NFT MARKETPLACE

FINAL YEAR PROJECT

SESSION 2020-2024

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NFT MARKETPLACE WEBSITE

Change Record

Author(s)	Version	Date	Notes	Supervisor's Signature
Umer. Qasim, Saira	1.0	18-2-22	Project requirements and goals	
Qasim, Saira	2.0	09-03-22	Website layout and user interface	
Umer. Qasim, Saira	3.0	28-07-22	React as a front-end framework implementation	
Umer	4.0	20-10-22	Node.js as a back-end framework implementation	
Umer	5.0	16-12-22	Connect the front-end and back-end using an REST API	
Umer. Qasim, Saira	6.0	04-01-22	Test and debug the website	

APPROVAL

PROJECT SUPERVISOR

Comments: _____

_____

Name:_____

Date:_____ Signature:_____

PROJECT MANAGER

Comments: _____

_____

Date:_____ Signature:_____

HEAD OF THE DEPARTMENT

Comments: _____

_____

Date:_____ Signature:_____

Dedication

This work is dedicated to all the beloved teachers we have ever had, who have been a source of guidance through every phase of our lives. The ones that have made us what we are today.

Acknowledgments

First, we would like to thank Allah Almighty for all His blessings. Then we would like to thank Mr. Jameel for being our project supervisor and providing us with guidance throughout this project. His brilliant ideas and his assessment techniques have helped us a lot which we are truly grateful for.

EXECUTIVE SUMMARY

The purpose of this project is to develop an NFT (Non-Fungible Token) marketplace. The marketplace aims to provide a platform for users to buy, sell, and trade unique digital assets securely and transparently. By completing this project, we aim to contribute to the growing NFT ecosystem and provide a reliable platform for artists, collectors, and enthusiasts to showcase, trade, and monetize their unique digital assets. The NFT Marketplace project seeks to contribute to the growing NFT ecosystem by providing a secure and user-friendly platform. The marketplace's intuitive interface, secure transactions through Smart Contracts, scalable infrastructure, and comprehensive features make it a valuable resource for the NFT community.

Why multi-vendor marketplace?

The NFT marketplace industry is a relatively new and rapidly growing space, with very few players already operating in the market. It presents a unique and valuable opportunity to empower creators, establish trust, expand market accessibility, provide liquidity, and embrace the potential of blockchain technology. By developing an NFT Marketplace, we aim to contribute to the growing digital asset ecosystem and create a platform that benefits creators, collectors, and enthusiasts alike.

What innovation do we bring?

Although there are existing platforms for buying and selling of NFTs, such as Open Sea, that offer marketplace services to their users, we found that there is still room for improvement in this area. Currently, you can sell or buy NFTs from these marketplaces using Etherium coin. We believe that purchasing and selling products should also be done using other cryptocurrency providers such as Bitcoin, doge coin etc. As a result, multiple cryptocurrency payment gateways will be included in these marketplace.

Objective

The goal of this project is to create a platform for creators and investors that is easy to use and also secure. The cryptocurrency feature will add value to our project along with machine learning and image processing modules that will make our website user-friendly.

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CHAPTER 1
Introduction

INTRODUCTION

Introducing our NFT marketplace, a revolutionary platform for buying, selling, and discovering unique digital assets. Our marketplace is designed for both established and emerging artists, creators, and collectors to showcase their works and connect with a global community of enthusiasts. Our platform offers a wide range of NFTs including art, music, videos, collectibles and more, all verified on the blockchain for authenticity and ownership.

1.1. BACKGROUND

The NFT Marketplace project is born out of the rapid growth and evolving landscape of the Non-Fungible Token (NFT) market. NFTs have gained significant traction and popularity, revolutionizing the way digital assets are bought, sold, and owned. As a final year Computer Science project, this endeavor aims to tap into the emerging opportunities presented by NFTs and develop an innovative marketplace that caters to the needs of creators, collectors, and enthusiasts.

By developing this project, we aim to contribute to the growing NFT ecosystem, empower creators, provide a secure and user-friendly platform for trading digital assets, and leave a lasting impact on the digital asset marketplace industry.

1.2. MOTIVATIONS AND CHALLENGES

Currently, there is a lack of a centralized, user-friendly platform for buying, selling, and discovering unique digital assets in Pakistan, making it difficult for established and emerging artists, creators, and collectors to showcase and monetize their work.

Additionally, there are limited tools and resources available in this country for creators to manage and track the performance of their digital assets, making it challenging for them to navigate the rapidly-evolving NFT market. [5].

1.3. GOALS AND OBJECTIVES

The goals and objectives are as follows:

- Our main objective is to provide both creators and investors with the best experience with our service.
- To integrate multiple payment gateway for cryptocurrencies.
- Implement a machine learning model that trains on user's search history and recommends products related to that.

1.4. LITERATURE REVIEW/EXISTING SOLUTIONS

The NFT marketplace industry is a relatively new and rapidly growing space, with several players already operating in the market. One of the main competitors in the NFT marketplace space is OpenSea, which is currently the largest and most established marketplace.

While OpenSea offers a vast selection of NFTs from artists and collectors around the world, our NFT marketplace will aim to create a more personalized and localized experience. DopeChain will focus on empowering local artists and content creators offering a unique value proposition to both artists and collectors [8].

1.5. GAP ANALYSIS

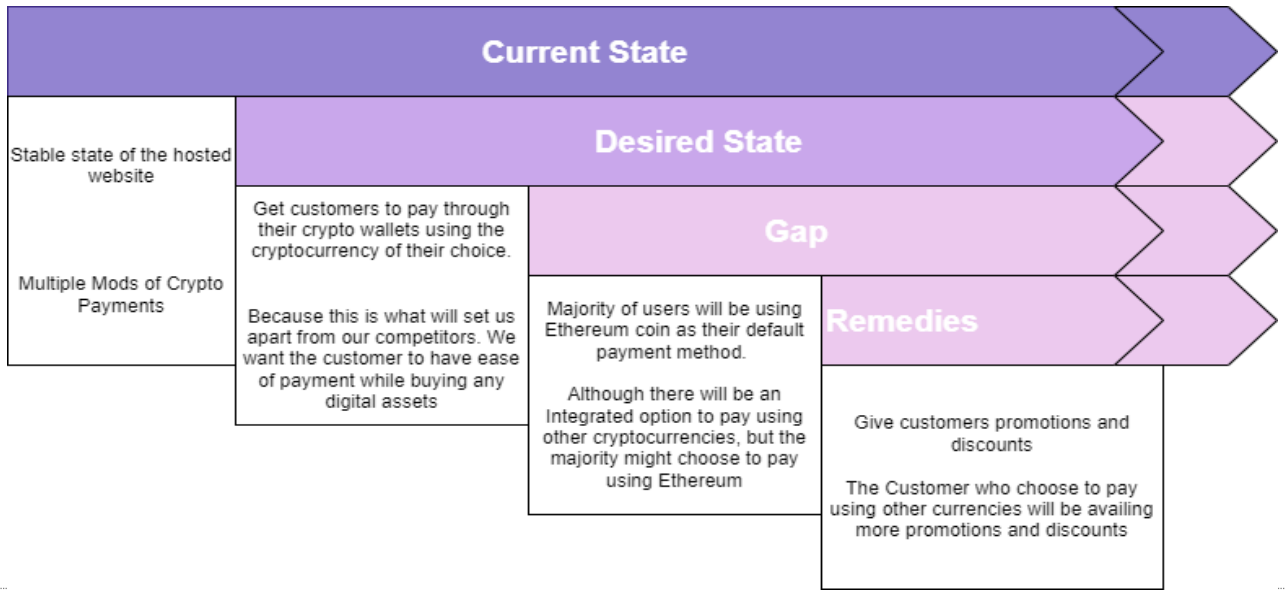


Figure 1 Gap Analysis

1.6. PROPOSED SOLUTION

The solution is a centralized, user-friendly NFT marketplace platform that addresses the needs of established and emerging artists, creators, and collectors in Pakistan.

This platform will allow them to showcase and monetize their work by offering a wide range of NFTs including art, music, videos, collectibles and more, all verified on the blockchain for authenticity and ownership. The platform will be designed to be accessible and inclusive, offering a platform for creators and artists of all backgrounds to showcase their work. [9].

Main functionalities:

- Payment Wallet for cryptocurrency.
- Change language of the website based on user's location.
- Verify seller account by matching seller's CNIC photograph and on spot selfie of the individual.

1.7. PROJECT PLAN

The project plan will be based on a work breakdown structure, which will simplify the complex parts of this project, and the roles and responsibilities of each member will be defined in the roles and responsibility matrix.

1.7.1. WORK BREAKDOWN STRUCTURE

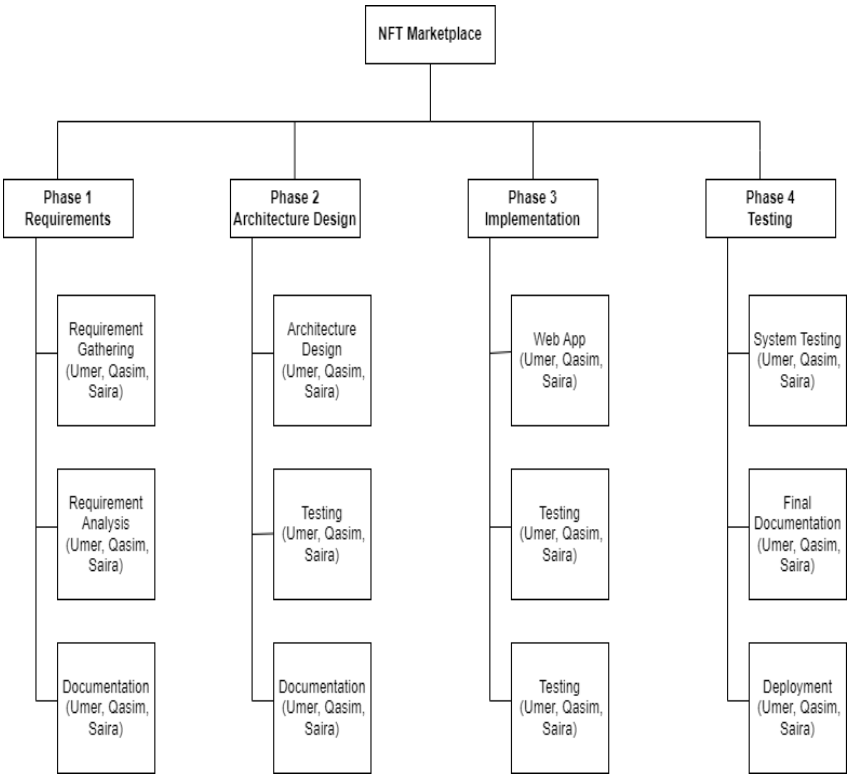


Figure 2 Work Breakdown Structure

1.7.1. ROLES & RESPONSIBILITY MATRIX

WBS #	WBS Deliverable	Activity #	Activity to Complete the Deliverable	Duration (# of Days)	Responsible Team Member(s) & Role(s)
1.	Learning Process	1.		15	Umer. Qasim, Saira
2.	Requirements Gathering	2.		15	Umer. Qasim, Saira
3.	Documentation	3.		45	Umer. Qasim, Saira
4.	Designing	4.		15	Umer. Qasim, Saira
5.	Coding	5.		100	Umer. Qasim, Saira
6.	Database	6.		15	Umer. Qasim, Saira
7.	Testing	7.		14	Umer. Qasim, Saira
8.	Debugging	8.		10	Umer. Qasim, Saira
9.	Deployment	9.		3	Umer. Qasim, Saira

The purpose of roles & responsibility matrix is to identify who will do what.

Table 1 ROLES AND RESPONSIBILTY MATRIX

1.7.2. GANTT CHART

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Planning												
Research/Learning												
Design												
Implementation												
Follow Up												

Table 2GANTT CHART

1.8. REPORT OUTLINE

Chapter 1 is a complete and defined introduction of our final year project.

1. **Background:** Need of improvement in NFT market lead us to develop something really interesting and challenging.
2. **Motivations and Challenges:** We are the motivations of each other and together as a team, we are ready to face every challenge. Innovation is our motivation.
3. **Goals and Objectives:** There should be pre-defined goals and objectives and we have already set our goals for which we have defined some objectives. We can achieve these objectives and goals as a team.

4. **Literature Review/Existing Solution:** There are also other websites working on the similar marketplace structure with comparatively less functionalities and information.
5. **Gap Analysis:** We have analyzed the market and according to our findings there is some gap in the market. In today's busy life, people find it difficult to visit stores to find their desired products, buy them efficiently through a variety of payment methods.
6. **Proposed Solution:** We are going to develop a platform about online buying and selling of digital so that users can creators of all kinds from anywhere can sale and earn from their artwork.
7. **Project Plan:** We created a work breakdown structure through which we are clearly aware of the development flow. We also distributed roles to each team member and for this purpose we created an R&R Matrix through which every team member is aware of every team member's task. We divided the number of days according to the intensity and load of a particular task through Gantt chart.

Chapter 2 is a complete and detailed SRS document of **NFT Marketplace**.

Chapter 3 deals with the system analysis of our website and also illustrates the use case and fully dressed use case.

Chapter 4 shows the diagrammatical representation of the system.

Chapter 5 is all about how the system will be implemented practically.

1.9. EMPATHY MAP

Empathy Map: DopeChain
Empathizing with
Artists and buyers who use DopeChain
Need
Artists: showcase and sell artwork, Buyers: browse and purchase NFTs
See
Artists: platform to reach larger audience and monetize work, Buyers: diverse collection of NFTs
Say
Artists: set own prices, track sales and revenue, Buyers: discover unique, authentic, valuable NFTs
Do
Artists: create/upload artwork, set prices, manage storefront, Buyers: browse, bid, purchase NFTs

CHAPTER 2

SOFTWARE REQUIREMENT SPECIFICATIONS

2.1. INTRODUCTION

2.1.1. PURPOSE

The purpose of this SRS document is to lay out the requirements for developing a web based online NFT marketplace.

2.1.2. DOCUMENT CONVENTIONS

HTML Hypertext Markup Language

JS JavaScript

MERNstack MongoDB, Express, React and Node

DB Databases

IP Internet Protocol

API Application Programming Interface

CSS Cascading Style Sheets

2.1.3. INTENDED AUDIENCE AND READING SUGGESTIONS

As we know the software requirement specification (SRS) document is written for a broader audience but this document is intended for individuals directly involved in the development of this web-based application. This includes team members, project supervisors, project managers, and department heads. This document does not have to be read in order. Users are encouraged to move to any section that intrigues them.

2.1.4. PRODUCT SCOPE

Our project's goal is to create an e-commerce multi-vendor website with a user-friendly interface and comprehensive capabilities. Our website will have a cryptocurrency wallet incorporated in addition to traditional payment methods, letting customers pay through their crypto wallets.

2.1.5. REFERENCES

This SRC refers to following documents and websites:

- OpenSea
- Sample UI Kits
- Usability Requirements
- Use case analysis

2.2. OVERALL DESCRIPTION

2.2.1. PRODUCT PERSPECTIVE

Our NFT Marketplace project will provide the following perspectives and features:

- **NFT Listings and Marketplace:**

  The core perspective of our NFT marketplace is to serve as a platform where users can list, buy, sell, and trade Non-Fungible Tokens (NFTs). Sellers will have the capability to create listings for their NFTs, specifying details such as title, description, media files, and pricing. Buyers can browse and search for NFTs based on various criteria, such as categories, artists, or popularity, and initiate transactions.

- **Multiple Vendor Stores:**

  Similar to the mentioned perspective, our marketplace will allow sellers to have their own stores within the platform. Each seller account will have the ability to create multiple stores for different product categories.

- **Seller and Customer Verification:**

  To ensure a secure and trustworthy environment, sellers will need to go through a verification process. They will be required to provide necessary information, such as addresses and identities. Customers, on the other hand, will be required to verify their identity by logging in using their phone number or email address. An OTP will be sent to them for authentication before they can proceed with their purchase.

- **Optional Crypto Wallet Integration:**

  Our NFT marketplace will offer the option for both buyers and sellers to authenticate their cryptocurrency wallets. By authenticating their wallets, users can seamlessly participate in transactions involving cryptocurrency payments, expanding the range of available payment options

2.2.2. USER CLASSES AND CHARACTERISTICS

Our website will accommodate two unique user groups: buyers and sellers, with administration playing the central role. All the users of this project must be familiar with website technology, and since it is web-based, any operating system will do the job for both parties in terms of accessing it. The buyers will have access to the following functionalities of the website:

- Create a user account on the site.
- Add their phone numbers and email addresses to the website's contact information.
- They can register their cryptocurrency wallets on the website.
- They explore a variety of NFTs and make a shortlist of the ones they want in the future.

The following are the features that we will provide to the sellers:

- Sellers will be able to create several storefronts under one account, ensuring a wide range of NFTs. Additionally, sellers will be able to link their addresses and phone numbers to their payment cards.
- Before creating any store front on the service, sellers must first authenticate themselves.
- The seller's account will require more detailed login information, such as their CNIC, complete addresses, and so on, which will be authenticated using their CNIC and real-time photos.

Furthermore, the website will have an administration to keep an eye on things from afar in order to provide better service to both customers and vendors. The following privileges will be granted to the administration:

- Take down a store if it violates the website’s policy of conduct.
- Permanently ban a seller account if it violates the policy.

- In the event of any disagreement between the vendor and the customer, listen to both sides.
- Respond to complaints and recommendations from customers via the company's official email address or chat box.

2.2.3. OPERATING ENVIRONMENT

The operating environment for our multi-vendor website is as listed below.

- The server side will be running on the Windows operating system environment.
- The client side must have an internet browser supporting HTML5 and JavaScript frameworks. The following browsers will work just fine:
- Chrome
- Safari
- Microsoft Edge
- Mozilla Firefox

2.2.4. DESIGN AND IMPLEMENTATION CONSTRAINTS

- **Language**

  The site's dominant language will be English initially, but a translation facility will be available based on the seller's or buyer's IP address and the region from which they are visiting the site.
- **Databases:**

  The developers will only be able to use MongoDB as a centralized data storage source, and cookies will be used as a traditional cache data storage option for quicker service for both the vendor and the customer.
- **Frameworks**

  The developers will be constrained to solely using the MERNstack on the front-end and back-end of the website.

2.2.5. ASSUMPTIONS AND DEPENDENCIES

Assumption: The website will include a crypto currency payment gateway; however, we have yet to determine which existing APIs we will utilize.

Dependencies:
We have considered the following API's for the project:

- Google translation API.
- Google Maps API.
- PayPal / Stripe Payment API.
- Binance API for Crypto Currency integration.

2.3. EXTERNAL INTERFACE REQUIREMENTS

2.3.1. USER INTERFACES

Front-end Framework: ReactJS, HTML, CSS and various API's. Back-end Framework: MongoDB, NodeJS, Express and various API's. Smart Contract: SOLIDITY

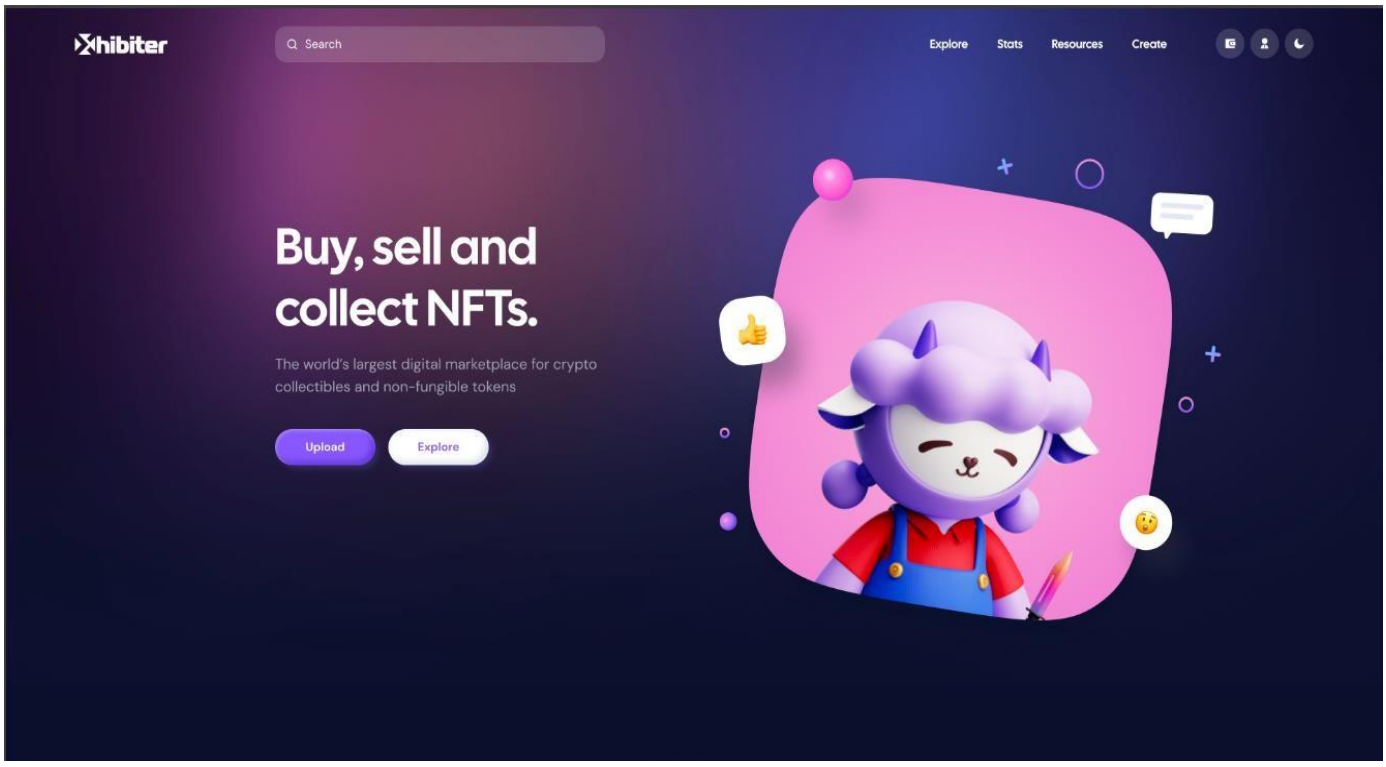
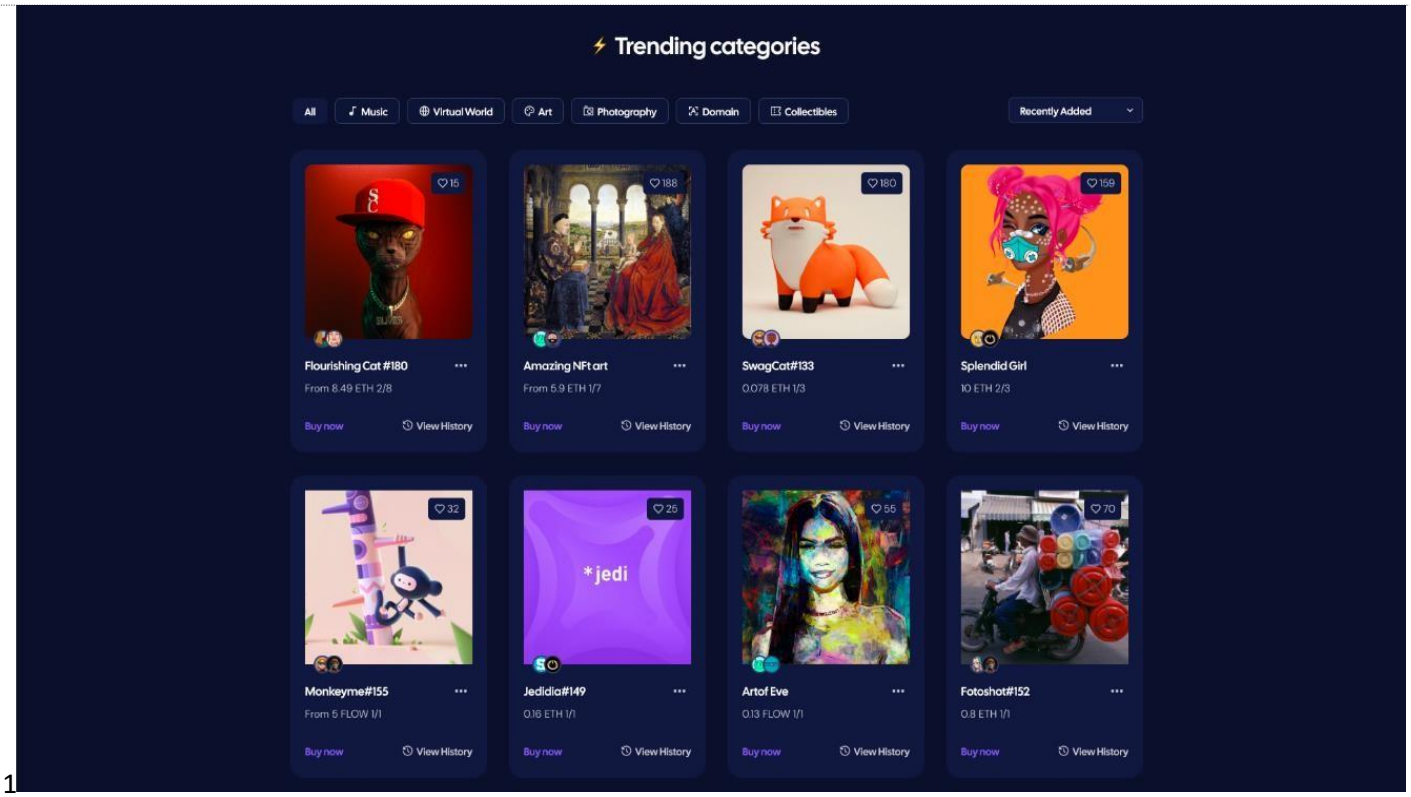


Figure 3 USER INTERFACE 1



1

Figure 4 USER INTERFACE 2

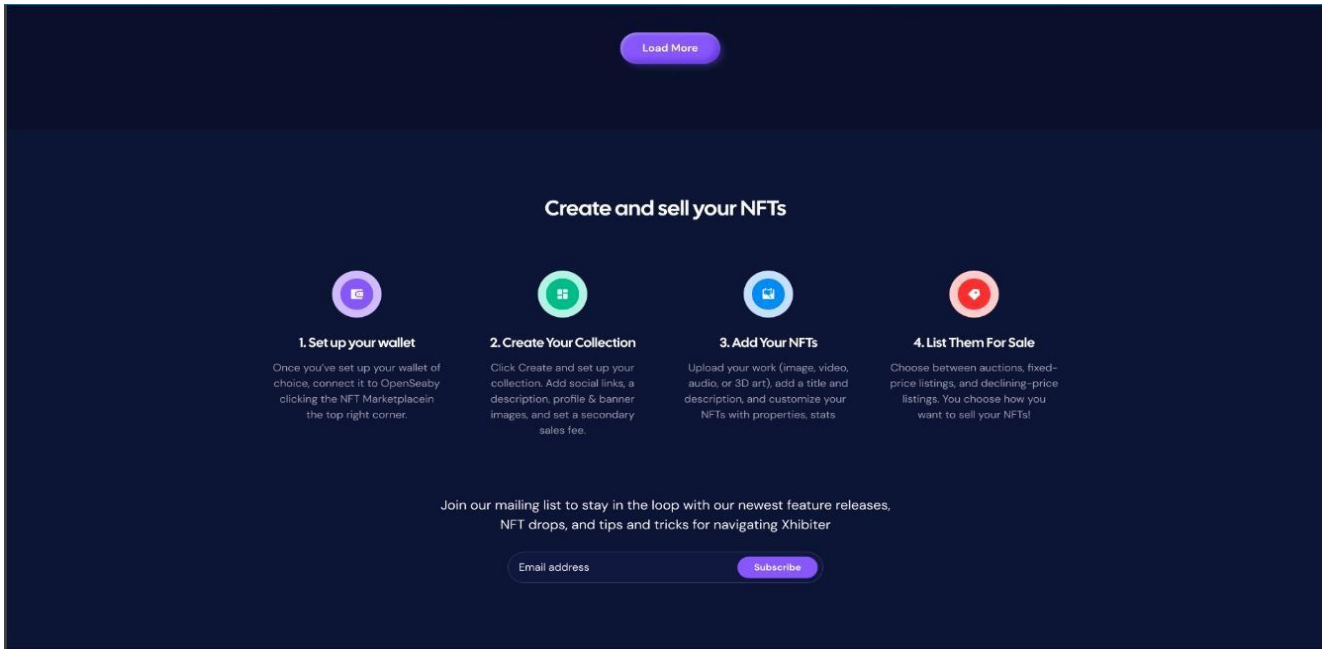


Figure 5 USER INTERFACE 3

2.3.2. HARDWARE INTERFACES

Since it will be a responsive website, it may be accessed from a variety of devices such as:

- Desktops
- Laptops
- Tablets
- Mobile Devices

2.3.3. SOFTWARE INTERFACES

Operating System	We have chosen Windows for the construction of this website because of its rich features and user-friendly environment.
IDE	We chose Visual Studio Code as our IDE because it offers quality extensions for JS web development.
Database	For our project, MongoDB will be our database of choice.
Technology	MERNstack will be implemented throughout our project, for both the back-end and the front-end. Smart Contracts will be written in Solidity.

Table 3 SOFTWARE INTERFACES

2.3.4. COMMUNICATIONS INTERFACES

Users will be able to access the website because it will be hosted over HTTPS. Users will only need a browser and access to the internet.

2.4. SYSTEM FEATURES

The system features for this NFT marketplace are as follows:

2.4.1. CRYPTO WALLET INTEGRATION

2.4.1.1. DESCRIPTION AND PRIORITY

Crypto wallet integration is a significant feature of our NFT marketplace. It allows buyers to make purchases using cryptocurrencies, providing an alternative method to traditional payment options like bank cards.

2.4.1.2. STIMULUS/RESPONSE SEQUENCES

Stimulus: The consumer intends to use their cryptocurrencies to make online purchases from the marketplace.

Response: The website presents users with the option to pay using their crypto wallets for their desired NFT purchases.

2.4.1.3. FUNCTIONAL REQUIREMENTS

REQ-SF2-1: Users must be able to link their crypto wallets to their accounts or even stores on the website (if the user is a seller).

REQ-SF2-2: Once a user's account has been authenticated and their crypto wallets have been linked, they will be able to make payments and purchases using their wallets.

2.5. NONFUNCTIONAL REQUIREMENTS

Nonfunctional Requirements of this project are as follows:

2.5.1. PERFORMANCE REQUIREMENTS

Performance requirements define how well the system accomplishes certain functions under specific conditions. Performance requirements are often based on supporting end-user tasks.

- A user can easily register from anywhere.
- A user can sell or purchase an NFT on our platform.
- By using cryptocurrency, a user can pay for their desired NFTs on this marketplace.
- Sellers are verified by their national IDs or live pictures.

2.5.2. SAFETY REQUIREMENTS

As we know, a safety requirement is something being protected from potential harm or something that has been designed to protect and prevent harm.

And in our project, we also follow some safety measures, like

- We use the trusted databases and domain to save the user's credentials.
- We use image verification to verify that the user is a real human being and is authentic.

2.5.3. SECURITY REQUIREMENTS

A security requirement is a statement of necessary security functionality that assures that one of the software's many different security attributes is met. Industry standards, current regulations, and a history of past vulnerabilities are used to create security requirements. The requirements for this project are as follows:

- SSL and HTTPS protocol should be implemented in order to secure user's information from potential threats.
- The cryptocurrency payment gateway should be secure and add value to user's experience.
- Authentication system should be implemented to verify that seller/buyer are real and not pretending to be someone else.
- Verify that the NFTs sold by sellers are exactly those as defined in the listing description on seller store in this marketplace.

2.5.4. USABILITY REQUIREMENTS

Usability requirements are known expectations and specifications designed to ensure that a product, service, process, or environment is simple to use. The following are the requirements for this project:

- A complex navigation system should not be implemented rather it should be kept simple and functional for the end user.
- Linear checkout processes should be designed for purchasing NFTs on this marketplace.
- If suppose something goes wrong at checkout, then the error notifications should be simple for the end user to understand.
- The speed of the web application should be fast to provide a smooth experience for the user.
- The search feature should be implemented to make product hunt easier for the user.

2.5.5. RELIABILITY REQUIREMENTS

Reliability requirements define system and software functions that prevent, detect, or tolerate software flaws, ensuring that these flaws do not cause system failure. Following are the requirements for this project:

- A modern interactive and user friendly website will make a reliable online marketplace.

- Good customer support will also help attract traffic to the website and increase its reliability.
- Review system for NFTs will provide authenticity to the website.

2.5.6. MAINTAINABILITY/SUPPORTABILITY REQUIREMENTS

The ability of an application to go through changes with relative ease is referred to as maintainability. This characteristic refers to the ease with which the application can be modified to fix bugs or add new functionality. Following are the requirements for this project:

- Developers should implement clean coding so that the code is easier to understand for future use and fixing bugs.
- Add comments along with the code that briefly explains the functionality of the code.

2.5.7. PORTABILITY REQUIREMENTS

The requirements for portability define how a system or its components can be launched into one environment or another. It typically includes hardware, software, or other platform usage specifications. Following are the requirements for this project:

- This project will launch as a responsive web application allowing its users to access it through a browser from variety of devices.
- Hardware specifications include having a device capable of running a web browser application efficiently.
- Software specifications having a web browser on user's device such as chrome, Firefox etc.

2.5.8. EFFICIENCY REQUIREMENTS

Efficiency requirements address the user's concerns about how quickly the system operates, how efficiently it accepts inputs and processes outputs, and how much data can be processed at one time.

- Seller's account verification process should be optimal.
- NFT(s) added in the cart should have a fast tranfer process to provide ease to the customers of this marketplace.
- Answering to valid customer queries and requests should be a priority and an efficient system should be designed for this purpose.

2.6. DOMAIN REQUIREMENTS

The other requirements for this SRS are as follows:

- The selected domain name should be short and concise so the users can memorize it quickly.
- The selected web hosting should be able to provide fast and quality service. In this era of technology, a user wants to achieve what they want as fast as possible so the delayed response from website will result in decrease in traffic.
- The content displayed on the website should be optimized according to the SEO standards so this website ranks higher on search engines.

CHAPTER 3

USE CASE ANALYSIS

In simple terms, use case analysis depicts the many responses a piece of software might have in response to the input it gets. Consider how a person would interact with a social networking site. A use case analysis could be used to record the many ways he or she interacts, as well as the outcomes of that interaction. An actor is a person or some external system with whom you are engaging. The user inputs their login and password after typing in the site's web URL. The homepage is immediately launched when the URL is input. A use case is used to capture the full procedure.

In this chapter, we will discuss use cases for an online multivendor marketplace which will help us to understand the behavior of a potential user who will be using our web application.

3.1. USE CASE MODEL

The use case model for this project is shown below:

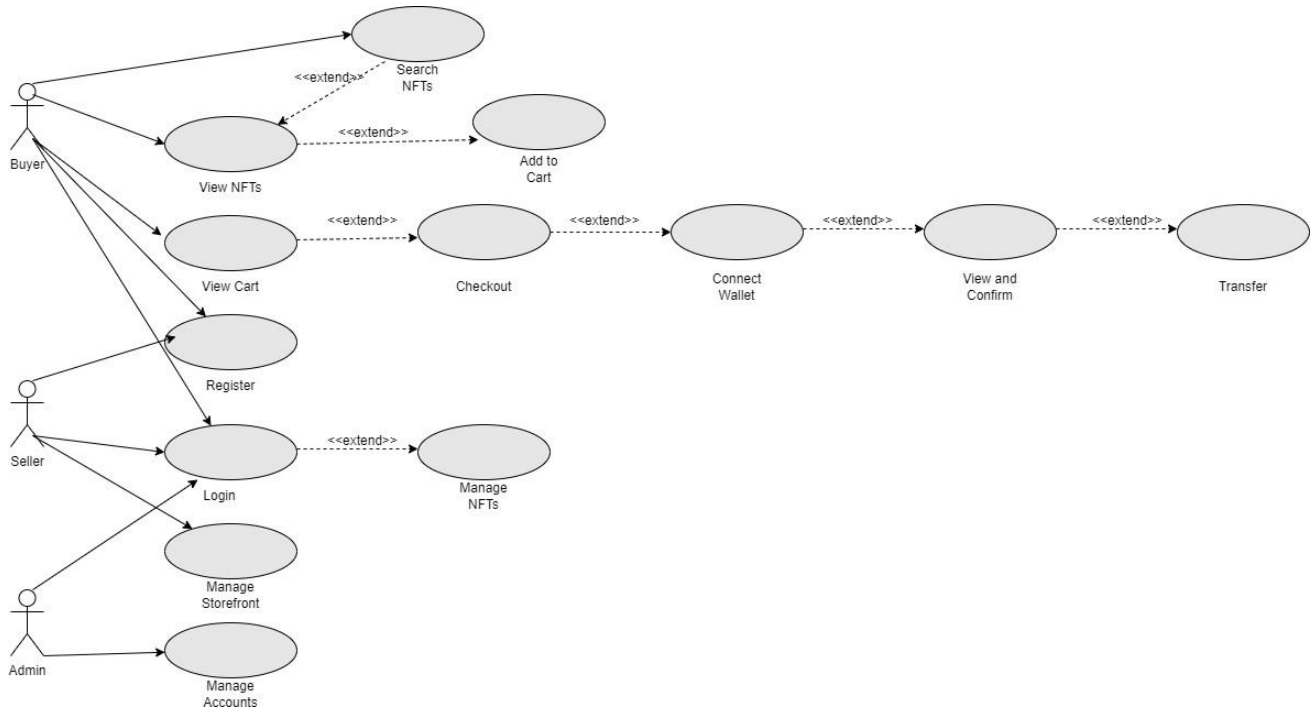


Figure 6 USE CASE MODEL

3.2. FULLY DRESSED USE CASES (USE CASE SPECIFICATION)

3.2.1. USE CASE NAME: REGISTER

Description: User registers on the marketplace using their credentials to view NFTs, add them to cart, and make purchases.

ID: 1

Primary Actors: Seller / Buyer

Pre-conditions: No pre-conditions required

Main Flow:

1. User access the website through a device connected to the internet.
2. User clicks on the “Create account” option.
3. User fills all the required personal details.
4. User clicks on the register button.
5. User will be asked whether he/she wants to sign in as a seller or a buyer.
6. System checks if the information given by the user is valid.
7. The user will be required to open their camera and capture a live selfie so that it can be compared by the system to verify the validity of user.
8. System saves the data in the databases and authenticate the user to log in.
9. User successfully logs in to his/her account.

Post Conditions: User information is valid and is saved into the databases. User can now log in with those credentials any time.

Alternative Flows:

1. User captures a live selfie.
2. The system compares that to the user CNIC picture and it did not match.
3. An error message is displayed saying that the picture did not match with your NIC.

Special Requirements:

- Text must be visible from one meter.
- Inputs verification within 30 seconds 90% of that time.

3.2.2. USE CASE NAME: LOGIN

ID: 2

Description: Users who are authenticated will be able to directly log in to their accounts, browse different NFT categories and make purchases.

Primary Actors: Buyer / Seller

Pre-conditions:

1. User must have signed in previously.
2. User must remember their username and password in order to log in.

Main Flow:

1. User visits the website via device over internet.
2. User clicks on “Login”.
3. User enters the username and password in input fields.
4. User clicks on the Login button.
5. System verifies the users’ validity by comparing username and password in the databases.
6. System will check whether the account belongs to seller or buyer domain.
7. User successfully logs in to his/her account.

Post-conditions: Username and password must match the ones already in the databases. User successfully logs in to his/her account.

Alternative Flows:

1. User do not remember his/her username or password and enters the wrong credentials.
2. System will generate an error that username or password is incorrect.

Special Requirements:

- Text must be visible from one meter.
- Inputs verification within 30 seconds 90% of that time.

3.2.3. USE CASE NAME: SEARCH NFT

ID: 3

Description: Once the user, specifically the buyer has logged in to his/her account. He/she will be able to search through various categories and stores.

Primary Actors: Buyer

Pre-conditions:

1. User must have logged in to his/her account.
2. User has searched for an item with a valid name in the search bar.

Main Flow:

1. User visits the website via device over internet.
2. User clicks on “Login”.
3. User enters the username and password in input fields.
4. User clicks on the Login button.
5. System verifies the users’ validity by comparing username and password in the databases.
6. System will check whether the account belongs to seller or buyer domain.
7. User successfully logs in to his/her account.

Post-conditions: Username and password must match the ones already in the databases. User successfully logs in to his/her account.

Alternative Flows:

1. User do not remember his/her username or password and enters the wrong credentials.
2. System will generate an error that username or password is incorrect.

Special Requirements:

- Text must be visible from one meter.
- Inputs verification within 30 seconds 90% of that time.

3.2.4. USE CASE NAME: ADD TO CART

ID: 4

Description: When the buyer decides what they want to buy they will add those NFTs to cart.

Primary Actors: Buyer

Pre-conditions: User must log in to his/her account.

Main Flow:

1. User visits the website via device over internet.
2. User logs in to his/her account.
3. User searches for a desired NFT.
4. User selects any NFT that they desire and then art those products to cart by clicking on "Add to Cart" option.

Post-conditions: Data for the quantity of buyer's desired NFT will be checked in the databases for availability. The user specified quantity will then be deducted from the databases. Then those NFT will be added to the buyer's cart. Message will be displayed that the following products are added to cart.

Alternative Flows:

1. User finds a desired NFT and then clicks on "Add to cart" option.
2. System checks for NFT's availability.
3. That particular NFT appears to be unavailable.
4. The system shows an error message "NFT Unavailable".

Special Requirements:

- Text must be visible from one meter.
- Inputs verification within 30 seconds 90% of that time.

3.2.5. USE CASE NAME: CONNECT WALLET

ID: 5

Description: Once the user decides what to buy and adds those NFTs to cart, then the user will have to connect their Crypto wallet for the transection.

Primary Actors: Buyer

Pre-conditions:

1. User must have logged in to his/her account.
2. User has searched for an item with a valid name in the search bar.
3. User must add the NFT of choice to the cart.

Main Flow:

1. User visits the website via device over internet.
2. User clicks on “Login”.
3. User enters the username and password in input fields.
4. User clicks on the Login button.
5. User adds some desired NFT(s) to the cart.
6. User must enter connect their crypto wallet to their account.
7. User successfully has bought the NFT of their choice

Post-conditions: Data entered is saved into the databases. Message is displayed to the user “Wallet connect successfully”.

Alternative Flows:

1. User tries to connect their wallet.
2. Their wallet address is not valid.
3. System displays an error message.

Special Requirements:

- Text must be visible from one meter.
- Inputs verification within 30 seconds 90% of that time.

3.2.6. USE CASE NAME: VIEW CART

ID: 6

Description: When the user adds NFTs to the cart. Before entering shipping details user can view cart.

Primary Actors: Buyer

Pre-conditions:

1. User must have logged in to his/her account.
2. User must add NFT(s) to cart.

Main Flow:

1. User visits the website via device over internet.
2. User logs in to their account.
3. User adds some NFT into the cart.
4. User then clicks on “View Cart” option to view the NFT in the cart.

Post-conditions: User gets to view the NFT he/she has added to the cart.

Alternative Flows:

1. User has not entered anything to the cart.
2. The system will show an error message displaying “The cart is Empty”.

Special Requirements:

- Text must be visible from one meter.
- Inputs verification within 30 seconds 90% of that time.

3.2.7. USE CASE NAME: CHOOSE A PAYMENT METHOD

ID: 7

Description: Before finalizing their purchases, users will be asked to choose a payment method whether it’s their credit/debit card, cash on delivery or their crypto wallet.

Primary Actors: Buyer

Pre-conditions:

1. User must have logged in to his/her account.
2. User must add products to cart.
3. Use must add their shipping details.

Main Flow:

1. User visits the website via device over internet.
2. User logs in to their account.

3. User adds some products into the cart.
4. User then adds their shipping details.
5. Then the user will be required to choose a payment method.

Post-conditions: User chooses a payment method and pays for the product accordingly.

Alternative Flows:

1. User has not entered anything to the cart.
2. The system will show an error message displaying “The cart is Empty”.

Special Requirements:

- Text must be visible from one meter.
- Inputs verification within 30 seconds 90% of that time.

3.2.8. USE CASE NAME: CHECKOUT

ID: 8

Description: User logs out from their account after performing the activities they wanted.

Primary Actors: User

Pre-conditions: User must have logged in to his/her account.

Main Flow:

1. User visits the website via device over internet.
2. User logs in to their account.
3. User performs their desired activity whether its browsing through NFTs and making purchases etc.
4. User then logs out.

Post-conditions: User logs out of their account successfully.

Alternative Flows:

1. User clicks on the log out button.
2. Due to internet connectivity issue, the system could not register that log out information.
3. The system will show an error message displaying “please try again”.

Special Requirements:

- Text must be visible from one meter.
- Inputs verification within 30 seconds 90% of that time.

3.2.9. USE CASE NAME: MANAGE ACCOUNTS

ID: 9

Description: Admin can manage the accounts of users and seller stores.

Primary Actors: Admin

Pre-conditions: Admin must login into the admin panel.

Main Flow:

1. Admin logs in to the admin panel.
2. System can authorize the accounts of users or seller stores.
3. Admin is able to view/delete accounts of both users and shopping stores domains.

Post-conditions: Admin is able to view/delete accounts.

Alternative Flows:

1. Admin has tried to delete/view a user account or a store.
2. Due to internet connectivity issues, the request could not be completed.
3. System asks to retry the given query.

Special Requirements:

- Text must be visible from one meter.
- Inputs verification within 30 seconds 90% of that time.

3.2.10. USE CASE NAME: MANAGE STORE

ID: 10

Description: Seller can manage NFTs, create collections and see performance in stores.

Primary Actors: Seller

Pre-conditions: Seller must log in to their seller account.

Main Flow:

1. System can authorize the NFTs of users or seller stores.
2. Seller is able to view/delete NFTs of the Seller stores and users.

Post-conditions: Seller can manage the NFTs and view statistics.

Alternative Flows:

1. Seller is able to view/delete NFTS of the seller stores and users.
2. If internet connection is poor, system asks to retry.

Special Requirements:

- Text must be visible from one meter.
- Inputs verification within 30 seconds 90% of that time.

3.2.11. USE CASE NAME: MANAGE NFTS

ID: 11

Description: Seller can manage NFTs in stores.

Primary Actors: Seller

Pre-conditions: Seller must log in to their seller account.

Main Flow:

1. System can authorize the NFTs of users or shopping stores.
2. Seller is able to view/delete NFTs of the seller stores and users.

Post-conditions: Seller can manage the NFTs and view statistics.

Alternative Flows:

3. Seller is able to view/delete NFTs of the seller stores and users.
4. If internet connection is poor, system asks to retry.

Special Requirements:

- Text must be visible from one meter.
- Inputs verification within 30 seconds 90% of that time.

CHAPTER 4

SYSTEM DESIGN

This chapter describes how the software will function and how the processes will be carried out. As we can see, we have several diagrams that show how the system is performing and what is required to complete the tasks. The diagrams and data clearly describe the process and aid in understanding the content.

4.1. ARCHITECTURE DIAGRAM

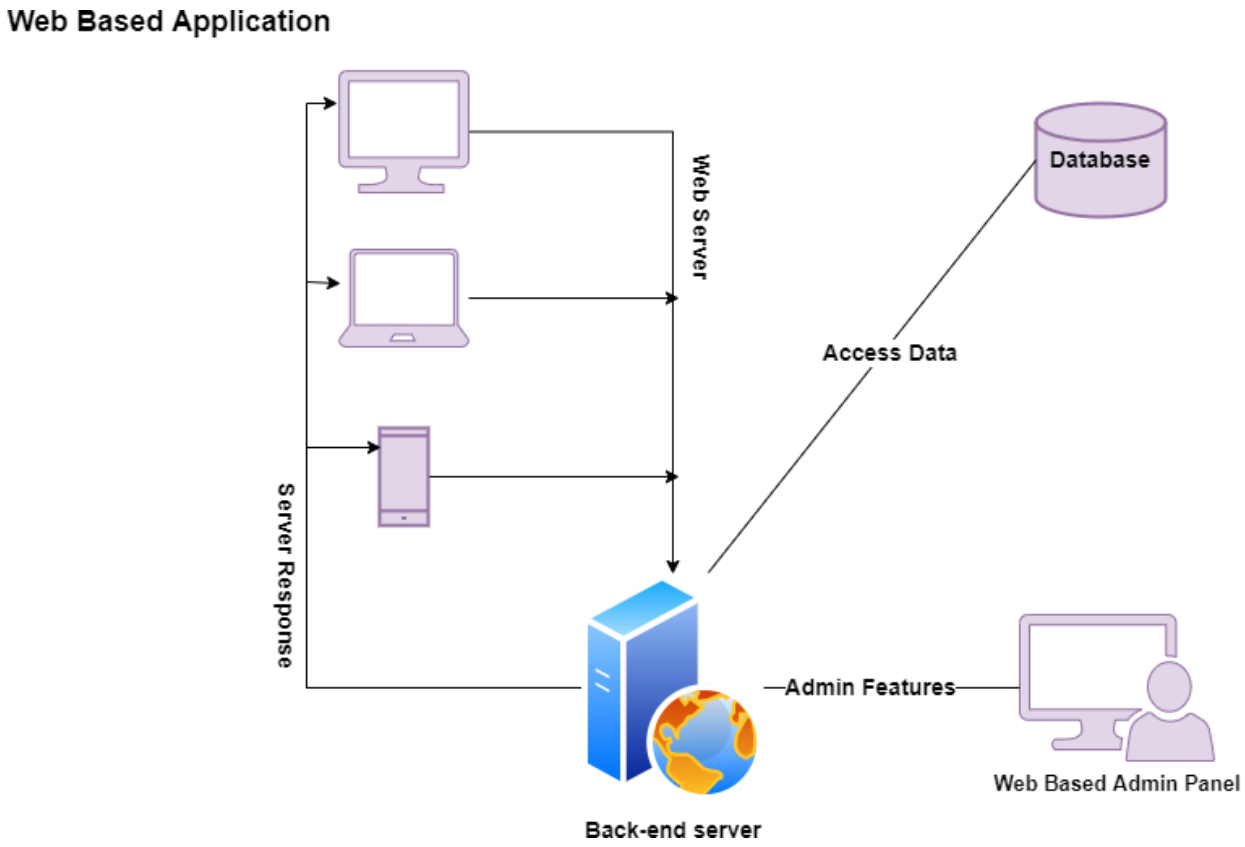


Figure 7 ARCHITECTURE DIAGRAM

4.2. DOMAIN MODEL

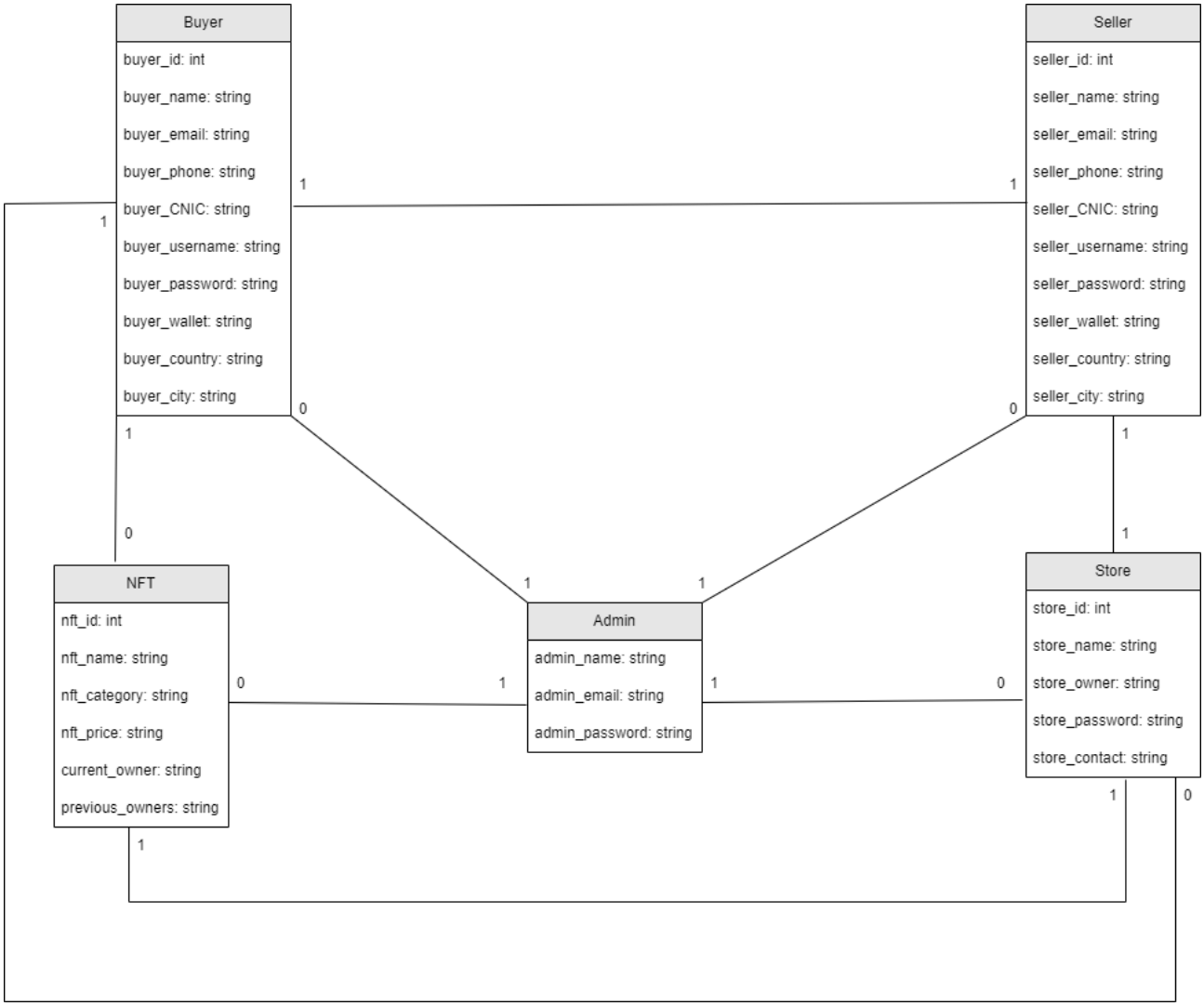


Figure 8 Domain Model

4.3. ENTITY RELATIONSHIP DIAGRAM WITH DATA DICTIONARY

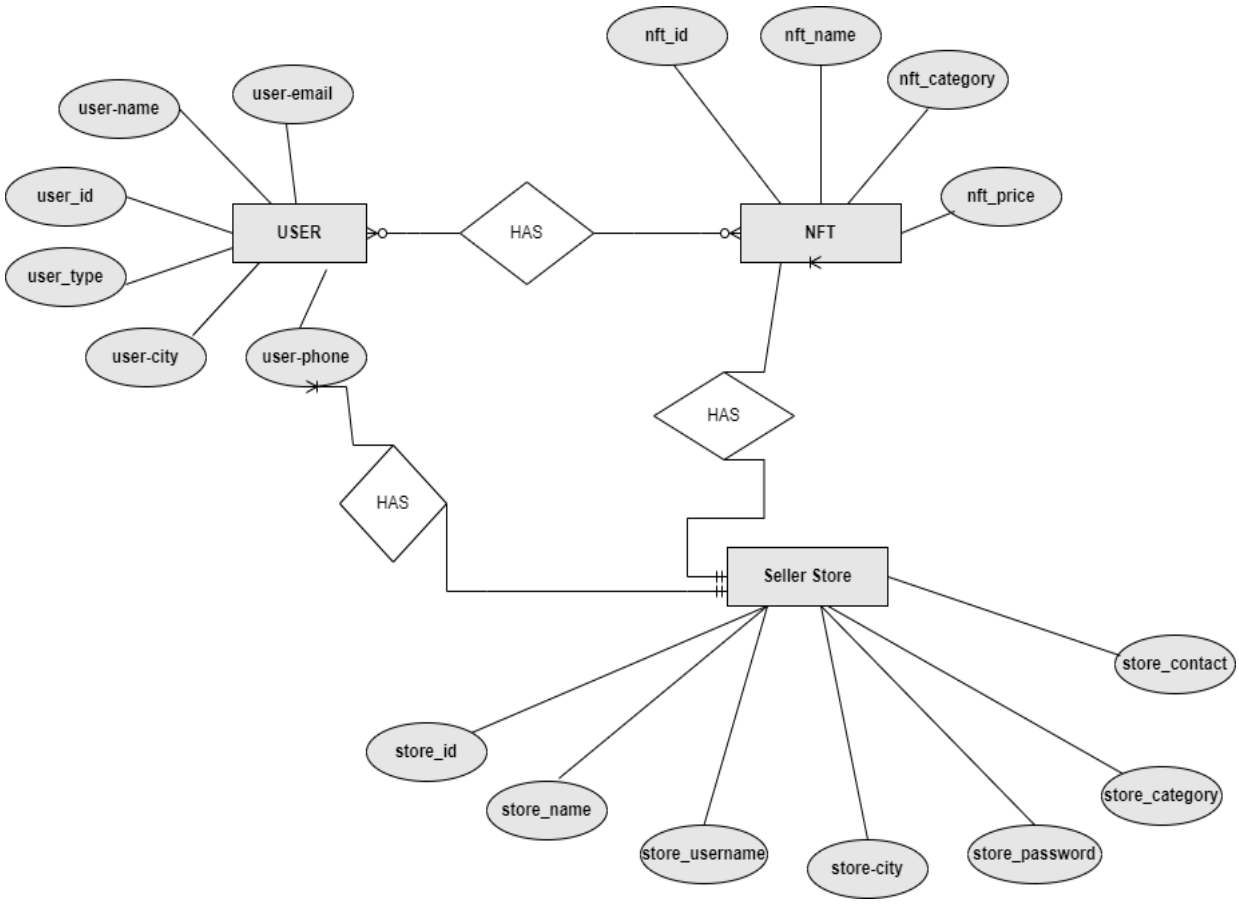


Figure 9 ERD

4.4. CLASS DIAGRAM

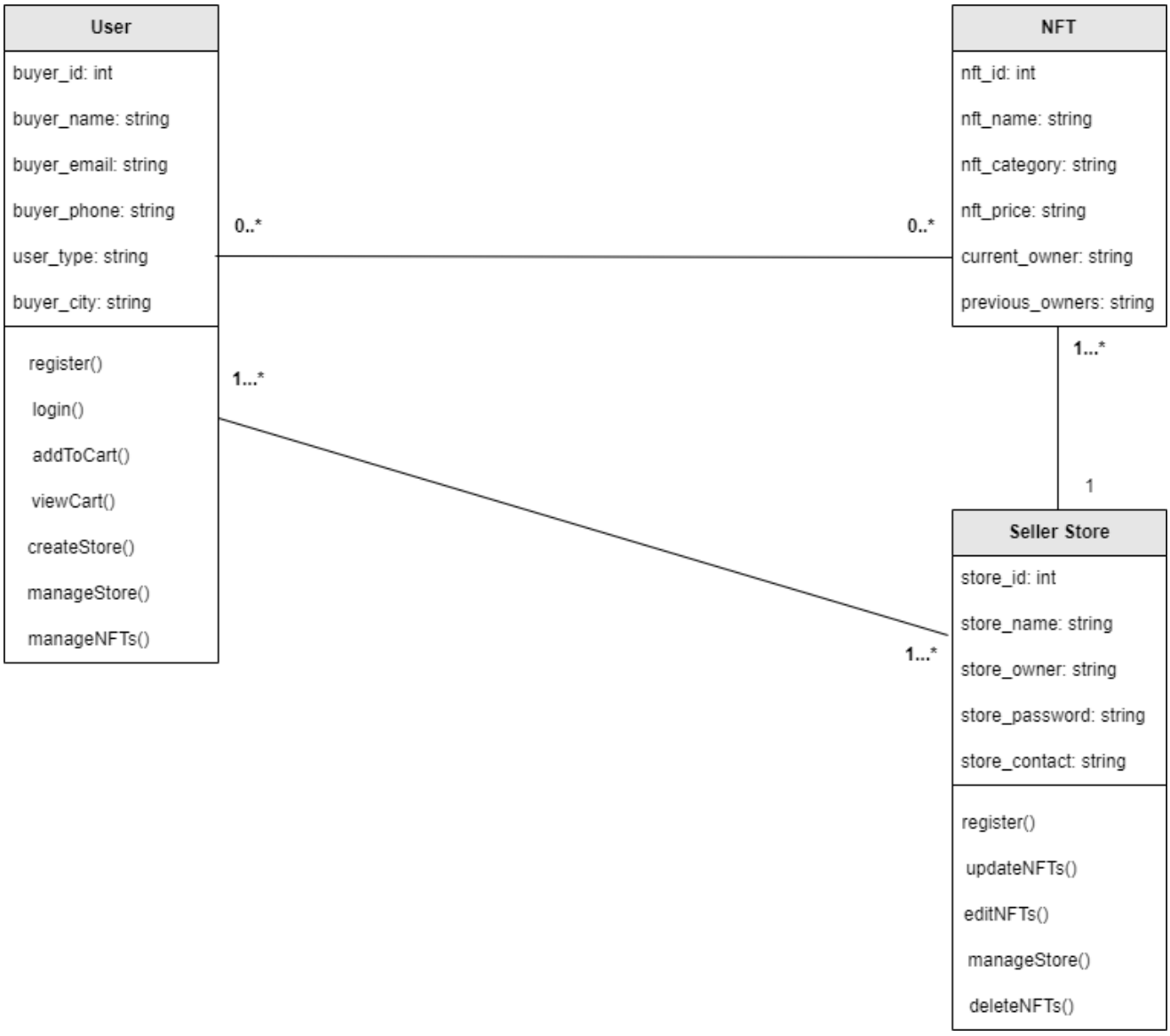


Figure 10 CLASS DIAGRAM

4.5. SEQUENCE / COLLABORATION DIAGRAM

Admin

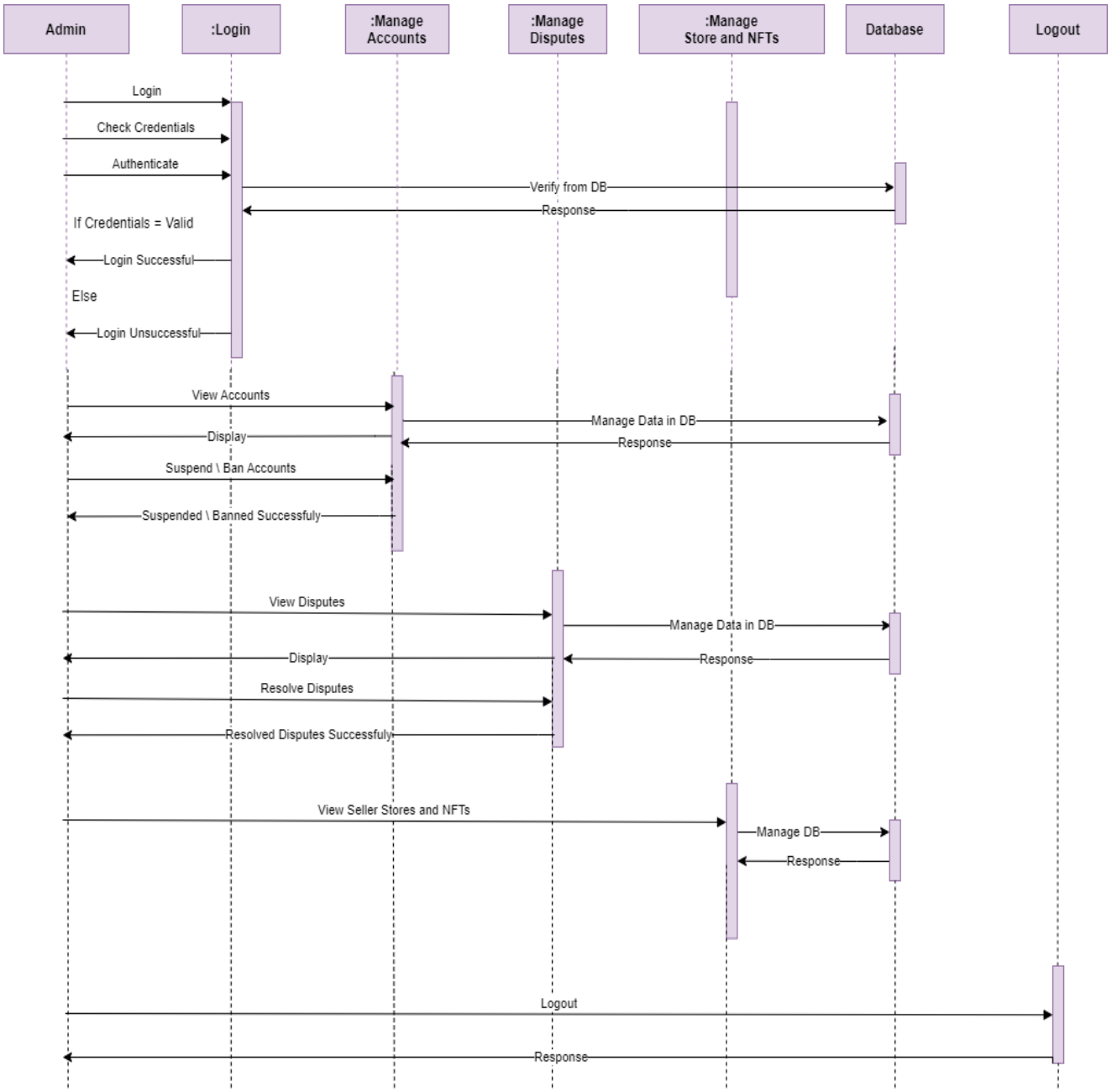


Figure 11 SEQUENCE DIAGRAM; ADMIN

Seller

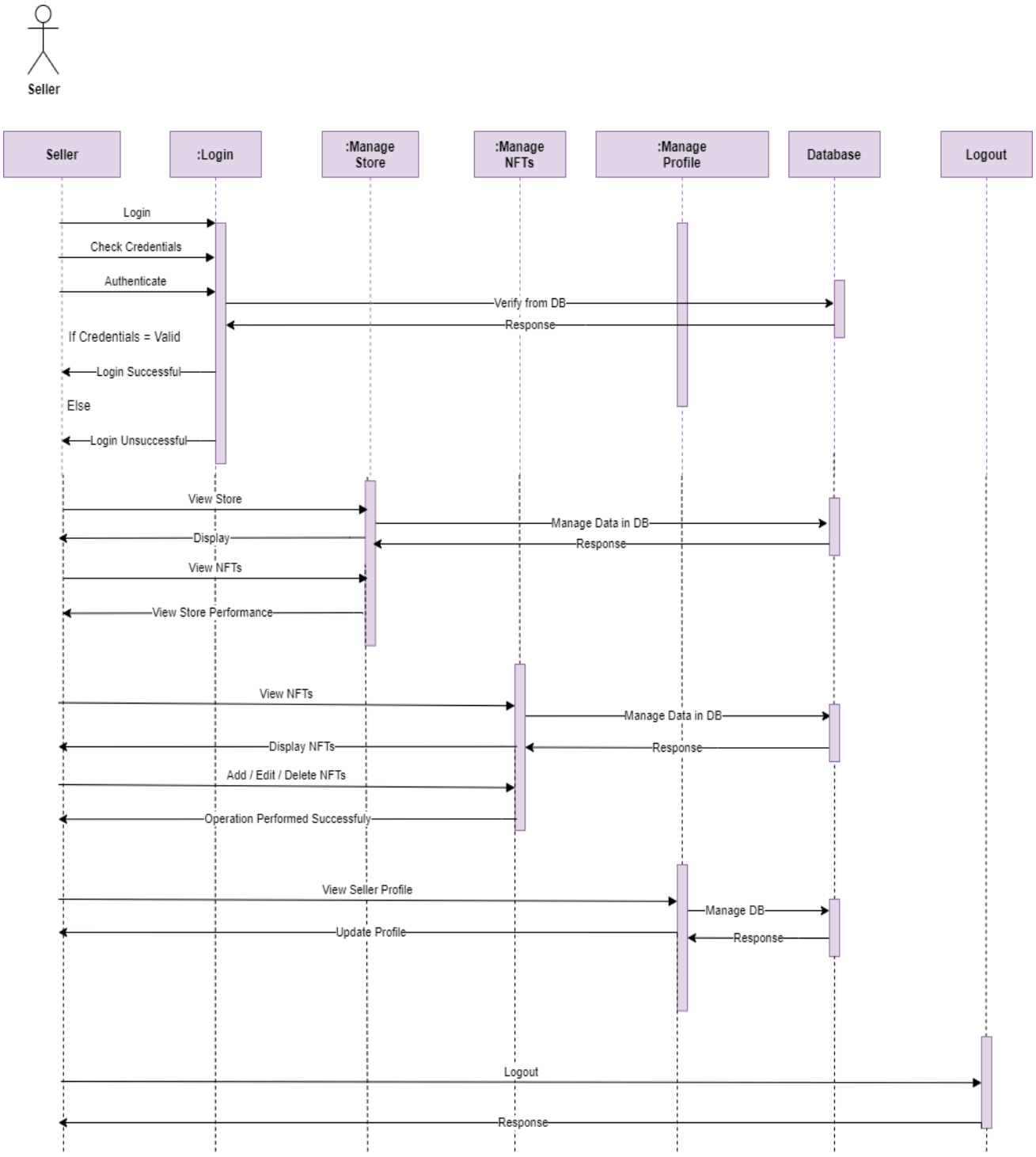


Figure 12 SEQUENCE DIAGRAM; SELLER

Buyer

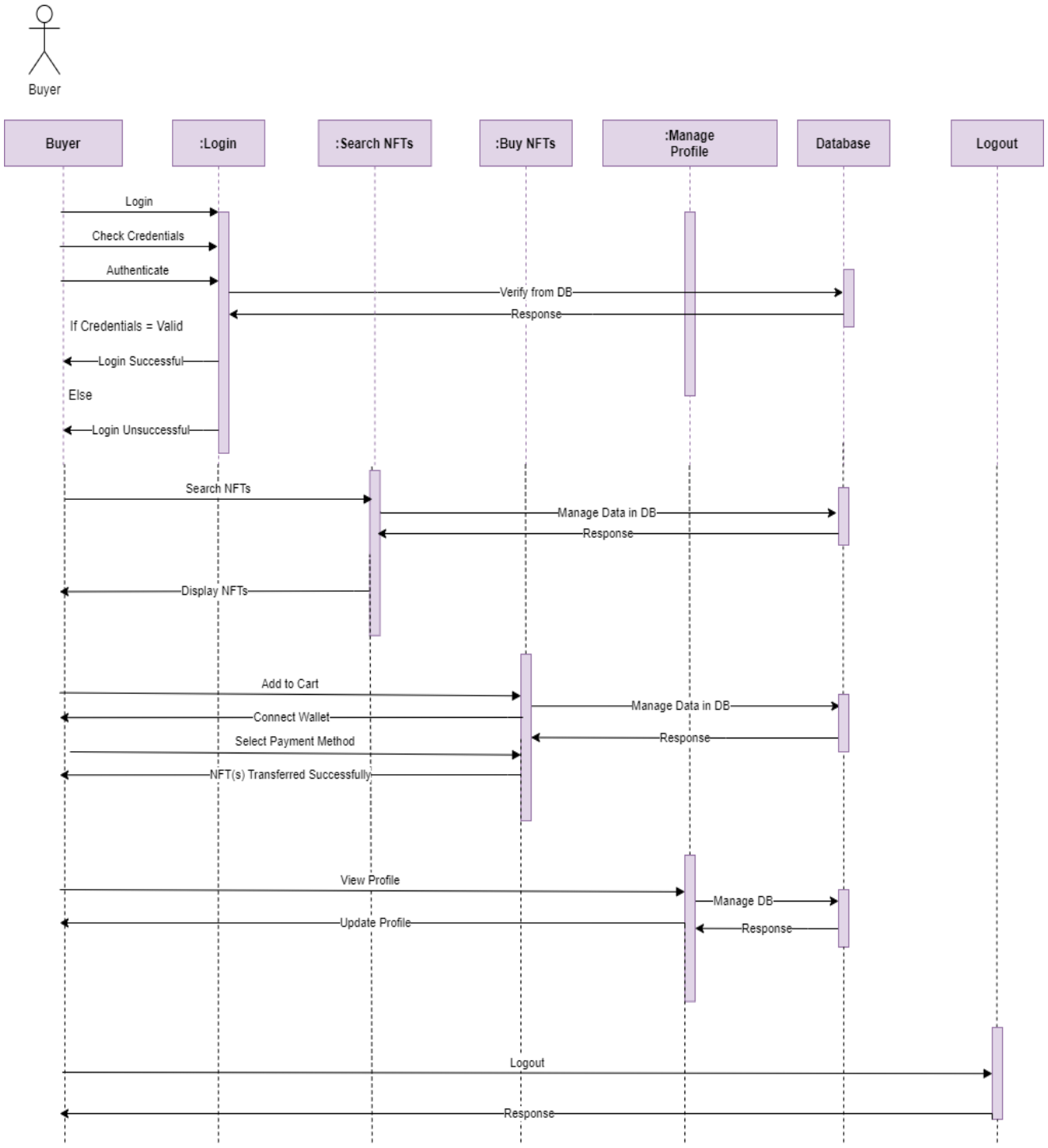


Figure 13 SEQUENCE DIAGRAM; BUYER

4.6. OPERATION CONTRACTS

Login Operation Contracts:

1. **Contract CO1: ClickLogin**

   Operation: ClickLogin()

   Cross References: User Login is underway and it is done by Buyer, Seller or Admin.

   Pre-Conditions: There is no pre-condition.

   Post-Conditions: User will be associated with Login Page.

2. **Contract CO2: EnterLoginDetails()**

   Operation: EnterLoginDetails (Username, Password, Type (Buyer, Seller or Admin.))

   Cross References: User Login is underway and it is done by Buyer, Seller or Admin.

   Pre-Conditions: The Login Page has been displayed by Application after clicking on Login Button.

   Post-Conditions: User will be associated with Login Page.

   Login details Username, Password, Type will be sent to Server to verify from database after clicking on Login button.

3. **Contract CO3: GetUserDetails()**

   Operation: GetUserDetails()

   Cross References: User Login is underway and it is done by Buyer, Seller or Admin.

   Pre-Conditions: A request will be sent by the User to server to search their information from the database.

   Post-Conditions: A Selected user details will be searched and then fetched from the User table of NFT Marketplace Database with attributes Username, Password, Email.

4. **Contract CO4: ClickForgotPassword**

   Operation: ClickForgotPassword()

   Cross References: User Login is underway and it is done by Buyer, Seller or Admin.

Pre-Conditions: User will be associated with Login Page.

Post-Conditions: User will be associated with Forgot Password Page.

Registration Operation Contracts:

5. **Contract CO1: ClickRegistration**

Operation: ClickRegistration()

Cross References: User Registration is underway.

Pre-Conditions: There is no pre-condition.

Post-Conditions: User will be associated with Registration Page.

6. **Contract CO2: EnterRegistrationDetails()**

Operation: EnterRegistrationDetails( )

Cross References: User Registration is underway**.**

Pre-Conditions: User will be associated with Registration Page.

Post-Conditions: User details will be sent to Server to check for validation after clicking on submit button.

7. **Contract CO3: GetVerificationOTP()**

Operation: GetVerificationOTP( )

Cross References: User Registration is underway.

Pre-Conditions: A request will be sent by the User to get a verification OTP from the database.

Post-Conditions: A verification OTP code will be sent from database.

8. **Contract CO4: AddUserDetails()**

Operation: AddUserDetails( )

Cross References: User Registration is underway**.**

Pre-Conditions: A new User's registration details will be sent to server to add into the database after clicking on Submit button.

Post-Conditions: A New User Registration will be associated with the Application.

A new User details with the user_type (Buyer, Seller or Admin) will be added in User table of multi-vendor e-commerce database.

Manage Seller Store Operation Contracts:

9. Contract CO1: ClickManageStore

Operation: ClickManageStore()

Cross References: Management of store is underway and it is done by Seller.**Pre-**

Conditions: The Seller Account has been displayed by the Application.

Post-Conditions: Seller will be associated with Seller Account Page.

10. Contract CO2: ClickAddNFT

Operation: ClickAddNFT()

Cross References: Management of store is underway and it is done by Seller.

Pre-Conditions: The Add NFT Page has been displayed by the Application after clicking on Add NFT button.

Post-Conditions: Seller will be associated with Add NFT Page.

11. Contract CO3: EnterNFTDetails()

Operation: EnterDetails (NFT Name, Description, Price, Images)

Cross References: Management of store is underway and it is done by Seller.

Pre-Conditions: The Add NFT has been displayed by the Application after clicking on Add NFT button.

Post-Conditions: Seller will be associated with Add NFT Page.

A new NFT(s) with details NFT Name, Description, Price, Images etc. will be sent to Server to add into the database after clicking on Add NFT button.

12. Contract CO4: AddNFTDetails()

Operation: AddNFTDetails( )

Cross References: Management of store is underway and it is done by Seller.

Pre-Conditions: A new NFT(s) with details NFT Name, Description, Price, Images etc. will be sent to Server to add into the database after clicking on Add NFT button.

Post-Conditions: Seller will be associated with Add NFT Page.

A new NFT's details will be added in NFT table of NFT Marketplace Database with attributes like NFT Name, Description, Price, Images etc.

13. Contract CO5: ClickDeleteNFT

Operation: ClickDeleteNFT()

Cross References: Management of store is underway and it is done by Seller.

Pre-Conditions: The Delete NFT Page has been displayed by the Application after clicking on Delete NFT button.

Post-Conditions: A NFT(s) will be selected by Seller to delete from the database.

14. Contract CO6: DeleteUserDetails()

Operation: DeleteNFTDetails( )

Cross References: Management of store is underway and it is done by Seller.

Pre-Conditions: A NFT(s) will be selected by Seller to delete from the database.

Post-Conditions: A Selected NFT will be disassociated with System.

A Selected NFT details will be deleted in NFT table of NFT Marketplace Database with attributes like NFT Name, Description, Price, Images etc.

15. Contract CO7: ClickUpdateNFT

Operation: ClickUpdateNFT()

Cross References: Management of store is underway and it is done by Seller.

Pre-Conditions: The Update NFT Page has been displayed by the Application after clicking on Delete NFT button.

Post-Conditions: Seller will be associated with Delete NFT Page.

16. **Contract CO8: GetNFTDetails()**

Operation: GetNFTDetails()

Cross References: Management of store is underway and it is done by Seller.

Pre-Conditions: A NFT will be selected by Seller to get their information from the database.

Post-Conditions: A Selected NFT details will be displayed on the Update NFT Page that has been fetched from the Product table of NFT Marketplace Database with attributes like NFT Name, Description, Price, Images etc.

17. **Contract CO6: UpdateNFTDetails()**

Operation: UpdateNFTDetails()

Cross References: Management of store is underway and it is done by Seller.

Pre-Conditions: An NFT(s) will be selected by Seller to update from the database.

Post-Conditions: A Selected NFT's details will be added to the Application.

A Selected NFT details will be updated in NFT table of NFT Marketplace Database with attributes like NFT Name, Description, Price, Images etc.

18. **Contract CO6: ViewSalesAndStockDetails()**

Operation: **ViewSalesAndStockDetails** ()

Cross References: Management of store is underway and it is done by Seller.

Pre-Conditions: An NFT(s) Sales and Stock Page has been displayed by the Application.

Post-Conditions: A Selected NFT's Sales and Stock will be displayed by the Application.

19. **Contract CO6: ViewNFTReviews()**

Operation: **ViewNFTReviews** ()

Cross References: Management of store is underway and it is done by Seller.

Pre-Conditions: A NFT(s) Review Page has been displayed by the Application.

Post-Conditions: A Selected NFT's Reviews and Ratings will be displayed by the Application.

Manage Profile Operation Contracts:

20. Contract CO1: ClickManageProfile

Operation: ClickManageProfile()

Cross References: Management of Profile is underway and it is done by User (Buyer or Seller).

Pre-Conditions: The User Profile has been displayed by the Application.

Post-Conditions: User will be associated with Manage Profile Page.

21. Contract CO2: ClickUpdateProfile

Operation: ClickUpdateProfile()

Cross References: Management of Profile is underway and it is done by User (Buyer or Seller).

Pre-Conditions: The Manage Profile Page has been displayed by the Application after clicking on Manage Profile button.

Post-Conditions: User will be associated with Update Profile Page.

22. Contract CO3: EnterUserDetails()

Operation: EnterUserDetails( )

Cross References: Management of Profile is underway and it is done by User (Buyer or Seller).

Pre-Conditions: The Update Profile Page has been displayed by the Application after clicking on Update Profile button.

Post-Conditions: User details will be sent to Server to update into the database after clicking on Update button.

23. Contract CO4: UpdateUserDetails()

Operation: UpdateUserDetails( )

Cross References: Management of Profile is underway and it is done by User (Buyer or Seller).

Pre-Conditions: User details will be send to Server to update into the database after clicking on Update button.

Post-Conditions: A selected User details will be updated in User table of NFT Marketplace Database.

Search Products Operation Contracts:

24. Contract CO1: ClickSearchNFT

Operation: ClickSearchNFT()

Cross References: Searching of NFT is underway and it is done by Buyer.

Pre-Conditions: The Home page has been displayed by the Application.

Post-Conditions: Buyer will be associated with Search Bar in the Header.

25. Contract CO2: EnterSearchNFTDetails

Operation: EnterSearchProductDetails(Text)

Cross References: Searching of NFT is underway and it is done by Buyer.

Pre-Conditions: The relevant NFT(s) have been displayed by the Application after clicking on the Search icon in Search bar.

Post-Conditions: A NFT name or relevant keyword will be sent to Server to search from the database after clicking on the Search icon.

26. Contract CO3: GetNFTDetails()

Operation: GetNFTDetails( )

Cross References: Searching of NFT is underway and it is done by Buyer.

Pre-Conditions: A request will be sent by the Buyer to get the information of NFTs from the database.

Post-Conditions: An entered NFT details will be displayed on the Search NFT Page that has been gotten from the NFT table of NFT Marketplace Database.

Admin Operation Contracts:

27. Contract CO1: ClickManageDisputes

Operation: ClickManageDisputes()

Cross References: Management of Disputes is underway and it is done by Admin.

Pre-Conditions: The Admin Dashboard has been displayed by the Application.

Post-Conditions: Admin will be associated with Manage Disputes Page.

28. Contract CO2: ClickResolveDisputes

Operation: ClickResolveDisputes()

Cross References: Management of Disputes is underway and it is done by Admin.

Pre-Conditions: Admin will be associated with Manage Disputes Page.

Post-Conditions: Admin will see all the disputes for the seller stores on Disputes Page and Resolve them accordingly.

29. Contract CO3: SeeNFTAndStoreReviews()

Operation: SeeNFTAndStoreReviews()

Cross References: Management of Store Quality is underway and it is done by Admin.

Pre-Conditions: The Store and NFT Feedback Page has been displayed by the Application after clicking on See Stores Feedback Button.

Post-Conditions: Ratings and Reviews of Stores and NFT inside them will be shown on the Feedback page.

Contract CO4: SuspendOrBanProfiles()

Operation: SuspendOrBanProfiles( )

Cross References: Management of Profile is underway and it is done Admin.

Pre-Conditions: User details will be shown on this page by the Application.

Post-Conditions: A selected User profile will be Suspended or banned by the Admin depending on the situation.

Buy Products Operation Contracts:

30. **Contract CO1: ClickAddToCart**

Operation: ClickAddToCart()

Cross References: Buying of NFT is underway and it is done by Buyer.

Pre-Conditions: The Selected NFT page has been displayed by the Application.

Post-Conditions: The Selected NFT(s) by the Buyer will be added to cart.

31. **Contract CO2: CheckOut**

Operation: CheckOut()

Cross References: Buying of NFTs is underway and it is done by Buyer.

Pre-Conditions: The Selected NFT(s) by the Buyer will be added to cart.

Post-Conditions: The Connect Wallet Page will be shown by the Application.

32. **Contract CO3: Connect Wallet ()**

Operation: Connect Wallet()

Cross References: Buying of NFTs is underway and it is done by Buyer.

Pre-Conditions: The Connect Page will be shown by the Application.

Post-Conditions: Wallet details will be sent to Server to add into the database after clicking on Next button.

33. Contract CO3: TransferRights()

Operation: TransferRight()

Cross References: Buying of NFT is underway and it is done by Buyer.

Pre-Conditions: Wallet details will be sent to Server to add into the database after clicking on Next button.

Post-Conditions: The rights of bought NFTs will be transferred to this buyer. The NFT owner name will be updated in the database.

4.7. ACTIVITY DIAGRAM

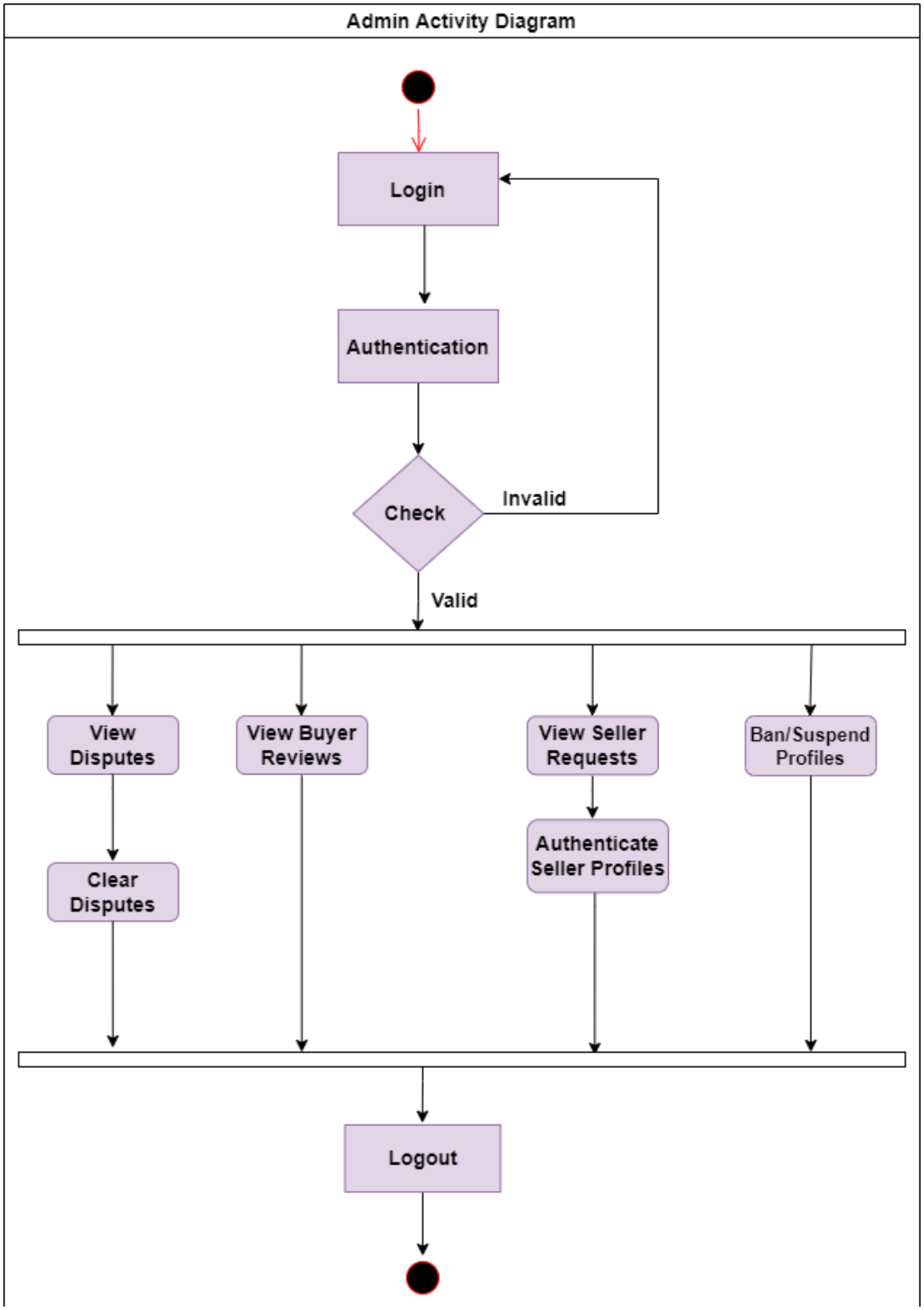


FIGURE 11. ACTIVITY DIAGRAM; ADMIN

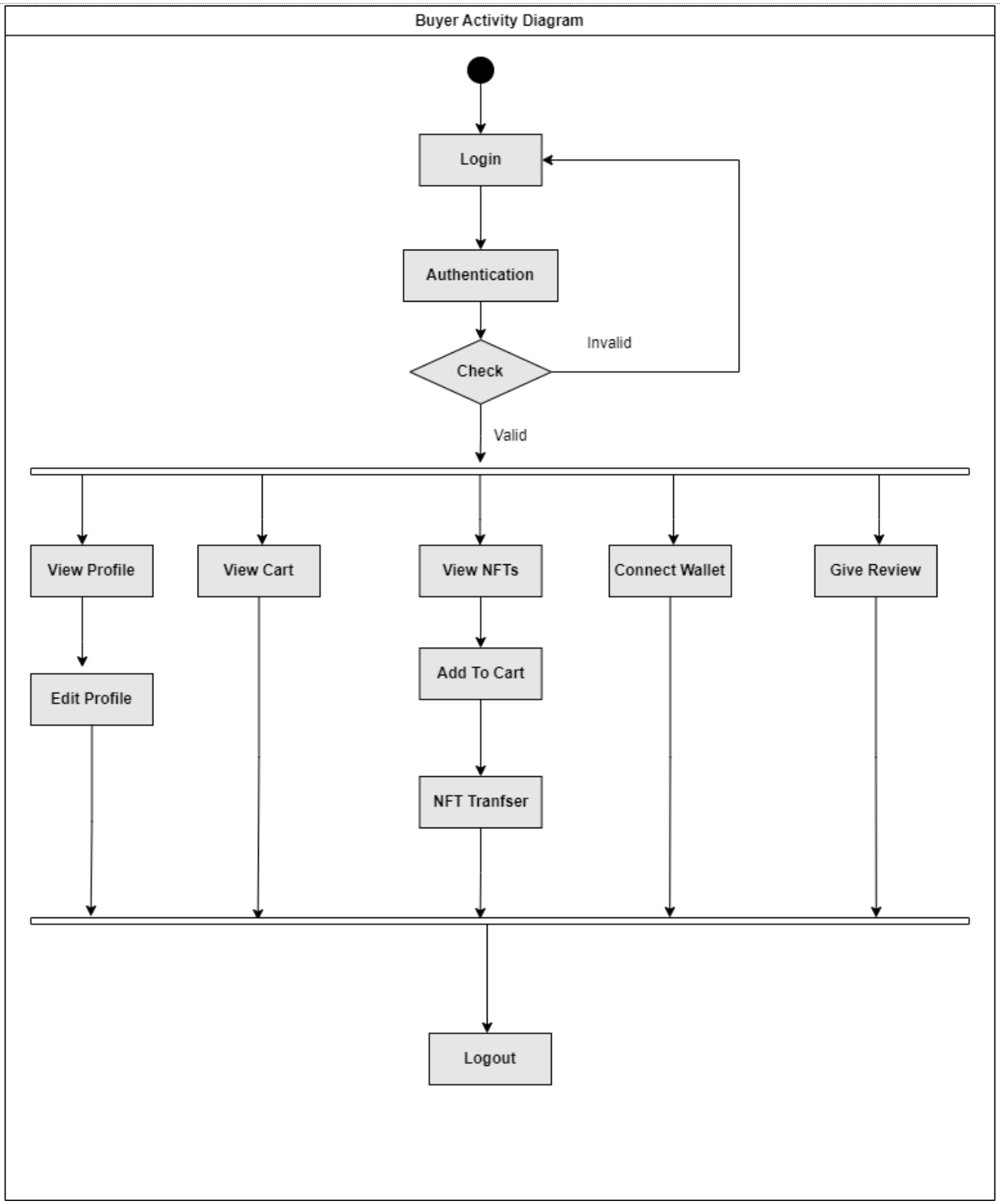


Figure 15 ACTIVITY DIAGRAM; BUYER

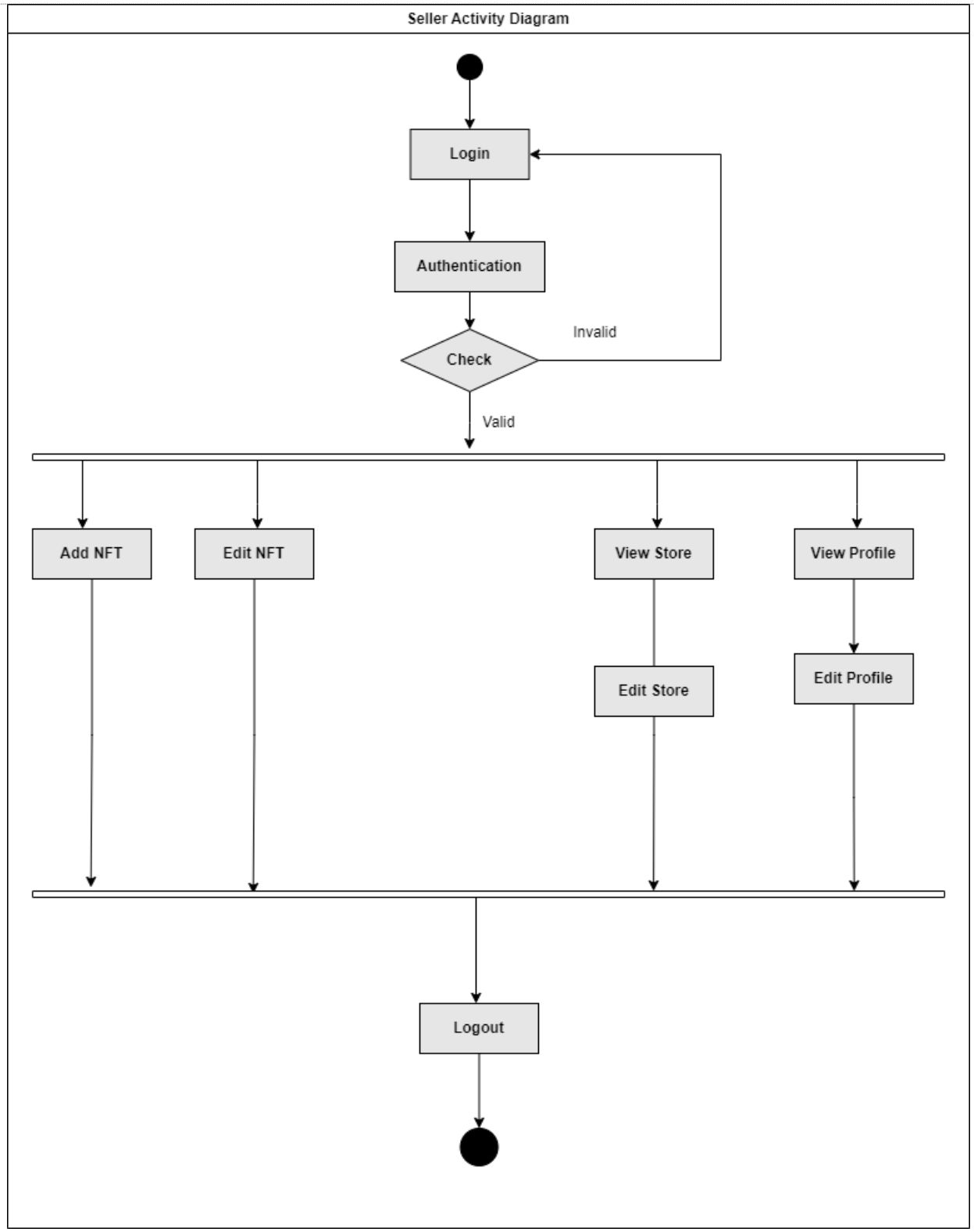


Figure 16 ACTIVITY DIAGRAM; SELLER

4.8. STATE TRANSITION DIAGRAM

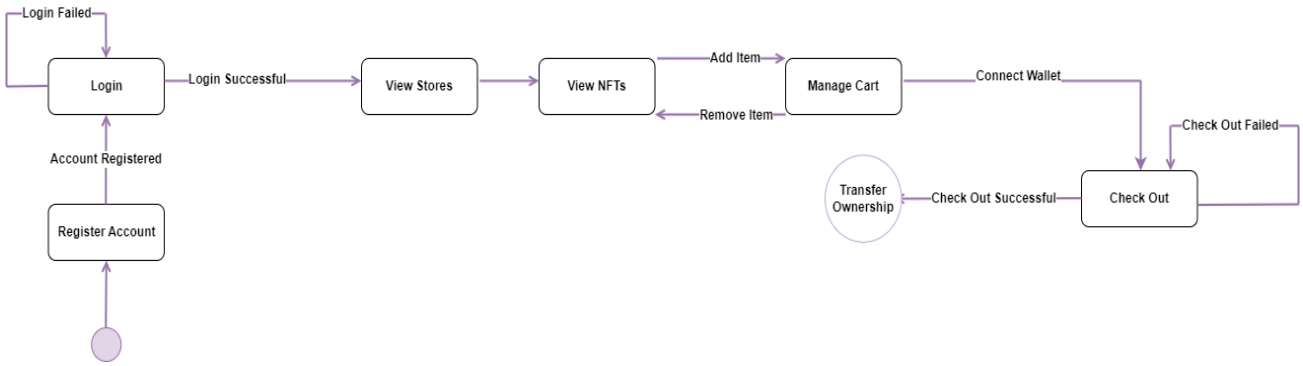


Figure 17 STATE TRANSITION DIAGRAM

4.9. COMPONENT DIAGRAM

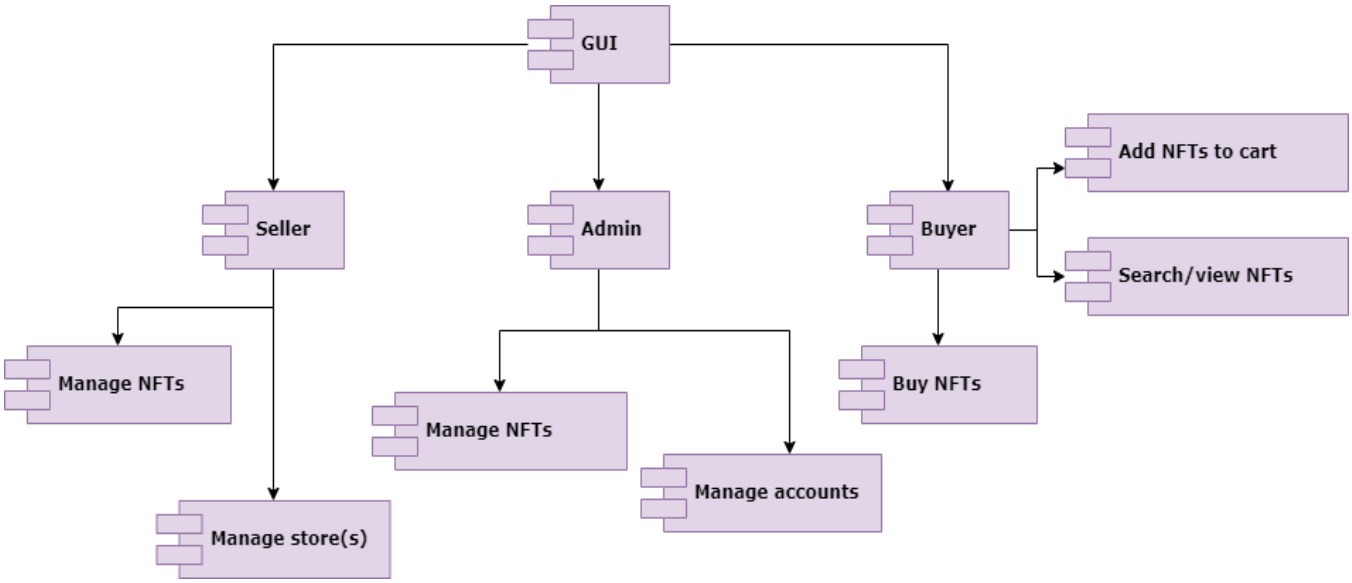


Figure 18 COMPONENT DIAGRAM

4.10. DEPLOYMENT DIAGRAM

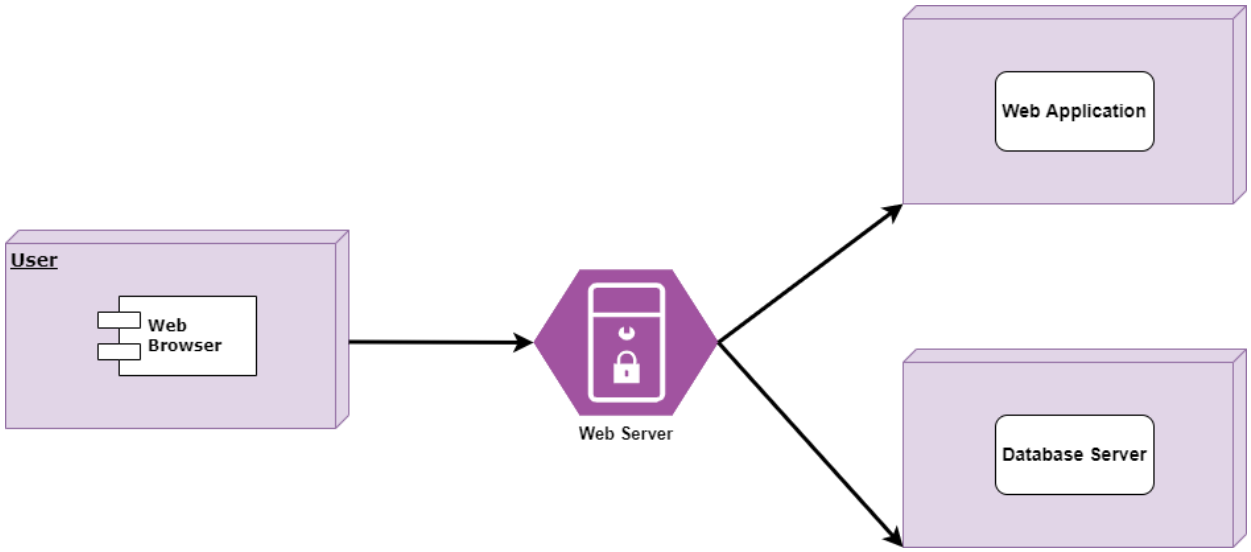


Figure 19 DEPLOYMENT DIAGRAM

4.11. DATA FLOW DIAGRAM

Level 0

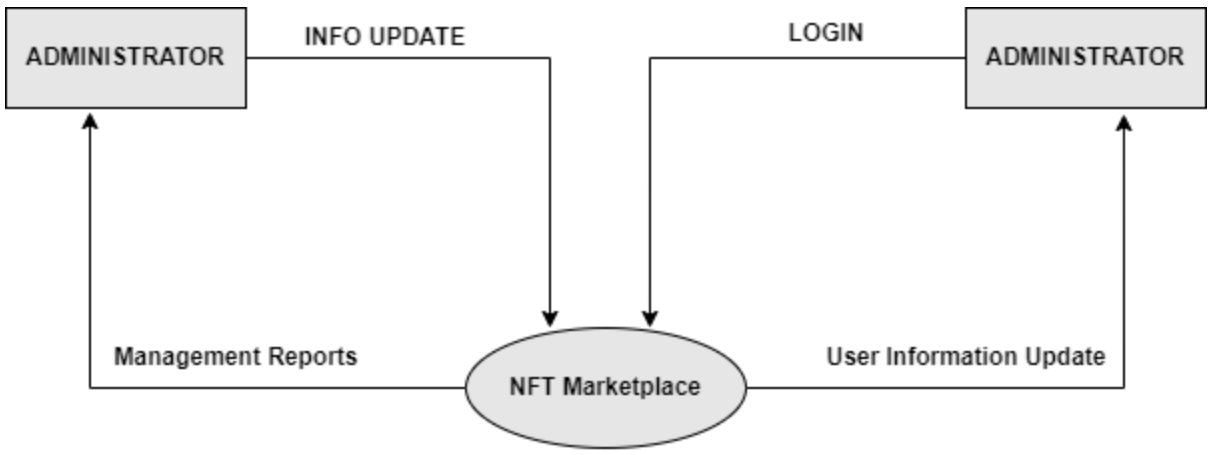


Figure 20 DATA FLOW DIAGRAM; Level 0

Level 1

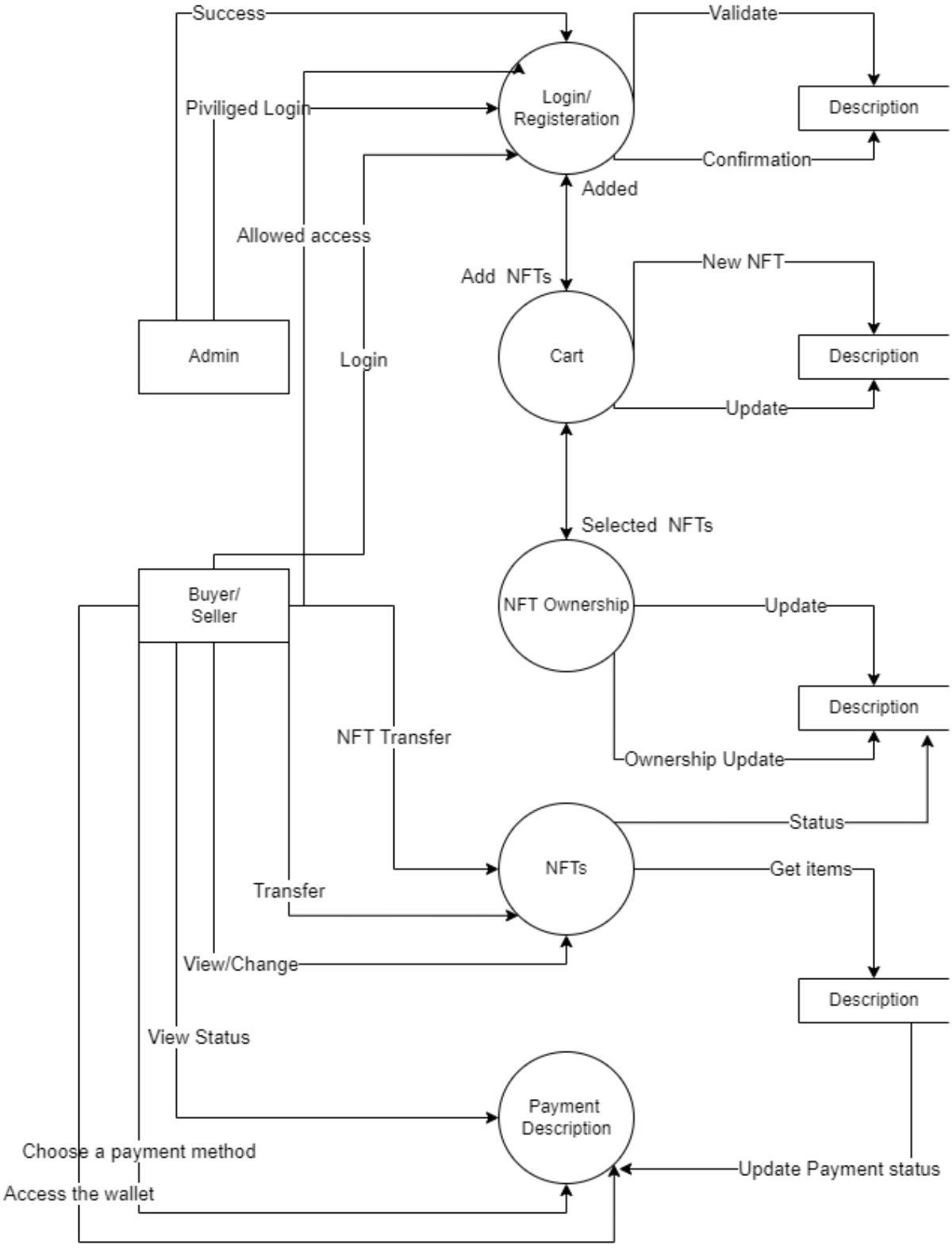


Figure 21 DATA FLOW DIAGRAM; LEVEL 1

CHAPTER 5

IMPLEMENTATION

This section deals with the goal of creating an essential site where multiple sellers can list their NFTs to eliminate the marketplace communication gap and consumers can view and buy these NFTs efficiently. This mechanism will make it easy for both parties to improve their businesses.

5.1. IMPORTANT FLOW CONTROL/PSEUDO CODES

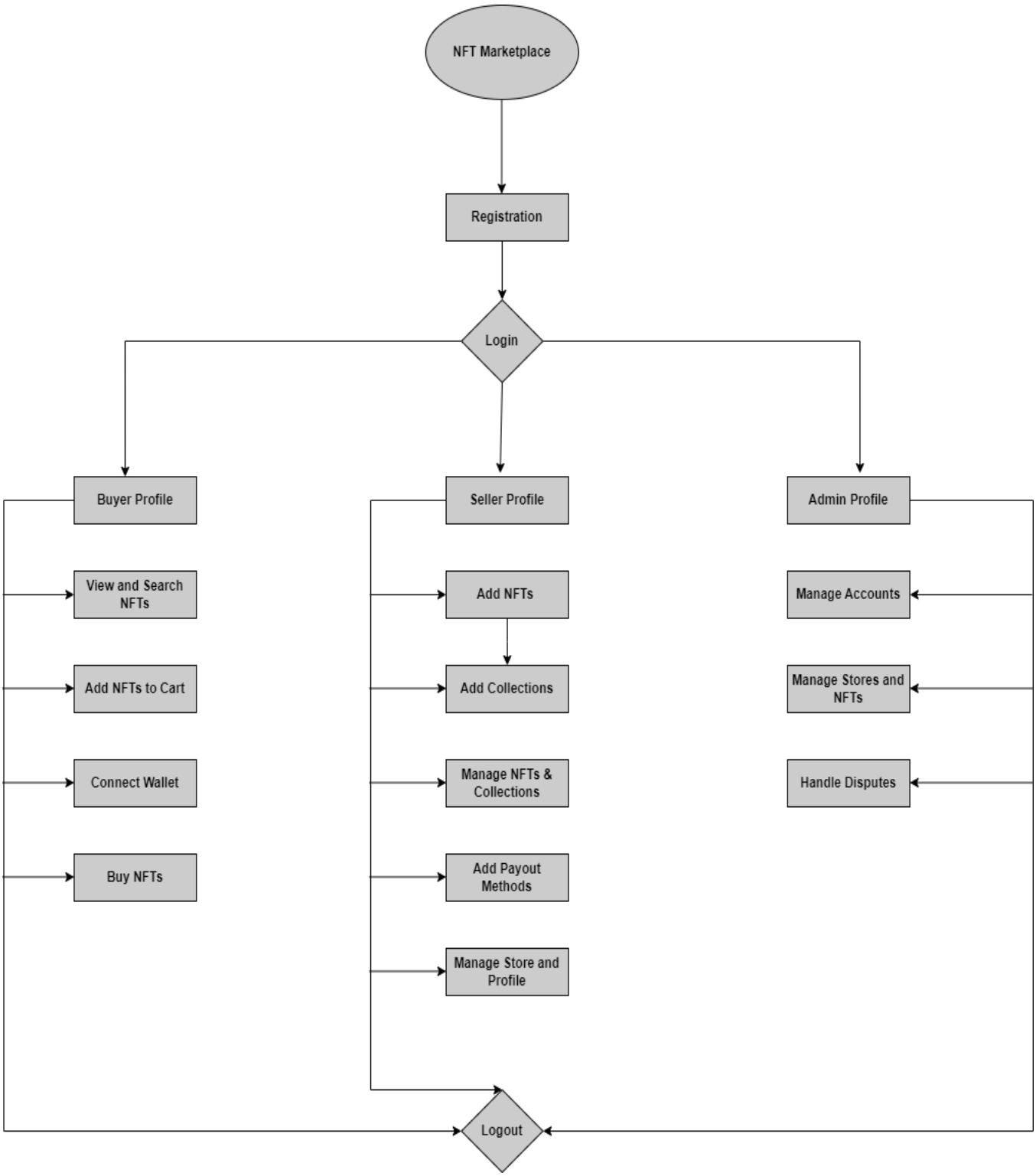


Figure 22 FLOW CONTROL/PSEUDO CODE

5.2. COMPONENTS, LIBRARIES, WEB SERVICES AND STUBS

Components:

1. Properly Structured Website

Our NFT Marketplace website is easy to use. If a seller wants to add an NFT, they can easily do that. If a buyer wants to view those NFTS, they can easily view NFTs. Our website has a simple structure, with the most important pages accessible from the main title bar. Our website has many filters for searching Products.

2. User Friendly

Our NFT Marketplace platform is a user friendly website. Every person can easily use all the features of the website. User can easily register their profile as either buyer or seller into our portal to buy or sell their desired NFTs.

Languages and Libraries:

Bootstrap5, Node JS, React JS, JavaScript, HTML, CSS, Express JS, MongoDB and Smart Contracts.

Web Services:

- 24-hr access
- Sellers can add the NFTs and also add discounts on customized collection for the NFTs.
- Buyers can view all the stores and the NFTs in it post or search for any specified product.
- Admin can manage the profiles of Buyers, sellers and shopping stores and can also handle the disputes

5.3. DEPLOYMENT ENVIRONMENT

Here we need a domain on which our website will exist and through the domain, People will access the website

Browser

- Safari
- Chrome
- Firefox
- MS edge

Server

It depends on the hosting service from which we will get our domain.

5.4. TOOLS AND TECHNIQUES

Node JS

It is a server-side scripting language designed for Web development. It provides latest

Functionalities regarding saving, fetching, updating and deleting the data.

Microsoft Word

Microsoft word is the word processor and would be used for documentation purpose

Throughout the whole project.

Microsoft Excel

Microsoft excel is spreadsheet and would be used for data analysis throughout the

Whole project.

Microsoft Project

Microsoft Projects provides extensive features on project management with a

Prominent feature of project scheduling. Gantt charts, resource allocations. This would be

Used as a project management tool throughout the whole project.

Draw.io

Draw.io is a tool for modeling different diagrams which would be addressed during

Analysis and design phases of the project.

Project Modeling

Rational Rose and Microsoft Visio are to be used to draw use cases with different

Perspectives as they support the language of Rational Unified Process (RUP). Use case

Diagram, Data Flow Diagram (DFD), domain model and all other OOAD analysis and

Design diagrams are supported.

Server

Server is required where whole data is stored.

5.5. BEST PRACTICES / CODING STANDARDS

- No coding repetition
- Function and classes are always commented showing expected input and output.
- Stable Requirements and Scope
- Defined Organization, Systems, and Roles
- Quality Assurance
- Planned Commitments

5.6. VERSION CONTROL

GitHub Version Control: GitHub is a free and open source distributed version control system designedto handle projects with speed and efficiency.

Software Development Life Cycle: Iterative and Incremental Process Model.

CHAPTER 6

TESTING AND EVALUATION

In this Chapter, we are going to test our software's credibility with various black box & white box testing techniques. This chapter will depict whether our software is promising or not.

6.1. USE CASE TESTING

Use Case Testing is a black-box testing technique that focuses on validating the system's functionality by testing scenarios based on use cases. Use cases represent interactions between actors (users or systems) and the system itself. Test cases, also known as scenarios, are designed to cover a wide range of user interactions, ensuring that the system behaves as expected from start to finish for each specific use case.

Here are some test cases, presented in a table format, based on common use cases or scenarios for an NFT Marketplace.

Test Case No.	Test Case Description	Preconditions	Test Steps	Expected Results
01	**User Registration**	The user is not registered.	1. Click on the "Register" button. 2. Provide valid registration details. 3. Verify email through the sent link.	User is successfully registered and can log in.
02	**Browse NFTs**	The user is logged in.	1. Navigate to the NFT listings page. 2. Browse available NFTs.	NFTs are displayed with relevant information (name, description, owner, etc.).
03	**Purchase NFT**	The user has sufficient funds in their wallet.	1. Select an NFT for purchase. 2. Click on the "Buy" button. 3. Confirm the purchase.	User's wallet is deducted, and they own the purchased NFT.
04	**Sell NFT**	The user owns an NFT they want to sell.	1. Navigate to the "Sell" section. 2. Select the NFT for sale. 3. Set a price and confirm the listing.	NFT is listed for sale, and user wallet is credited upon successful sale.
05	**Search and Filter**	NFT listings are available.	1. Use the search bar or filters to find specific NFTs.	Relevant search results or filtered NFTs are displayed.
06	**Manage NFTs in the Wallet**	User has NFTs in their wallet.	1. Go to the user's wallet section. 2. View and manage owned NFTs.	List of owned NFTs is displayed, and user can perform management actions.
07	**Notification of Unavailability**	User attempts to buy an unavailable NFT.	1. Select an NFT marked as unavailable. 2. Attempt to purchase.	User receives a notification that the NFT is unavailable for purchase.

Test Case No.	Test Case Description	Preconditions	Test Steps	Expected Results
08	**User Authentication**	User is logged out.	1. Log in with valid credentials.	User is successfully authenticated and gains access to the system.

These test cases cover various aspects of the NFT Marketplace, including user registration, browsing, buying and selling NFTs, searching and filtering, managing the wallet, handling unavailability notifications, and user authentication. They provide a comprehensive test coverage for different use case scenarios in the NFT Marketplace.

6.2. EQUIVALENCE PARTITIONING

Equivalence partitioning is applied to various scenarios in an NFT (Non-Fungible Token) Marketplace to divide input spaces into classes, making it easier to derive test cases. This technique helps ensure comprehensive test coverage while minimizing the number of test cases needed.

1st Partitioning Example: NFT Purchase Age Restrictions

- **Valid Input Range:** 18 – 56
- **Invalid Inputs:**
    - Invalid Class 1: Ages less than or equal to 17 (<=17)
    - Invalid Class 2: Ages greater than or equal to 57 (>=57)

Equivalence Classes:

- Valid Class: Pick any one input test data from the range 18 – 56 (e.g., 25 years old)
- Invalid Class 1: Pick any one input test data less than or equal to 17 (e.g., 16 years old)
- Invalid Class 2: Pick any one input test data greater than or equal to 57 (e.g., 60 years old)

2nd Partitioning Example: Mobile Phone Number Validation

- **Valid Input:** 10 digits
- **Invalid Inputs:**
    - Invalid Class 1: 9 digits
    - Invalid Class 2: 11 digits

Equivalence Classes:

- Valid Class: Enter a 10-digit mobile number (e.g., 9876543210)
- Invalid Class 1: Enter a mobile number with less than 10 digits (e.g., 987654321)
- Invalid Class 2: Enter a mobile number with more than 11 digits (e.g., 98765432109)

By applying equivalence partitioning to these scenarios, we ensure that the NFT Marketplace is tested comprehensively for various valid and invalid inputs, allowing for efficient and effective testing of key functionalities.

6.3. BOUNDARY VALUE ANALYSIS

Boundary value analysis (BVA) is a software testing technique that focuses on testing the extremes of input values. This can be used to identify potential problems with the software, such as errors, crashes, or unexpected behavior.

In the context of an NFT marketplace, BVA can be used to test the following:

- The minimum and maximum values of bids and asks. This can help to identify problems with the way that prices are calculated or displayed.
- The number of NFTs that can be listed for sale. This can help to identify problems with the way that the marketplace stores and retrieves data.
- The amount of time that an NFT can be listed for sale. This can help to identify problems with the way that the marketplace handles expirations.
- The number of NFTs that a user can buy or sell at once. This can help to identify problems with the way that the marketplace handles transactions.
- BVA is a valuable tool for testing NFT marketplaces. By identifying potential problems early, BVA can help to ensure that the marketplace is reliable and secure.
- Here are some examples of how BVA can be used to test an NFT marketplace:
- Test that a bid cannot be placed for an amount that is less than the minimum bid price.
- Test that an ask cannot be placed for an amount that is greater than the maximum ask price.
    - Test that a user cannot list more than the maximum number of NFTs for sale.
- Test that an NFT cannot be listed for sale for longer than the maximum listing period.
- Test that a user cannot buy or sell more than the maximum number of NFTs at once.
- By using BVA, testers can help to ensure that the NFT marketplace is operating correctly and that users are not able to exploit any vulnerabilities.

6.4. DATA FLOW TESTING

Data flow testing is a software testing method that focuses on how data moves through an application. In the context of NFT marketplaces, it involves examining the flow of data between different components, such as smart contracts, wallets, blockchains, and user interfaces. The goal of data flow testing is to identify potential security vulnerabilities, inconsistencies, or errors that could compromise user funds or the integrity of NFTs.

Why is data flow testing important for NFT marketplaces?

NFT marketplaces are a relatively new and evolving technology, so it is important to ensure that they are secure and reliable. Data flow testing is one of the best ways to identify potential problems before they can cause serious damage.

What are the benefits of data flow testing for NFT marketplaces?

- It can help to identify security vulnerabilities that could be exploited by attackers.
- It can help to identify inconsistencies in the data that could cause problems.
- It can help to identify errors in the code that could cause NFTs to be lost or stolen.

How is data flow testing implemented in NFT marketplaces?

Data flow testing can be implemented manually or automatically. Manual data flow testing involves tracing the flow of data through the application by hand. This can be a time-consuming process, but it can be very effective at identifying complex problems.

Automated data flow testing involves using a tool to trace the flow of data through the application. This can be a much faster and more efficient process, but it may not be able to identify all of the same problems as manual data flow testing.

What are some examples of data flow testing scenarios for NFT marketplaces?

- Creating an NFT
- Listing an NFT for sale
- Buying an NFT
- Transferring an NFT
- Minting an NFT

What are some best practices for data flow testing NFT marketplaces?

- Start by identifying the most critical data flows.
- Use a combination of manual and automated testing.
- Keep your test cases up to date as the application evolves.
- Make data flow testing a part of your continuous integration and continuous delivery (CI/CD) pipeline.

Data flow testing is an essential part of ensuring the security and reliability of NFT marketplaces. By carefully considering the data flow through your application, you can identify and mitigate potential problems before they can cause serious damage.

DATA UNIT NAME	DATA FLOW METHOD	TEST RESULTS
NFT CREATION	User -> Create NFT -> Upload NFT image -> Set NFT title, description, and price -> Publish NFT	NFT is successfully created and published to the marketplace.
NFT LISTING	User -> Browse NFT listings -> View NFT details -> Click Buy NFT	NFT listing is successfully displayed and the user can view NFT details.
NFT PURCHASE	User -> Buy NFT -> Confirm purchase -> Payment	NFT is successfully purchased and transferred to the user's wallet. The seller receives the sale proceeds in their wallet.
NFT BIDDING	User -> Place bid -> Confirm bid -> Payment	Bid is successfully placed and the user is notified if they are the highest bidder.
NFT AUCTION	Auction starts -> Bids are placed -> Auction ends -> Highest bidder wins NFT	Auction successfully ends and the highest bidder wins the NFT.
NFT OWNERSHIP TRANSFER	NFT is sold or gifted -> Ownership of NFT is transferred to the new owner	NFT ownership is successfully transferred to the new owner.
NFT MANAGEMENT	User -> Manage NFTs -> Edit NFT details -> Edit NFT price -> Add NFT to collection	User can successfully manage their NFTs, including editing NFT details, editing NFT price, and adding NFTs to collections.
NFT COLLECTION CREATION	User -> Create NFT collection -> Set collection name,	NFT collection is successfully created and the user can add NFTs to the collection.

	description, and cover image -> Add NFTs to collection	
NFT COLLECTION MANAGEMENT	User -> Manage NFT collections -> Edit collection details -> Add NFTs to collection -> Remove NFTs from collection	User can successfully manage their NFT collections, including editing collection details, adding NFTs to collections, and removing NFTs from collections.
NFT SEARCH	User -> Search NFTs -> Enter search criteria -> Search results are displayed	User can successfully search NFTs using various criteria, such as NFT title, description, and category.
NFT FILTERING	User -> Filter NFTs -> Select filter criteria -> Filtered results are displayed	User can successfully filter NFTs using various criteria, such as NFT category, price, and owner.

6.5. UNIT TESTING

Unit testing is a software testing technique that focuses on testing individual units of code. This can be used to identify potential problems with the code, such as errors, crashes, or unexpected behavior. In the context of an NFT marketplace, unit testing can be used to test the following:

- The smart contracts that govern the buying, selling, and transfer of NFTs.
- The user interface that allows users to interact with the marketplace.
- The backend services that power the marketplace.

Unit testing is an important part of the development process for NFT marketplaces. By identifying potential problems early, unit testing can help to ensure that the marketplace is reliable and secure.

Here are some examples of how unit testing can be used to test an NFT marketplace:

- Test that a smart contract cannot create an NFT with an invalid ID.
- Test that the user interface displays the correct information about an NFT.
- Test that the backend services can handle a large number of concurrent users.

By using unit testing, developers can help to ensure that the NFT marketplace is working correctly and that users are not able to exploit any vulnerabilities.

Here are some of the benefits of unit testing NFT marketplaces:

- Early identification of problems
- Reduced risk of bugs and security vulnerabilities
- Improved quality and reliability of the marketplace
- Reduced maintenance costs
- Increased developer confidence

6.6. INTEGRATION TESTING

Integration testing is a software testing method that focuses on ensuring that different components of an application work together correctly. In the context of NFT marketplaces, it involves testing the interactions between different components, such as smart contracts, wallets, blockchains, and user interfaces. The goal of integration testing is to identify potential problems that arise when different components interact with each other.

Why is integration testing important for NFT marketplaces?

NFT marketplaces are complex systems that rely on a number of different components working together. It is important to ensure that these components are compatible with each other and that they work together as expected. Integration testing is one of the best ways to identify potential problems before they can cause serious damage.

What are the benefits of integration testing for NFT marketplaces?

- It can help to identify compatibility issues between different components.
- It can help to identify communication problems between different components.
- It can help to identify errors in the code that cause different components to behave unexpectedly.

How is integration testing implemented in NFT marketplaces?

Integration testing can be implemented in a number of different ways. One common approach is to use a testing environment that simulates the real-world environment of the NFT marketplace. This can be a physical environment or a virtual environment.

Another common approach is to use a combination of testing environments. For example, you could use a physical environment to test the interactions between smart contracts and wallets, and a virtual environment to test the interactions between the user interface and the blockchain.

What are some examples of integration testing scenarios for NFT marketplaces?

- Creating an NFT and listing it for sale
- Buying an NFT
- Transferring an NFT
- Minting an NFT

What are some best practices for integration testing NFT marketplaces?

- Start by identifying the most critical integrations.
- Use a combination of testing environments.
- Keep your test cases up to date as the application evolves.
- Make integration testing a part of your continuous integration and continuous delivery (CI/CD) pipeline.

Integration testing is an essential part of ensuring the security and reliability of NFT marketplaces. By carefully testing the interactions between different components, you can identify and mitigate potential problems before they can cause serious damage.

6.7. PERFORMANCE TESTING

Performance testing is a software testing method that focuses on measuring the performance of an application under load. In the context of NFT marketplaces, it involves measuring the throughput, latency, and resource utilization of the application under a variety of load conditions. The goal of performance testing is to identify performance bottlenecks and to ensure that the application can meet the needs of its users.

Why is performance testing important for NFT marketplaces?

NFT marketplaces are high-traffic applications that must be able to handle a large number of concurrent users. It is important to ensure that the application can perform well under load, otherwise users may experience long wait times or even error messages. Performance testing is one of the best ways to identify potential performance problems before they can cause a negative user experience.

What are the benefits of performance testing for NFT marketplaces?

- It can help to identify performance bottlenecks that could cause a negative user experience.
- It can help to ensure that the application can meet the needs of its users.

6.8. STRESS TESTING

Stress testing assesses the performance of an NFT marketplace (NFTM) when subjected to an abnormal or excessive workload, usually beyond its operating limits. The objective is to determine its breaking point in terms of handling heavy loads without collapsing or failing to perform crucial functions. Through stress testing, potential performance bottlenecks, flaws, and issues that the NFTM might encounter under extreme conditions can be identified and addressed.

It is crucial to stress test NFT marketplaces due to the increasing demand and high-volume transactions they may undergo. NFTs, or non-fungible tokens, have gained significant popularity, leading to a surge in NFT marketplace usage. By conducting stress tests, NFT marketplace developers can ensure that their platform can handle peak demand, prevent downtime, and safeguard user funds and investments.

Here are some of the benefits of stress testing NFT marketplaces:

1. Identify performance bottlenecks: Stress testing exposes performance limitations and resource constraints that may hinder the NFT marketplace's ability to handle peak traffic.
2. Prevent unexpected breakdowns: By understanding the application's breaking point, developers can take proactive measures to prevent failures and crashes under high load.
3. Ensure scalability: Stress testing helps determine the NFT marketplace's ability to scale and accommodate increasing user demand and transaction volume.
4. Protect user funds and investments: By safeguarding the platform's stability and robustness, stress testing helps minimize the risk of system failures that could jeopardize user assets.

CHAPTER 7

SUMMARY, CONCLUSION & FUTURE ENHANCEMENTS

1.1. PROJECT SUMMARY

Project Overview:

The NFT Marketplace project aims to establish a robust and secure platform for the creation, minting, buying, selling, and trading of non-fungible tokens (NFTs). It will empower creators to showcase their unique digital assets, connect with art enthusiasts and collectors, and generate revenue from their creative endeavors.

Key Features:

- User-friendly interface for seamless NFT creation, minting, and listing
- Secure escrow system to protect transactions and ownership rights
- Advanced search and filtering functionalities to enhance user experience
- Multi-currency support for global accessibility

Target Audience:

- Artists, musicians, photographers, and digital content creators
- NFT enthusiasts, collectors, and investors
- Blockchain technology enthusiasts seeking to engage with NFTs

Project Deliverables:

- Fully functional NFT Marketplace platform
- Comprehensive integration with various blockchain networks
- Secure transaction processing and wallet support
- User-friendly interface and intuitive user experience

Project Impact:

- Empowering creators to monetize their digital artwork and content
- Fostering a vibrant community of NFT enthusiasts and collectors
- Enhancing the accessibility and transparency of the NFT ecosystem
- Promoting the adoption of blockchain technology for digital asset ownership

Project Goals:

- Establish a leading NFT Marketplace with a diverse range of NFTs

- Attract a significant user base of creators, collectors, and investors
- Ensure a secure and user-friendly platform for NFT transactions
- Contribute to the growth and innovation of the NFT ecosystem

Project Timeline:

- Phase 1: Development of the NFT Marketplace platform (3 months)
- Phase 2: Testing, integration, and deployment (2 months)
- Phase 3: Launch and marketing of the NFT Marketplace (1 month)
- Phase 4: Ongoing maintenance, updates, and community engagement

Project Success Metrics:

- Number of NFTs listed on the platform
- Volume of NFT transactions
- User engagement and satisfaction
- Growth of the NFT Marketplace community

Project Conclusion:

The NFT Marketplace project is poised to revolutionize the way digital assets are owned, traded, and valued. By providing a secure, user-friendly, and innovative platform, it will empower creators, connect collectors, and contribute to the growth of the NFT ecosystem.

1.2. ACHIEVEMENTS AND IMPROVEMENTS

Project Achievements:

- Successful development and launch of the NFT Marketplace platform
- Acquisition of a significant user base of creators, collectors, and investors
- Facilitation of numerous NFT transactions with secure and robust escrow system
- Establishment of a strong reputation for reliability and user-friendliness

Project Improvements:

- Continuous enhancement of the user interface to improve user experience

- Integration with new blockchain networks to expand accessibility
- Implementation of advanced security measures to safeguard user funds and assets
- Introduction of innovative features to enhance NFT engagement and discovery

1.3. CRITICAL REVIEW

Despite the increasing popularity of NFTs, NFT marketplaces face several critical challenges that hinder their wider adoption and long-term sustainability. These challenges include:

1. Security concerns: The inherent nature of blockchain technology and the digital assets involved in NFT transactions expose users to potential security risks such as hacking, scams, and fraudulent activities.
2. Scalability limitations: As the NFT ecosystem expands, existing blockchain networks may face scalability issues, leading to slower transaction speeds, higher transaction fees, and network congestion.
3. Limited liquidity: The relatively new and niche market for NFTs can result in limited liquidity, making it difficult for users to easily buy and sell NFTs at fair prices.
4. Environmental impact: The energy-intensive nature of blockchain mining and transactions raises concerns about the environmental impact of NFT marketplaces.
5. Uncertainty of regulations: The lack of clear and consistent regulations surrounding NFTs creates uncertainty for both creators and collectors, potentially hindering the long-term growth of the NFT market.

1.4. LESSONS LEARNT

Here are some lessons learned for NFT marketplaces:

- Security is paramount. Implement industry-standard security measures to protect user funds and assets from hacking, scams, and fraudulent activities. Employ advanced cryptography, smart contracts, and multi-signature authentication protocols to safeguard the integrity of the platform.
- User experience is key. Design a user-friendly interface that is easy to navigate and provides a seamless experience for both creators and collectors. Intuitive onboarding processes, clear instructions, and responsive customer support are essential for attracting and retaining users.
- Community engagement is vital. Foster a vibrant community of NFT enthusiasts by creating social spaces, hosting virtual events, and collaborating with influential individuals. Utilize social media platforms and online forums to engage with users, gather feedback, and promote the platform.

- Marketing and education are crucial. Raise awareness about NFT marketplaces through targeted marketing campaigns and comprehensive educational content. Explain the benefits of NFTs, showcase compelling use cases, and provide guidance on responsible investment and collection practices.
- Collaborations are powerful. Partner with established brands, artists, and influencers to expand the reach of the NFT marketplace and attract new users. Collaborations can help generate excitement, promote unique NFTs, and enhance the overall value proposition of the platform.
- Adaptability is essential. The NFT landscape is rapidly evolving, so staying ahead of trends and adapting to new technologies is crucial. Embrace innovation, experiment with new features, and respond to user feedback to maintain a competitive edge.
- Scalability is paramount. Anticipate growth and ensure the NFT marketplace can handle increasing transaction volume and user traffic. Implement robust infrastructure, optimize code, and utilize efficient blockchain networks to ensure smooth performance under load.
- Regulatory compliance is important. Keep abreast of emerging regulations and ensure the NFT marketplace adheres to relevant guidelines. Proactive compliance will foster trust and credibility among users.
- Environmental consciousness is necessary. Address concerns about the environmental impact of blockchain technology by exploring eco-friendly alternatives, promoting sustainable practices, and collaborating with green initiatives.

1.5. FUTURE ENHANCEMENTS/RECOMMENDATIONS

The NFT marketplace is rapidly evolving, and there are many potential future enhancements and recommendations for both established and emerging platforms. Here are some key areas of focus:

1. Improved user experience: NFT marketplaces should focus on making the user experience more intuitive and user-friendly. This includes simplifying the process of creating, minting, and buying NFTs, as well as providing better search and discovery tools.
2. Enhanced security: Security is paramount in the NFT space, as users are entrusting the platforms with valuable digital assets. NFT marketplaces should continue to invest in advanced security measures, such as multi-signature authentication, secure storage solutions, and regular vulnerability assessments.
3. Scalability and performance: As the popularity of NFTs continues to grow, NFT marketplaces need to be able to handle increasing transaction volume and user traffic. This will require investments in robust infrastructure, efficient blockchain networks, and optimized code.
4. Integration with additional blockchain networks: Currently, most NFT marketplaces operate on a single blockchain network. However, expanding support to multiple blockchain networks would provide users with more choices and increase the accessibility of NFTs.
5. Exploration of new NFT use cases: NFTs have the potential to revolutionize various industries beyond art and collectibles. NFT marketplaces can explore new use cases in gaming, real estate, supply chain management, and other areas.
6. Integration with DeFi protocols: Decentralized finance (DeFi) protocols can offer new possibilities for NFT marketplaces, such as enabling fractional ownership of NFTs, providing NFT-backed loans, and facilitating more advanced financial transactions.

7. Promoting cross-platform interoperability: The NFT ecosystem is currently fragmented, with NFTs often locked into specific platforms or blockchain networks. NFT marketplaces can play a role in promoting cross-platform interoperability, allowing users to move NFTs between different platforms and networks.
8. Addressing environmental concerns: The energy-intensive nature of blockchain technology raises concerns about the environmental impact of NFTs. NFT marketplaces can explore eco-friendly alternatives, such as using proof-of-stake blockchains or investing in carbon offset initiatives.
9. Enhancing regulatory compliance: As regulations around NFTs develop, NFT marketplaces should stay up-to-date and ensure compliance with relevant guidelines. This will help foster trust and credibility among users.
10. Fostering community engagement: A strong community is essential for the success of any NFT marketplace. Platforms should actively engage with users, gather feedback, and host events to promote a sense of connection and belonging.

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