678" (valid Ethereum address format)
Invalid	- Does not contain '@' (userexample.com).Include characters - Includes characters (user@exampl*e.com).Not End with '.' - Includes special characters (user@ex!ample.com). - Does not end with '.' (user@examplecom).

Test Case ID:	TC-2
Form:	Login Form
Stakeholder:	User
Field:	All fields
Technique:	Boundary Testing, Equivalence Partitioning
Valid:	• Email: "test@example.com" (valid email format) • Password: "Password123!" (correct password)
Invalid	• No uppercase and lowercase characters • No special character No numeric character

Test Case ID:	TC-3
Form:	Search Form
Stakeholder:	User
Field:	Search Query
Technique:	Boundary Testing, Equivalence Partitioning
Valid:	• Query: "cool" (1-100 characters, matches existing NFTs)

Test Case ID:	TC-4
Form:	Favorites Action
Stakeholder:	User
Field:	User ID, NFT ID
Technique:	Boundary Testing, Equivalence Partitioning
Valid:	• User ID: 1 (valid existing user ID) • NFT ID: 1 (valid existing NFT ID)

Test Case ID:	TC-5
Form:	Favorites Action
Stakeholder:	User
Field:	User ID, NFT ID
Technique:	Boundary Testing, Equivalence Partitioning
Valid:	• User ID: 1 (valid existing user ID) • NFT ID: 1 (valid existing NFT ID)

Test Case ID:	TC-6
Form:	Purchase Form
Stakeholder:	User
Field:	User ID, NFT ID
Technique:	Boundary Testing, Equivalence Partitioning
Valid:	• User ID: 1 (valid existing user ID)

	- NFT ID: 1 (valid existing NFT ID) - Payment Method: "MetaMask" (valid payment method) - Amount: 1.5 (valid amount, within user's balance)

Chapter 5

Conclusion and Future Directions

5.1 Conclusion

The suggested process and essential elements for creating a full-stack NFT marketplace were described in this document. The process places a strong emphasis on identifying your target market and specialty, creating a user-friendly interface, creating safe smart contracts, and giving scalability and continuous maintenance top priority. The classes User, NFTListing, Favourite, Bid, and Purchase, as well as their interactions, were used in the class diagram to illustrate the essential functions. This project establishes a strong framework for developing a strong and user-focused NFT marketplace. Prospective Courses Innovation is welcome in your project, as the NFT economy is a dynamic environment. Here are some fascinating potential future paths to think about: Combining Emerging Technologies with Integration: Investigate integrating with cutting-edge technology to increase transaction speed and cost effectiveness, such as sidechains or Layer 2 scaling solutions. Advanced Lookup and Suggestion.

5.2 Features for Advanced Search and Recommendations:

Apply machine learning to advanced search features for effective NFT discovery based on user preferences and criteria. Create a recommender system that gives users recommendations for pertinent NFTs.

- Emphasis on Sustainability: To reduce the environmental impact of NFT transactions, consider including sustainable consensus methods into your marketplace, such as proof-of-stake. Integration with the Metaverse: As the metaverse develops, take into account features that let people display their NFTs in these virtual environments, making for a more engaging experience.

- Changing Regulatory Environment: Keep up with the changing legal and regulatory environment that surrounds NFTs. To comply with upcoming regulations, this can entail adding features or disclaimers.