**Full Stack NFT Marketplace**

|  |
| --- |
| **Riphah** |

**By:**

**Usman Ayub**

**27952**

**Muhammad Afzaal Hameed**

**23733**

**Mussab Saeed**

**27660**

**Supervised by:**

**Mr. Tajamul Shahzad**

**Faculty of Computing**

**Riphah International University, Islamabad**

**Spring 2024**

**A Dissertation Submitted To**

**Faculty of Computing,**

**Riphah International University, Islamabad**

**As a Partial Fulfillment of the Requirement for the Award of the Degree of**

**Bachelors of Science in Computer Science**

**Faculty of Computing**

**Riphah International University, Islamabad**

Date: [date of final presentation]

**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).

**Committee:**

|  |  |
| --- | --- |
| **1** | Mr. Tajamul Shahzad  (Supervisor) |
|  |  |
| **2** | Dr. Muhammad Musharraf  (Head of Department) |

**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.

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Uaman Ayub**

**27952**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Muhammad Afzaal Hameed**

**23733**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Mussab Saeed**

**27660**

**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.

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Uaman Ayub**

**27952**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Muhammad Afzaal Hameed**

**23733**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Mussab Saeed**

**27660**

**Table of Contents**

|  |  |
| --- | --- |
| List of Figures | 1 |
| List of Tables | 2 |
| [Chapter 1: Introduction](#_Introduction) | 3 |
| * 1. [Opportunity & Stakeholders](#_1.1_Opportunity_&) | 4 |
| * 1. [Motivations and Challenges](#_1.2_Motivations_and) | 5 |
| * 1. [Goals and Objectives](#_1.3__) | 6 |
| * 1. [Solution Overview](#_1.4__Solution) |  |
| * 1. [Report Outline](#_1.5_Report_Outline) |  |
| Chapter 2: Literature / Market Survey |  |
| [2.1 Introduction](#_2.1_Introduction) |  |
| 2.2 [Literature Review/Technologies Overview](#_2.1_Literature_Review/Technologies) |  |
| 2.3 [Summary](#_2.3_Summary) |  |
| Chapter 3: Requirement Engineering |  |
| 3.1 [Introduction](#_3.1_Introduction) |  |
| 3.2 [Problem Scenarios](#_3.2_Problem_Scenarios) |  |
| 3.3 Functional Requirements |  |
| 3.4 Non-Functional Requirements  3.5 SQA activities: Defect Detection  3.5.1 Test Case Design |  |
| Chapter 4: System Design |  |
| 4.1 Introduction |  |
| 4.2 Architectural Design |  |
| 4.3 Detailed Design  4.4 SQA activities: Defect Detection  4.4.1 Test Case Design |  |
| Chapter 5: Implementation |  |
| 5.1 Endeavour (Team + Work + Way of Working) |  |
| 5.2 Flow Control/Pseudo codes |  |
| 5.3 Components, Libraries, Web Services and stubs  5.4 IDE, Tools and Technologies |  |
| 5.5 Best Practices / Coding Standards  5.5.1 Software Engineering Practices  5.5.2 Development Practices & Standards |  |
| 5.6 Deployment Environment  5.7 SQA activities: Defect Detection  5.7.1 Test Case Design (White box) |  |
| 5.8 Summary |  |
| Chapter 7: Conclusion and Outlook |  |
| 7.1 Introduction |  |
| 7.2 Achievements and Improvements |  |
| 7.3 Critical Review |  |
| 7.4 Future Recommendations/Outlook |  |
| 7.5 Summary |  |
| References |  |
| Appendices |  |
| Appendix-A: Software Requirements Specifications (SRS) |  |
| Appendix-B: Design Documents |  |
| Appendix-C: Coding Standards/Conventions |  |
| Appendix-D: Test Scenarios |  |
| Appendix-E: Work Breakdown Structure |  |
| Appendix-F: Roles & Responsibility Matrix |  |

**List of Figures**

|  |  |
| --- | --- |
| 1.1 Caption of first figure of first chapter | 6 |
| 1.2 Caption of second figure of first chapter | 7 |
| 2.1 Caption of first figure of second chapter | 14 |
| 2.2 Caption of second figure of second chapter | 22 |
| 2.3 Caption of third figure of second chapter | 26 |
| 5.1 Caption of first figure of fifth chapter | 49 |
| 5.2 Caption of second figure of fifth chapter | 49 |

**List of Tables**

|  |  |
| --- | --- |
| 1.1 label of first table of first chapter | 6 |
| 1.2 label of second table of first chapter | 7 |
| 2.1 label of first table of second chapter | 14 |
| 2.2 label of second table of second chapter | 22 |
| 2.3 label of third table of second chapter | 26 |
| 5.1 label of first table of fifth chapter | 49 |
| 5.2 label of second table of fifth chapter | 49 |

**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.

**Chapter 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.

# 1.1 Opportunity & Stakeholders

# 1.1.1 Opportunity

* **Emerging Market:** It is a greater chance for new marketplaces to enter and take market share as the NFT market is boosting rapidly.
* **Income Generation for Creators:** By presenting their works as distinct digital assets, NFTs provide creators a unique method to review their all the digital creations like videos, art, and music.
* **Worldwide Reach:** Together with the global audience of experts and collectors, NFT marketplaces allow them to extend the base of prospective purchaser.
* **Secondary Sales Revenue:** After the initial sale, creators can keep up to generate money by receiving royalties from subsequent sales of their NFTs.
* **Digital Collectibles:** NFTs can be used to produce and exchange digital collectibles, creating new avenues for the entertainment and gaming sectors.
* **Provenance and Authenticity:** By guaranteeing the provenance and authenticity of NFTs, blockchain technology allays ownership and copyright worries.
* **Community Building:** By encouraging a sense of cooperation and belonging among artists and collectors, NFT marketplaces can help to develop a sense of community.
* **Cross-Platform Integration:** By integrating NFTs into different apps and platforms, user engagement and value proposition are improved.
* **Brand Engagement:** By producing limited-edition digital goods, brands can use NFTs to interact with their audience in fresh and creative ways.
* **Educational Opportunities:** To analyze various new models of distribution and digital ownership, NFT give educational academies with abundant of opportunities.

# 1.1.2 Stakeholders:

* **Artists/Creators:** They mostly use your platform to promote and exchange their NFTs
* **Collectors/Buyers:** These are the operators who buy NFTs from your marketplace
* **Investors:** These are the persons who supply commercial backing for the project’s growth and development.
* **Developers:** The team of developers are responsible for constructing and supporting the platform
* **Blockchain Network:** The Solana and Ethereum are some basic blockchain technology that works on your marketplace.
* **Security Auditors:** They work on the security of platforms such as identification and addressing potential vulnerabilities
* **Regulators:** The rules and regulations of government must be apply, depends on the place and characteristics of marketplace

# 1.2 Motivations and Challenges

# 1.2.1 Motivations

* **Innovation:** Designing the full stack marketplace of NFT enables you to provide the improvement and transformation of ecosystem of NFT.
* **Opportunity:** NFT offering a special chance to build a prosperous marketplace therefore it gained a outstanding reputation
* **Monetization:** A famous outstanding NFT marketplace can produce revenues with the help of partnerships, premium services, and transaction fees.
* **Community Building:** Different platforms are provided for creators, collectors and artists to link, coordinate, and create a community around collectibles and digital art.
* **Learning Experience:** Operating a cutting edge technologies and vast experience in Web development, and blockchain are required to developed a full stack NFT marketplace

# 1.2.2 Challenges

* **Competition:** The marketplace of NFT is ruthless, which need a high competitive marketing scheme and distinctive aspects
* **Regulatory Uncertainty:** Digital assets and crypto currency are demanding in market which needs an expert person to work. It navigate the regulate view around NFTs
* **Scalability:** For long term success, marketplace must handle a huge number of transactions and customers
* **Security:** For the protection of platforms, digital assets, customer data, from hackers, a strong security measures must be implemented
* **User Adoption:** It is challenging to educate a new customers about advantage of marketplace and digital ownership

# 1.3 Goals and Objectives

# 1.3.1 Goals

* Build a customer friendly platforms for selling and purchasing NFTs
* Confirm the safe transactions by using blockchain technology
* Issue a broad area of NFT group for the customers to explore
* Apply a filter system and strong search for comfortable browsing
* Build coordination with creators and experts to encourage the platform
* Allow customers to design and organize the contributions of NFT
* Must give the access to retailers for checking their NFTs performance
* Provide a smooth incorporation with famous wallets of cryptocurrency
* Apply a receptive draft for greatest customer experience over devices
* Make sure the acceptance with official and regulatory demands linked with NFTs

# 1.3.2 Objectives

* Build a front end interface for buying and browsing NFTs
* Apply unique agreements on the blockchain to control the transactions of NFTs
* Develop a customer verification system for accurate registration and login
* Integrate payment channels for cryptocurrencies to purchase NFTs
* Develop a back end system to control customer account and transactions
* Apply the filter and search utility for NFTs postings
* Provide a dashboard where consumers may oversee their transactions and NFT collections.
* Conduct extensive testing on the platform to guarantee security and functionality.
* Improve the platform for better performance and scalability
* Develop a marketing initiative to publicize the platform and engage the users

# 1.4 Solution Overview

"**The full stack NFT marketplace** project aims to create a decentralized platform for trading non-fungible tokens (NFTs), providing users with a secure and efficient way to buy, sell, and trade digital assets. The project will be built using **Next.js** for the frontend, providing a modern and responsive user interface. The backend will be developed using **Node.js**, which will handle the business logic, database operations, and communication with the **Ethereum** blockchain. **Solidity** will be used for smart contract development on the Ethereum blockchain, ensuring the security and integrity of transactions. **MetaMask** will be integrated for user wallet management and transaction processing, enabling users to securely interact with the marketplace. The project will also implement features such as user authentication, NFT listing and browsing, bidding and auction functionality, as well as transaction history tracking. Overall, the full stack NFT marketplace aims to provide a seamless and intuitive platform for NFT enthusiasts to engage in the growing digital collectibles market."

**1.5 Report Outline**

**1.5.1 Introduction**

* + - Outline of NFTs and their role in automated world
    - Significance of NFT marketplaces
    - Basis and objectives of project
    1. **Technologies Used**
  + Hardhat for Ethereum development environment
  + React.js for the front end
  + MetaMask for wallet integration
  + Ethereum blockchain for NFTs
  + Node.js for the back end
  + Solidity for smart contract development
  + OpenZeppelin for smart contract libraries

1. **Marketplace Architecture**
   * Review of the architecture system
   * React.js used for Front end structure
   * Node.js used for Back end structure
   * Ethereum used for block chain incorporation
     1. **Front-End Development**
   * Plan basis and detail features
   * Accomplishment of characteristics like searching, browsing, and buying NFTs.
   * Combination with MetaMask for interaction of wallet.
     1. **Back-End Development**
   * API representation and application
   * Combination with block chain
   * Administrator user attestation and authority.
     1. **Smart Contract Development**
   * Summary of smart agreement functionality
   * Development of smart contract using Solidity
   * Incorporation of agreement with front and back end
     1. **Security**
   * Precautionary measures to stable customer data and transactions
   * Stop fraud and secure the intellectual property of rights
     1. **Testing**
   * Different tools to examine front end, back end, and smart agreements
   * Testing procedure applied
     1. **Deployment**
   * Formation activity for front end, back end, and smart agreements
   * Reflection for adaptivity and improvement of performance
     1. **Challenges and Solutions**
   * Troubles faced during formation and development
   * Results applied to defeat the challenges
     1. **Future Enhancements**
   * Collaboration with other blockchain tools
   * Ability for advancement of the marketplace
     1. **Conclusion**
   * Overview of the plan and its procurement
   * Knowledge and understanding gained from the formation of NFT marketplace
     1. **References**
   * List of various tools, resources and libraries used in the project

**Chapter 2**

**Literature / Market Survey**

**2.1 Introduction**

The advent of blockchain technology has sparked the development of Non-Fungible Tokens (NFTs) in recent years, revolutionizing the field of digital asset ownership and management. NFT markets are online venues that make it easier to trade and exchange these exclusive digital goods. A survey of the literature and an overview of the technology in this field include an investigation of blockchain protocols like Ethereum, which support the development and transactions of NFTs, as well as smart contract frameworks like Solidity for business logic implementation. Furthermore, web development frameworks like Vue.js or React.js, when combined with Node.js for backend functionality, are essential for building strong server-side infrastructure and user-friendly interfaces. Further improving the stability and functioning of these marketplaces within the dynamic NFT ecosystem are the incorporation of decentralized finance (DeFi) protocols for safe transactions and storage, as well as IPFS or other comparable decentralized storage solutions for content hosting.

**2.1 Literature Review/Technologies Overview**

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.

**2.3 Summary**

Your full-stack NFT marketplace project's literature research and market survey provide a dynamic and quickly changing scene, driven by the growing acceptance of NFTs across a range of industries. Regarded as a groundbreaking technology, NFTs provide digital asset owners with decentralized ownership and authenticity verification. The project has selected Next.js, Solidity, Hardhat, Node.js, MetaMask, OpenZeppelin, and React.js as key technologies. These were selected based on their compatibility and capacity to produce a smooth user experience. Competitor study demonstrates the significance of user-friendly interfaces and strong smart contract architecture by highlighting well-known platforms such as Foundation, Rarible, and OpenSea. Focus on specialty markets or distinctive value propositions to set your marketplace apart, and keep abreast of new trends and legal changes to encourage adoption and preserve your position as a leader in the NFT marketplace ecosystem.

**Chapter 3**

**Requirement Engineering**

**3.1 Introduction**

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.

**3.2 Problem Scenarios**

**3.2.1 Security Breaches**:

* + Unapproved access to customer accounts results of stealing the NFTs or particular information
  + Smart agreements susceptibility results of manipulation of loopholes.
    1. **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.

* + 1. **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
    1. **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
    1. **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
    1. **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
  1. **Functional Requirements**

**3.3.1 User**

|  |  |
| --- | --- |
| **ID** | **Requirements** |
| **1.1** |  |
| **1.2** |  |
| **1.3** |  |
| **1.4** |  |
| **1.5** |  |
| **1.6** |  |
| **1.7** |  |

* + 1. **Admin**

|  |  |
| --- | --- |
| **ID** | **Requirements** |
| **2.1** |  |
| **2.2** |  |
| **2.3** |  |
| **2.4** |  |
| **2.5** |  |
| **2.6** |  |
| **2.7** |  |