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ArtEcho

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Abstract

This document outlines the purpose and objectives of a groundbreaking project aimed at revolutionizing the art world in the digital era. Traditional art forms often require significant human effort to navigate complexities, but with advancements in technology, the opportunity for artists to modernize their craft arises. The project's goal is to create an online social platform catering to artists worldwide, offering a user-friendly, interactive interface for sharing artwork, connecting with a global audience, and participating in virtual art exhibitions and events. This innovative application seeks to automate the intricacies of traditional art, providing an aesthetic and accessible experience for all art enthusiasts.

Executive Summary

At its core, ArtEcho is an online social platform designed exclusively for artists, both emerging and established. The platform offers a user-friendly interface, and introduces comprehensive art timelines, and carves out a dedicated space for virtual art exhibitions and events, allowing artists to showcase their work on a global stage.

ArtEcho's documentation is structured into several chapters based on the related information they contain. Chapter 1 covers the purpose of the document, which mainly focuses on its creation, and the targeted audience. The second chapter outlines the project's vision, which defines the system's goals. The third chapter reviews related work, including applications that have been developed to provide similar functionality. Finally, the fourth chapter outlines the various requirements for the project.

The starting chapters of the report discuss ArtEcho's scope which is to create an online social platform specifically tailored for artists and art enthusiasts worldwide. It offers a digital canvas where connections are made, creativity flourishes, and artwork is shared. Our platform covers various aspects, from crafting an interactive user interface and ensuring powerful database management to implementing security measures. Our project's core objectives revolve around user-friendliness, streamlined registration, social media functionalities, and innovative features like art timelines and NFT-driven galleries, all while embracing the power of blockchain technology. The application will respond to user-inputted information and be subject to testing during the development phase which will be central to creating a seamless platform. ArtEcho seeks to simplify the intricate world of art by applying the power of high-end web technologies and offering a modern makeover to traditional art practices.

Moreover, the third chapter of ArtEcho description includes a review of several related works such as DeviantArt, CGSociety, Behance, Pinterest, Etsy, and Redbubble. While these existing platforms have made significant contributions to the art community, they fall short in digitalizing traditional art and delivering an immersive experience to users.

Lastly, the fourth chapter of ArtEcho details the list of features, functional and non-functional requirements, software and hardware requirements necessary to develop the system.The chapter also includes various use cases such as signup and login. The GUI samples show how the application will look after completion, giving an idea of the design and layout of the interface. Additionally, the database part of the chapter includes the relationship of different entities with each other, followed by a data dictionary table that describes different attributes, data types, and functionalities. Finally, it provides a risk analysis of different types of risks that may be encountered during the development of the project and provides solutions to manage and mitigate those risks.

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Chapter 1 Introduction

Introducing ArtEcho, a social media platform designed exclusively for artists sets the stage for the goals of this project. This dynamic hub brings together both emerging and established individuals providing a user registration and login system along, with standard social media features like liking and commenting on posts.. Beyond these functionalities ArtEcho offers artist tools that include comprehensive art timelines, a dedicated virtual art exhibition, an event section and an integrated marketplace for seamless buying and selling of artwork.

To create an experience the application incorporates cutting edge technologies such as Virtual Reality (VR) and Non Fungible Tokens (NFTs) to recreate the atmosphere of an art gallery. The technological foundation of ArtEcho is built on the MERN Stack, complemented by elements like blockchain, Web3 and NFTs. These ensure a virtual art gallery experience that aims to bridge the gap, between digital art while nurturing a vibrant global artistic community.

1.1 Purpose of this Document

This document aims to clarify the goals and reasons, behind our Final Year Project (FYP) that focuses on creating ArtEcho, a social media website specifically designed for artists. Our project strives to bring digital art by providing a dynamic platform where both emerging and established artists can connect and display their artwork.

The primary goal of our research is to provide artists with a sophisticated and immersive platform, integrating technologies such as Virtual Reality (VR) and Non-Fungible Tokens (NFTs) to recreate the ambiance of physical art galleries within a virtual space. We aim to answer the research question: Can we create a virtual art community that enhances artists' and art enthusiasts' sharing, connection, and engagement while embracing modern technological advancements?

In pursuit of this objective, our report will comprehensively detail the methodology, design, implementation, testing, and evaluation of the ArtEcho project. In addition, we will identify inherent limitations and identify avenues for future improvement. Launching this effort, we aim to transform how artists interact with their audiences, making art more accessible and engaging in the digital age.

1.2 Intended Audience

The intended audience for this Final Year Project (FYP) report includes a range of people who have been heavily involved in the ArtEcho project. This inclusive audience includes the development team,

which relies on the documentation as an important reference to write code on and ensure consistency with specifications Testers assigned to monitor application implementation and management also get the information they need for their work in this report. The marketing team uses these documents to develop effective strategies and promotions, while users looking to understand ArtEcho's characteristics, features, and limitations can rely on them on as an informative item You can measure consistency with expectations . This FYP report serves as a comprehensive guide for a multifaceted audience, spanning development, testing, marketing, and user engagement, all contributing to and benefiting from the ArtEcho project.

1.3 Definitions, Acronyms, and Abbreviations

FYP: Final Year Project

MERN: MySql, Express, React.js, Node.js

NFT: Non-Fungible Token

VR:: Virtual Reality

ML:: Machine Learning

GUI: Graphical User Interface

UI: User Interface

API: Application Programming Interface

1.4 Conclusion

This Introduction chapter sets the stage for our comprehensive exploration of the ArtEcho project. To provide a clear roadmap, we offer a concise outline of each subsequent chapter:

Chapter 2 delves into the Project Vision.

Chapter 3 presents the Literature Review and Related Works.

Chapter 4 covers the Software requirement Specifications.

Chapter 5 focuses on Approach and Methodology.

Chapter 6 provides a High and Low level design for the project.

Lastly, Chapter 7 is concerned with Implementation and Test Cases.

Chapter 2 Project Vision

ArtEcho envisions a transformative platform at the intersection of art and technology, empowering creators across the globe to transcend borders and showcase their art to a worldwide audience. Central to this vision is the seamless conversion of artists' work into NFTs, unlocking the potential for artists to buy and sell their creations globally. These NFTs will find a captivating showcase in immersive VR Art galleries, transcending physical limitations and enabling international exposure like never before.

ArtEcho stands as a stand-alone web application accessible via standard web browsers, providing a unique and engaging space for collectors, experts, and enthusiasts to connect with art innovatively. The system uses the MERN stack to create a user-friendly interface, prioritizing accessibility and simplicity for users from all backgrounds.

Within this vision, ArtEcho seamlessly interfaces with external systems, including popular social media platforms and art-related websites. This integration empowers users to effortlessly share and promote their curated artwork to a wide variety of audiences. Additionally, the platform fosters connections between like-minded individuals, enabling users to participate in live art events and performances, creating a vibrant global arts community is greatly improved.

ArtEco's vision is to break down geographic barriers, democratize art appreciation, and create a dynamic, inclusive ecosystem where practitioners can thrive, enthusiasts can explore, and the world can capture infinite design beauty in the digital age.

2.1 Problem Domain Overview

ArtEco is a dynamic platform that addresses issues of under-represented Pakistani artists. It provides virtual art with a lens to global visibility, complex marketing tools, online art education, NFT funding, cultural recognition, international representation, copyright protection, financing Essentially ArtEcho empowers artists, compels them encouraging reach out and support, transforming Pakistan's art scene.

2.2 Problem Statement

Wages of Pakistani artisans decline due to limited employment opportunities, marketing challenges and economic hardship arising from broader low-light issues they face, including trade barriers, economic hardship, cultural stigma , and so on.

2.3 Problem Elaboration

Like their counterparts around the world, artists in Pakistan face many challenges that contribute to limited exposure and visibility and recognition. Some of those under-realized stories in Pakistani art include:

2.3.1 Limited Exhibition Opportunities:

Accomplished artists often have access to galleries and galleries, making it impossible for them to showcase their work, especially in places where arts facilities are limited

2.3.2 Lack of Promotion and Marketing:

Artists are struggling to effectively promote and sell their creations, hindering their access to potential buyers and art enthusiasts due to a lack of online and marketing infrastructure

2.3.3 Limited Art Education and Training:

Quality arts education and training can be scarce in some parts of Pakistan, hindering artists' skill development and opportunities for expression.

2.3.4 Economic Constraints:

The financial challenges outside of an art career, including the cost of art supplies and studio space, can be overwhelming and restrict an artist's ability to be creative

2.3.5 Lack of Representation:

Pakistani artists may find it difficult to gain recognition in international art markets and fairs, limiting their ability to express their talent beyond local contexts.

2.3.6 Limited Access to Art Grants and Funding:

Finding funds for art projects and exhibitions is a formidable obstacle in Pakistan, as access to arts grants and financial support is limited.

2.4 Goals and Objectives

ArtEco is dedicated to addressing the challenges Pakistani artists face to expose themselves and increase their income. Driven by advanced technology and creative solutions, the platform offers practical solutions. ArtEcho focuses on user friendliness, using machine learning to match user preferences to categorize art, simplify registration and login, and standard social media features as well. It has a ready-made art timeline, a dedicated page for virtual art events and a marketplace for buying and selling art is available. The platform introduces immersive virtual art shows featuring NFT-based artworks, and emphasizes security through blockchain technology. The ultimate goal is to create an environment where artists thrive, gain global recognition, access resources and maximize their income.

2.5 Project Scope

The scope of our project, ArtEcho, is to develop a web application that serves as a virtual space that unites artists and art enthusiasts worldwide. The application will allow its users to:

- User registration and login
- Create, view, and edit user profiles
- Create and share digital mood boards of their favorite artworks
- Discover new art based on personal preferences and recommendations through ML
- Participate in virtual art events and exhibitions
- Browse an interactive art history timeline, complete with images, descriptions, and information about key artists and art movements
- Zoom in on specific periods and click on individual artworks to learn more
- Like and comment on artworks and mood boards
- Follow other users and receive updates on their activity
- Toggle dark mode for a better user experience

The project will be developed using a combination of MySQL, Express, React.js, and Node.js. The application will use a RESTful API to communicate with a back-end database. The project will be developed using Agile development principles, and project management will be done using SCRUM.

However, the project scope does not include the following:

- Providing hosting or server infrastructure for the application
- Developing mobile applications (iOS or Android)

This project scope will be used as a guide throughout the development

2.6 Sustainable Development Goal (SDG)

The ArtEcho method is in line with the United Nations Sustainable Development Goal (SDG) No. 8, ”Decent Work and Economic Growth.” ArtEcho promotes persistent, inclusive, and sustainable economic growth, full and productive employment, and decent work for all by overcoming the underexposure difficulties encountered by Pakistani artists and enable them to make much more money. The platform’s emphasis on financial empowerment through NFT monetization and exploring funding opportunities directly correlates with SDG No.8’s aim to provide economic opportunities and income growth, particularly for marginalized or disadvantaged groups. ArtEcho actively supports the broader global agenda of achieving sustainable economic development and reducing inequalities by fostering a thriving ecosystem for artists and enhancing their economic prospects.

2.7 Constraints

Several design and implementation constraints that need to be catered for the development of our application. The development team can then ensure the final product meets the users’ needs while also delivering a high-quality user experience. Some of the constraints include:

- The application must be compatible with a wide range of web browsers and devices to ensure optimal user experience
- Artist’s history can be accessed by only clicking on his/her profile
- The application should be designed to handle a large volume of users and artwork
- The system’s user interface must be intuitive and user-friendly
- Password must be hidden
- The username and password must be authenticated
- The application must always be accessible

2.8 Business Opportunity

Career opportunities in the ArtEco project are at the intersection of art, technology and community building. Here's a breakdown of where and how this opportunity presented itself.

2.8.1 Monetization through NFT

One of the main sources of income for ArtEcho is the monetization of artwork as NFT. The platform allows artists to charge for publishing and authoring their NFTs, and earn revenue from each successful sale. As the NFT market continues to evolve, Arteco will be able to participate in this lucrative business.

2.8.2 Virtual art galleries and exhibition spaces

Offering virtual art galleries and exhibition spaces, ArtEcho can charge artists and collectors for premium gallery installations and virtual exhibitions. This generates revenue by providing a platform for artists to showcase their work to a global audience.

2.8.3 Subscription and Premium Features

ArtEcho may use a freemium model, providing premium features or subscriptions and basic services for free with a subscription fee. Luxury items can include enhanced marketing tools, priority events, or advanced research for artists and collectors.

2.8.4 Art Marketplace

An integrated marketplace for buying and selling artworks can generate revenue through transaction fees or bonuses for successful sales. In addition, they can earn money on feature catalog promotions to increase artist visibility.

2.8.5 Online Art Education

The delivery of online art education materials and courses may be funded through tuition fees or subscription models. This expands the revenue stream beyond the main platform.

2.8.6 Data and Analytics

The platform can provide data analytics services to artists and collectors, helping them understand market trends, audience behavior and sales metrics

2.9 Stakeholders Description/ User Characteristics

This phase examines stakeholders in the process, including people with an interest in project development and the users.

2.9.1 Stakeholders Summary

ArtEcho will have a number of stakeholders involved, these include:

- The team of developers is responsible for developing the application and making sure it works It meets the needs of the end users.
- The main users of the application are art enthusiasts, artists and interested individuals and the experience of sharing art.
- Approval by FAST NUCES, the project management organization.
- The person(s) who supports and guides the clients in achieving the project goals.
- Individuals or organizations that have invested in the project financially.

All of these stakeholders are important to the success of the ArtEcho project, as well as the goals and objectives The work will be done only with their participation and support.

2.9.2 Key High-Level Goals and Problems of Stakeholders

Listed below are the top key objectives and problems among stakeholders.

2.9.3 Key High-Level Goals:

- Developers aim to provide a successful product that will appeal to the target market.
- Users want a reliable platform that is easy to use, speeds up operations and saves time.
- Owners aim to save costs while increasing productivity and efficiency.

2.9.4 Problems:

The following are some of the most important issues stakeholders are currently facing.

- New technologies may require manufacturers to adopt new capabilities, which can cost time and money. When combining multiple systems or technologies, compatibility issues may arise.
- Users may need guidance to properly use the product and may be reluctant to adopt new technology.

- Data security and privacy issues should be addressed to protect sensitive user data and customer confidence.
- Production and maintenance can be difficult due to lack of funds, skilled labor, or other resources.

2.10 Conclusion

In conclusion, this chapter provides a comprehensive analysis of the ArtEcho app, including its goals, objectives, and potential market impact. Technology provides a key answer to the problems that event organizers have in meeting the needs of users and designers. The project objectives are also in line with the SDGs on quality and economic development, and demonstrate its potential for beneficial social and economic impact Overall, this chapter prepares a foundation for building and policy efficient and modern meeting the requirements of stakeholders

Chapter 3 Literature Review / Related Work

This chapter will concentrate on existing applications and comparable works that have a similar concept or problem statement as ArtEcho.

3.1 Detailed Literature Review

In this section, we will be performing an in-depth literature review of related works and existing applications for artists and art enthusiasts all around the world. We picked six relevant studies and applications to offer a detailed review of existing solutions in this domain. Each linked study will be described and critically examined for strengths and weaknesses, and its relevance to the proposed application will be discussed.

3.1.1 Related Research Work 1: DeviantArt [1]

3.1.1.1 Summary of the research item

DeviantArt is a social networking website and community for artists, with a wide range of creative forms available, including digital art, traditional art, and photography. It was created in 2000 and gained the reputation of a prominent art community. It not only delivers itself as a digital space for artists and art enthusiasts but also as a platform for creative workers to promote their work.

3.1.1.2 Critical analysis of the research item (Strengths and Weaknesses)

DeviantArt has strengths, including a large and engaged community of users a wide range of artistic content, and an easy-to-use design. It has proven to be a platform for artists to showcase their work and engage with others, in the community. However, there are some limitations to consider. DeviantArt primarily focuses on showcasing the work of artists rather than offering virtual art gallery experiences or immersive interactions. As a result, it may not fully align with the goals of the proposed project, which aims to create a gallery that incorporates both digital art.

3.1.1.3 Relationship to the proposed research work

The focus, on fostering artist interactions and facilitating content sharing on DeviantArt aligns well with the aspects of our project that aim to create a platform for artists to connect. However the absence of virtual gallery features sets it apart from the goals we have, for our planned project.

3.1.2 Related Research Work 2: CGSociety [2]

3.1.2.1 Summary of the research item

The CGSociety, also known as the Computer Graphics Society is a platform, for artists working in art, CGI (computer-generated imagery), and visual effects. It provides a space for digital artists, animators and experts in computer graphics to come together.

3.1.2.2 Critical analysis of the research item (Strengths and Weaknesses)

One of the strengths of CGSociety is its expertise in art and its strong professional community. It serves as a hub for networking and showcasing within the industry. However, it may not be the fit for art forms as it doesn't offer extensive virtual gallery features. Due to this limitation, it may not be suitable for our proposed project which aims to encompass art forms.

3.1.2.3 Relationship to the proposed research work

While CGSociety's focus on art aligns with some aspects of our application its lack of support for art makes it less relevant, to the objectives of our proposed project.

3.1.3 Related Research Work 3: Behance [3]

3.1.3.1 Summary of the research item

Behance is a platform owned by Adobe that focuses on showcasing and discovering work, within the fields of graphic design, illustration, and photography. It allows creative people to build portfolios and promote their work on a public platform.

3.1.3.2 Critical analysis of the research item (Strengths and Weaknesses)

Behance is renowned for its user-friendly design, and its capabilities include making professional portfolios and networking with creative people. However, its focus on design-related domains may limit its impact on traditional art. It lacks the features that cater to virtual art galleries, which are an important component of our project.

3.1.3.3 Relationship to the proposed research work

The focus on design and limited support for traditional art in Behance shows less coordination with the goals of our proposed project, which aims to create an accomplished digital artist-centric platform.

3.1.4 Related Research Work 4: Pinterest [4]

3.1.4.1 Summary of the research item

Pinterest is a visual discovery social networking site that helps users find and save creative ideas and customize inspiration boards with content gathered from the web.

3.1.4.2 Critical analysis of the research item (Strengths and Weaknesses)

Pinterest's strength is in facilitating visual discovery and idea exchange. The users can curate visual content groupings for inspiration. However, it is not geared toward artists because the lack of features for displaying art in virtual galleries or exhibitions makes it insignificant to our proposed project's aims.

3.1.4.3 Relationship to the proposed research work

Pinterest is an excellent site for broad visual discovery, but it does not correspond with our project's goals, which include developing a digital platform for artists and art fans with virtual gallery experiences.

3.1.5 Related Research Work 5: Etsy [5]

3.1.5.1 Summary of the research item

Etsy is an e-commerce platform that provides a marketplace for handmade and unique items, including artwork and crafts created by artists and artisans, to a global audience.

3.1.5.2 Critical analysis of the research item (Strengths and Weaknesses)

Etsy's benefits include its large marketplace, which allows artists to access interested buyers. However, it is an e-commerce site and may not offer realistic virtual gallery experiences that align with our project's objectives.

3.1.5.3 Relationship to the proposed research work

While Etsy allows artists to sell their work, it primarily focuses on e-commerce and may not entirely coordinate with our project's aims of defining virtually realistic art galleries and an interactive artists' community.

3.1.6 Related Research Work 6: Redbubble [6]

3.1.6.1 Summary of the research item

Redbubble is a website where artists can submit and sell their artwork on various things, such as apparel, home decor, and accessories, and reach a worldwide audience.

3.1.6.2 Critical analysis of the research item (Strengths and Weaknesses)

Redbubble's strengths include an easy-to-use platform and the ability for artists to monetize their work by applying it to various items. However, it is largely focused on selling artwork and may not deliver the virtual gallery experiences required by our project.

3.1.6.3 Relationship to the proposed research work

Redbubble is useful for artists looking to commercialize their work, but it is not built to provide realistic virtual art gallery experiences or link artists in a dedicated art community, both of which are important components of our planned project.

3.2 Literature Review Summary Table

The following table 3.1, highlights and summarizes the important results of the literature review, emphasizing the strengths, limitations, and significance of each related work/application to the planned research work for our development project.

3.3 Conclusion

In this literature review, we looked at six related works and applications in the field of digital platforms for artists and art enthusiasts, including DeviantArt, CGSociety, Behance, Pinterest, Etsy, and Redbubble. Given that each forum has its strengths and weaknesses, none of them fully aligns with the goals of our project. The project aims to create a versatile online platform with engaging virtual art galleries. ArtEcho's plan, as proved by the literature research, coincides with the increasing demands of potential artists, which makes it a revolutionary platform in the era of tech-driven art trends.

Table 3.1: Summary of Related Works

This table summarizes the features, relevance, and limitations of related research works to the application

Application	**Features**	**Relevance to Application**	**Limitations**
DeviantArt [1]	User interface design	Offers a diverse art community but lacks virtual galleries	Limited to individual artists
CGSociety [2]	Digital art focus	Specialized in digital art, not suitable for traditional art	Not a comprehensive virtual gallery platform
Behance [3]	Graphic design focus	User-friendly interface, but not tailored to traditional art	Limited scope outside of design fields
Pinterest [4]	Visual discovery	General visual discovery platform, not artist-centric	Lacks tools for showcasing art in virtual galleries
Etsy [5]	E-commerce platform	Provides a marketplace for artists, primarily for sales	Limited support for immersive virtual gallery experiences
Redbubble [6]	Art merchandise focus	Allows artists to sell artwork on merchandise, but lacks virtual galleries	Primarily a merchandising platform

Chapter 4 Software Requirement Specifications

The ArtEcho project's software specifications and design guidelines are described in this chapter. Assumptions, use cases, non-functional needs, design constraints, quality attributes, hardware and software requirements, graphical user interface, database design (if necessary), risk analysis, and functional requirements are all described here. To guarantee that the scope and features of the application are well understood, a detailed description of the project requirements must be given.

4.1 List of Features

The following section lists the essential features of the ArtEcho system.

- User Registration and Login
- Create and Share Digital Mood Boards
- Discover Art Based on Personal Preferences
- Participate in Virtual Art Events and Exhibitions
- Browse the Interactive Art History Timeline
- Like, Dislike, and Comment on Artworks
- Toggle Dark Mode for User Experience
- Art Marketplace for Buying and Selling Artwork
- Virtual Art Galleries with NFT-based Artworks
- Blockchain Integration for Security and NFTs

4.2 Functional Requirements

1. **User Registration and Login:** The users can sign up for an account and access the application by providing their email address and password. It guarantees safe account access to users.
2. **Create and Share Digital Mood Boards:** Users can share their digital mood boards, which they can fill with their most beloved works of art, with others. This feature promotes art collaboration and sharing.
3. **Discover Art Based on Personal Preferences:** The application provides recommendations and search capabilities based on the user's likes and interests to assist them in finding new jobs.

4. **Participate in Virtual Art Events and Exhibitions:** Users may take part in online art events and exhibits, interacting with others who share their interests and showcasing their work.
5. **Browse Interactive Art History Timeline:** The system's interactive chronology, which includes images, descriptions, and statistics on key artists and art trends, allows users to study art history.
6. **Like, Dislike, and Comment on Artworks:** Users may join in the community by like, disliking, and commenting on pieces of art.
7. **Toggle Dark Mode for User Experience:** The dark mode functionality improves user experience by providing a new UI color scheme.
8. **Art Marketplace for Buying and Selling Artwork:** The system will include an online marketplace where artists and consumers may purchase and sell artwork, enabling platform transactions.
9. **Virtual Art Galleries with NFT-Based Artworks:** Users will have access to virtual art galleries featuring NFT-based artworks, allowing them to immerse themselves in the platform's art experience.
10. **Blockchain Integration for Security and NFTs:** The program will use blockchain technology to improve security and make it easier to integrate NFTs (Non-Fungible Tokens) for digital art authentication and ownership tracking.

4.3 Quality Attributes

1. **Usability:** The system should be simple to use for users of diverse technical levels.
2. **Reliability:** The system should operate without error and smoothly recover from errors.
3. **Maintainability:** The code in the program should be well-structured and easy to update and maintain.
4. **Portability:** The system must be able to work in a variety of situations and systems.
5. **Scalability:** The system must be able to handle increasing user traffic without decreasing substantially.
6. **Testability:** The system should be designed to allow for effective and thorough testing.
7. **Security:** The system must be able to defend itself against any assault.

4.4 Non-Functional Requirements

The non-functional requirements of our application are given as follows:

4.4.1 Performance Requirements

- The system should be able to support at least 10,000 concurrent users, including art enthusiasts and other users.
- The system should be able to accommodate at least 1,000 user-created mood boards every day.
- The system should be able to manage at least 100 virtual art events each month, each with a maximum of 1,000 participants.
- The system should be able to provide users with artwork and relevant information within 2 seconds of their request.
- The system should be able to handle user uploads of pictures and videos for postings with a file size restriction of 10 MB.
- The system should be able to process at least 100 sales of art pieces each day, together with processing payments and order fulfillment.
- The system should be able to store at least 1 million works of art with photographs, descriptions, and other information.
- The system should be able to alert customers in real-time with a maximum 5-second latency between the incident and message reception.

4.4.2 Safety Requirements

- Ensuring the password is challenging to guess will prevent the system from accessing any user's or artist's personal information.
- Users and artists posting any illegal or inappropriate content must instantly flag it and get it removed by the application.
- Users shouldn't be able to modify or remove previously uploaded resources via the program. These operations are only available to the admin.
- The application must follow any safety certifications required by external standards or regulations.
- To preserve their privacy, the website server should not store any personal data about users, such as their passwords or phone numbers.

4.4.3 Security Requirements

- Mechanisms for users and artists to securely authenticate and authorize users.
- Securely store sensitive user data, including payment information and passwords.
- Put in place secure measures to stop unauthorized users from accessing the database.
- To guarantee the secure movement of funds during art sales, implement a secure payment gateway.
- Backup data regularly to ensure data recovery in the case of a security breach.
- Put safeguards in place to prevent unauthorized access to user collections and mood boards.
- Monitor the platform, look for any suspicious activity, and then take the necessary steps to reduce the risks.
- Users should be given precise instructions on the best ways to preserve the security of their accounts and data.

4.5 Assumptions

- The project assumes that the third-party components used in the system will be accessible and compatible with the MERN stack, which could have an impact on the requirements listed in this chapter.
- The project assumes that the development environment will remain constant and reliable throughout the development cycle.
- The project assumes that the operating environment will be consistent and reliable throughout the system's life.
- The project anticipates that the system would be designed with scalability because any unanticipated scaling problems could damage the system's operation and performance.
- Data leaks or security breaches could harm the project. To secure user data, the project therefore, assumes that the system will be built with the necessary data security mechanisms in place.

4.6 Use Cases

All the use cases that would be essential for the proper functioning ArtEcho project are enlisted below:

4.6.1 Register

The table 4.1 provides a use case for registration to the application.

Table 4.1: Use Case for Registration

Name	Register		
Actors	Artist		
Summary	The Register feature allows users and artists to register to the website by inputting their name, email address and password and after successful account creation, redirect the user to the login page.		
Pre-Conditions	The user must have a valid email address		
Post-Conditions	The user's account is successfully created and shall be redirected to the login page.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	The user opens the register page.	2	The registration page is displayed asking for name, username, email and password.
3	The user enters valid email and password.	4	The system verifies the email and password, establishes an account for the user and redirects the user to the login page.
Alternative Flow			
3	The user enters invalid email or password.	4-A	The system responds with an error message: Email Address invalid

4.6.2 Login

The table 4.2 provides a use case for Login.

4.6.3 Make Post

The table 4.3 provides a use case for Make Post.

4.6.4 Logout

The table 4.4 provides a use case for Logout.

4.6.5 View Market

The table 4.5 provides a use case for View Market.

4.6.6 Sell Art

The table 4.6 provides a use case for Sell Art.

Table 4.2: Use Case for Login

Name	Login		
Actors	Artist, Admin		
Summary	The user shall provide their username and password on the login form, and after successful verification, redirect the user to the home page.		
Pre-Conditions	The user must be in the database records, either added by any of the authorized users or added manually by a developer. The user must not already be logged in.		
Post-Conditions	The user's session is successfully established and shall be redirected to the home page.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	The user opens the Login page.	2	The Login page is displayed asking for username and password.
3	The user enters valid username and password.	4	The system verifies the username and password, establishes a session for the user and redirects the user to the login page.
Alternative Flow			
3	The user enters invalid username or password.	4-A	The system responds with an error message: Account does not exist!

Table 4.3: Use Case for Make Post

Name	Make Post		
Actors	Artist		
Summary	A logged-in user posts their ideas on the platform, with the opportunity to include images, videos, or mood boards as attachments.		
Pre-Conditions	The user must already be logged in.		
Post-Conditions	The user's post is shared on the platform.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	The Artist is on the homescreen.		
2	The Artist clicks the make post box.		
3	The Artist types words and/or uploads pictures, videos or moodboards.		
4	The Artist clicks the upload button.	5	The system adds the post to the Artist's feed and also uploads the post details to the database.
Alternative Flow			
3	The Artist clicks the upload button.	4-A	The system responds with an error message: No Details added

4.6.7 Toggle Dark Mode

The table 4.7 provides a use case for Toggle Dark Mode.

Table 4.4: Use Case for logout

Name	Logout		
Actors	Artist, Admin		
Summary	The user shall logout from their account in one click.		
Pre-Conditions	The user must be logged in.		
Post-Conditions	None.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	The user clicks the logout button	2	System will end the user session and redirect the user to the Login page
Alternative Flow			
1	The user clicks the logout button	2-A	System gives a server error.

Table 4.5: Use Case for View Market

Name	View Market		
Actors	Artist, Admin		
Summary	This use case explains how a user can view NFTs being sold by artists in the ArtEcho community.		
Pre-Conditions	The user must be logged in.		
Post-Conditions	The user is redirected to the Market page.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	The user clicks the MarketPlace Button on the left panel.	2	System will redirect the user to the Marketplace page.
Alternative Flow			
1	The user clicks the MarketPlace Button on the left panel.	2-A	System gives a server error.

4.6.8 View User

The table 4.8 provides a use case for View User.

4.6.9 Add Friend

The table 4.9 provides a use case for Add Friend.

4.6.10 Like/Unlike

The table 4.10 provides a use case for Like/Unlike.

Table 4.6: Use Case for Sell Art

Name	Sell Art		
Actors	Artist, Admin		
Summary	This use case describes how a user can convert their artwork into an NFT and sell it in the marketplace.		
Pre-Conditions	The user must be logged in. The user is in the Marketplace. The user has digital artwork that they want to convert to an NFT.		
Post-Conditions	User's artwork is successfully converted to an NFT and listed in the marketplace.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	The user clicks the Sell Art Button.	2	
3	The user selects the artwork they want to sell.	4	System will end the user session and redirect the user to the Login page
5	User fills out specifications of the artwork.	6	The system generates a unique NFT for the artwork and registers it on the marketplace for other users to purchase.
Alternative Flow			
5	User fills out specifications of the artwork.	6-A	The system responds with an error message: Insufficient Details.

Table 4.7: Use Case for Toggle Dark Mode

Name	Toggle Dark Mode		
Actors	Artist, Admin		
Summary	This use case explains how a user can enable or disable dark mode to view the application in a visually darker environment.		
Pre-Conditions	The user must be logged in.		
Post-Conditions	The application's display mode is switched to dark or light as per the user's choice.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	User taps on the dark mode icon.	2	The system switches the application's modules to a darker or greyish color scheme.
Alternative Flow			
1	None.	2-A	None.

4.6.11 Comment

The table 4.11 provides a use case for Comment.

4.6.12 Create Event

The table 4.12 provides a use case for Create Event.

Table 4.8: Use Case for View User

Name	View User		
Actors	Artist, Admin		
Summary	This use case details how a user can view other users' profiles and newsfeeds.		
Pre-Conditions	The user must be logged in.		
Post-Conditions	The user is viewing the selected user's profile and newsfeed.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	The user taps on another user's name or profile.	2	The system displays the selected user's profile.
Alternative Flow			
1	None.	2-A	None.

Table 4.9: Use Case for Add Friend

Name	Add Friend		
Actors	Artist		
Summary	This use case outlines the process of a user making friends in the ArtEcho community and saving them as friends.		
Pre-Conditions	The user must be logged in.		
Post-Conditions	The selected user is added to the user's friend list. The two users' Friendship relation is updated in the Database.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	User taps on the "Add Friend" button on another user's profile if they are not already friends.	2	The system adds this person to the user's friend list.
Alternative Flow			
1	None.	2-A	None.

4.6.13 Enter Event

The table 4.13 provides a use case for Enter Event.

4.6.14 View History

The table 4.14 provides a use case for View History.

4.6.15 Create Gallery

The table 4.15 provides a use case for Create Gallery.

Table 4.10: Use Case for Like/Unlike

Name	Like/Unlike		
Actors	Artist		
Summary	This use case explains how a user can express their feelings about a post by either liking or unliking it.		
Pre-Conditions	The user must be logged in.		
Post-Conditions	The user's like/unlike is registered for the post. The two users' Like relation is updated in the Database.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	User taps either the like or unlike button below the post.	2	The system highlights the like/unlike button to indicate the user's choice.
Alternative Flow			
1	None.	2-A	None.

Table 4.11: Use Case for Comment

Name	Comment		
Actors	Artist		
Summary	This use case describes how a user can express their thoughts about a post by leaving a comment under it.		
Pre-Conditions	The user must be logged in.		
Post-Conditions	The user's comment is added to the list of comments below the post. The two users' comment relation is updated in the Database.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	The user selects the comment icon under a post to view existing comments.		
2	The user types their comment in the text box and presses "OK" to upload it.	3	The system adds the comment to the list of comments below the post.
Alternative Flow			
1	None.	2-A	None.

4.7 Hardware and Software Requirements

Both hardware and software requirements are provided below

4.7.1 Hardware Requirements

A simple Computer System such as a desktop or laptop where the internet can be connected would be required

Table 4.12: Use Case for Create Event

Name	Create Event		
Actors	Artist		
Summary	This use case outlines the steps for a logged-in user to create an art competition event where other users can participate and vote for their favorite artwork.		
Pre-Conditions	The user must be logged in. User is on the events page.		
Post-Conditions	An art competition event is created.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	User clicks on the ”Create Event” button.		
2	User enters event description and requirements for participation. and presses ”Create Event.”	3	The system displays the event on user’s newsfeed. for participation.
		4	The system determines the winner based on the highest number of votes within a fixed amount of time.
Alternative Flow			
1	None.	2-A	None.

Table 4.13: Use Case for Enter Event

Name	Enter Event		
Actors	Artist		
Summary	This use case describes the process of a logged-in user participating in an art competition event created by another user.		
Pre-Conditions	The user must be logged in. User is on Events page		
Post-Conditions	User has entered an art competition event.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	The user clicks ”Enter Event” on an existing event.		
2	The user uploads their artwork and description and presses enter.	3	The system generates a poll for the new participating user.
		4	The system determines the winner based on the highest number of votes within a fixed amount of time.
Alternative Flow			
2	The user uploads their artwork and description and presses enter.	3-A	The system responds with an error message: Try Again.

Table 4.14: Use Case for View History

Name	View History		
Actors	Artist		
Summary	This use case describes how a user can view the history of art throughout the years.		
Pre-Conditions	The user must be logged in.		
Post-Conditions	User is viewing artworks from the selected historical period.		
Special Requirements	None		
Basic Flow			
Actor Action		**System Response**	
1	The user clicks ”Art Timeline” on the left panel.	2	The systems redirects user to the art history page.
3	User selects a time period to explore artworks from.	4	The system displays artworks from the selected period with details.
Alternative Flow			
1	None.	2-A	None.

Table 4.15: Use Case for Create Gallery

Name	Create Gallery		
Actors	Artist		
Summary	This use case describes how a user can upload artworks to be used within a spatial API integrated into the ArtEcho application to create a 3D art gallery.		
Pre-Conditions	The user must be logged in.		
Post-Conditions	Artworks are successfully uploaded and integrated into the spatial API. Users can access and view the 3D art gallery within the application.		
Special Requirements	Integration with a spatial API capable of rendering 3D art galleries. Artwork files must adhere to supported formats and quality standards for 3D rendering.		
Basic Flow			
Actor Action		**System Response**	
1	User navigates to the ”3D Gallery” feature within the app.		
2	User selects one or more artworks from their device’s storage.	3	The application validates the selected artwork files for compatibility and displays 3D Gallery for the user to navigate through.
Alternative Flow			
1	None.	2-A	None.

4.7.2 Software Requirements

- **Visual Studio Code:** IDE for coding
- **React JS:** Front-End JavaScript Library
- **Node JS:** Back-End JavaScript runtime environment
- **Python:** General Purpose programming language

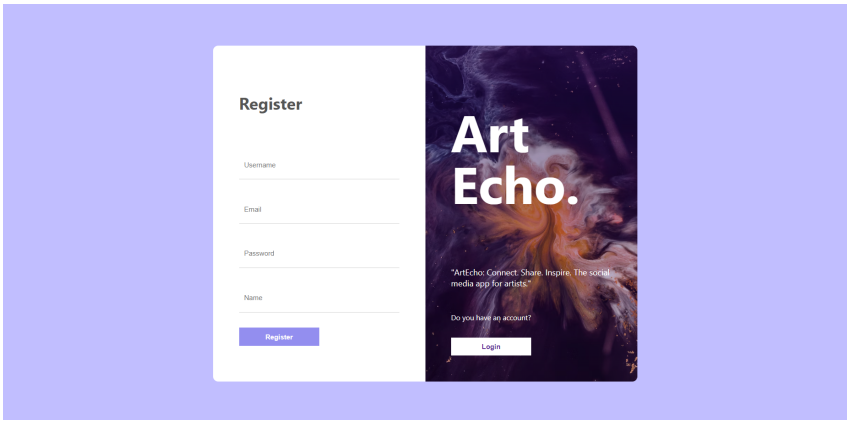

Figure 4.1: User Registration Page.
GUI for ArtEcho Registration page.

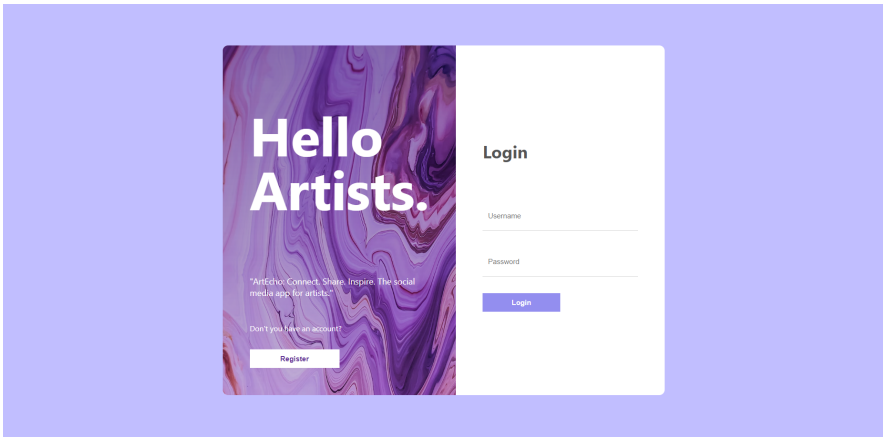

Figure 4.2: Login Page.
GUI for ArtEcho Login page.

- **MySQL:** For Database
- **Express JS:** Back-End web application framework

4.8 Graphical User Interface

The Graphical user interface of the application will look something like the following mockups:

4.8.1 Registration Page

The registration page is given in figure 4.1

4.8.2 Login Page

The Login page is given in figure 4.2

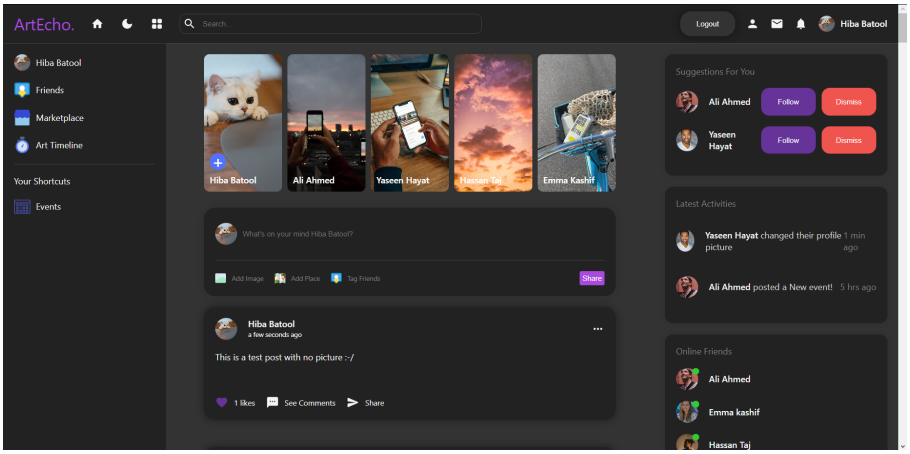

Figure 4.3: Home Page.
GUI for ArtEcho User/Artist page.

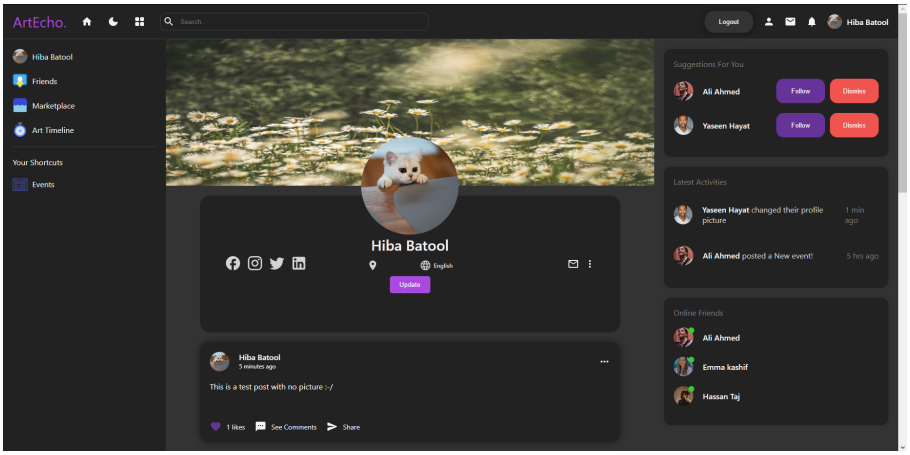

Figure 4.4: User's own profile page.
GUI for ArtEcho User/Artist Profile page.

4.8.3 Home Page

The Home page is given in figure 4.3

4.8.4 User/Artist Profile Page

The User's/Artist's profile page is given in figure 4.4

4.8.5 Marketplace Page

The Marketplace page is given in figure 4.5

4.8.6 Events Page

The Events page is given in figure 4.6

4.8.7 Art Timeline Page

The Art Timeline page is given in figure 4.7

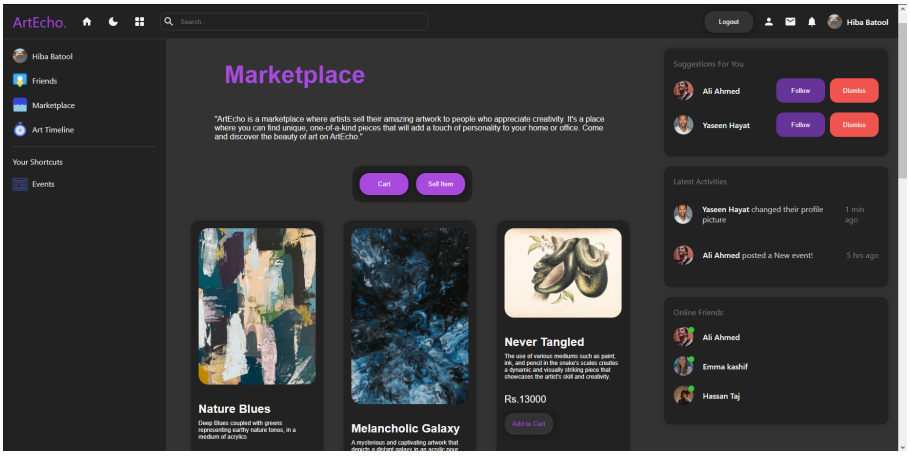

Figure 4.5: MarketPlace page

GUI for ArtEcho Marketplace page.

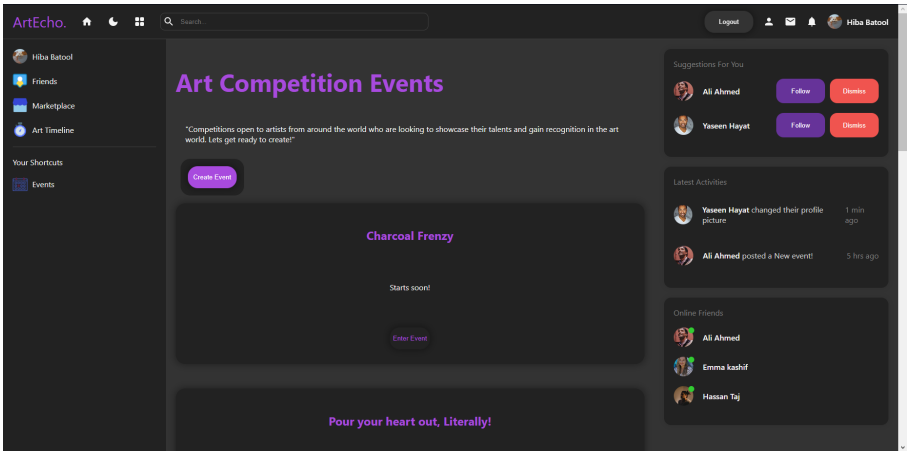

Figure 4.6: Events Page

GUI for ArtEcho User/Artist Events page.

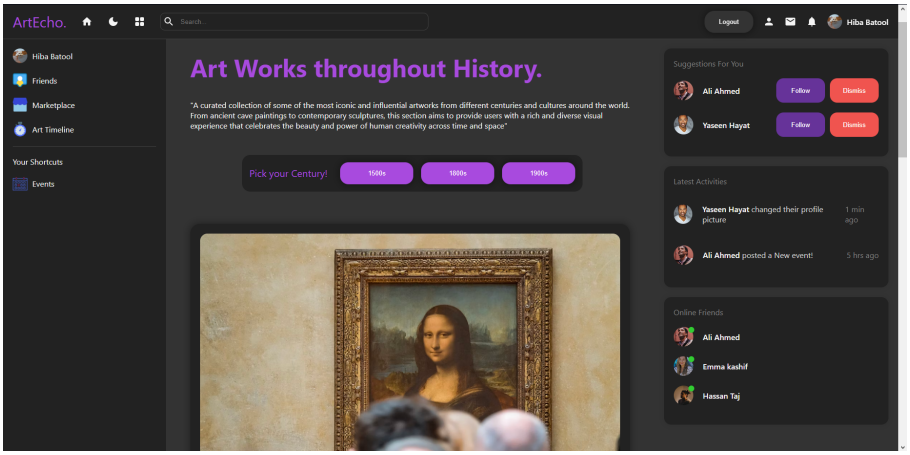

Figure 4.7: Artworks throughout the centuries page.

GUI for ArtEcho Art Timeline page.

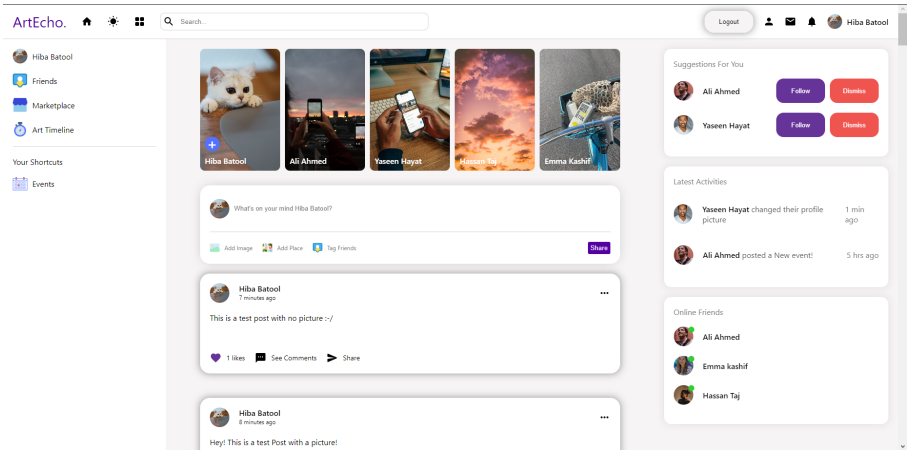

Figure 4.8: The application in light Mode.
GUI for ArtEcho User/Artist Home page in LightMode.

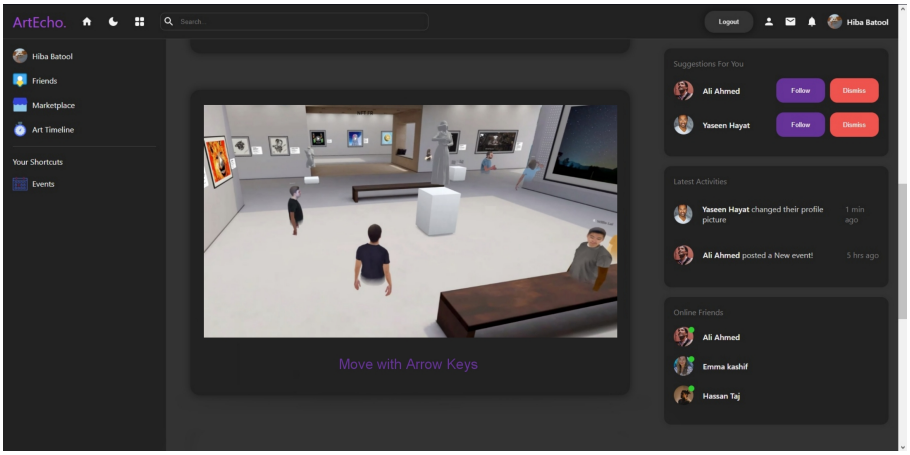

Figure 4.9: Virtual Reality Gallery Page.
GUI for ArtEcho VR Gallery page.

4.8.8 LightMode

The Home page in light mode is given in figure 4.8

4.8.9 Gallery Page

The VR Gallery page is given in figure 4.9

4.8.10 Admin Dashboard

The Admin dashboard page is given in figure 4.10

4.9 Database Design

The following section displays the entity relationship diagram with the data dictionary.

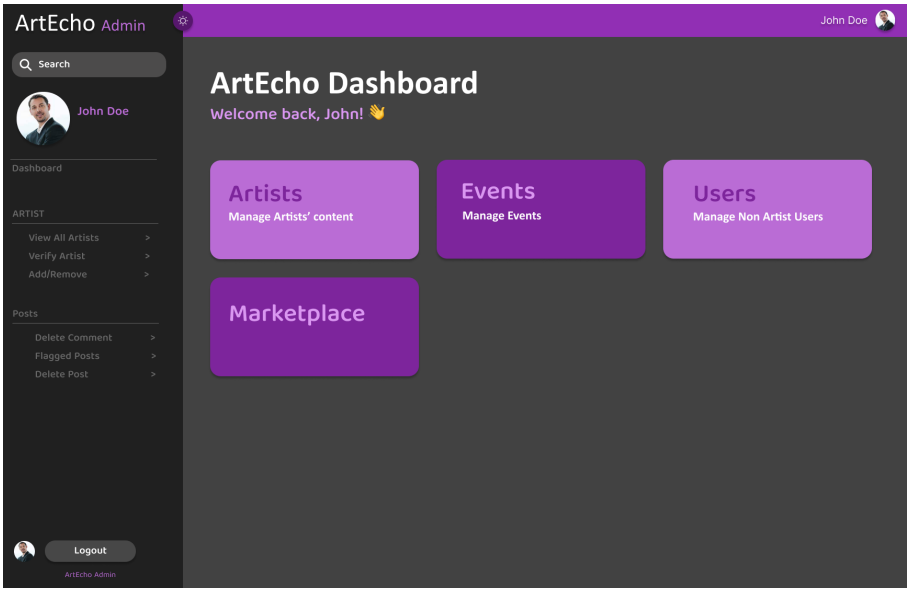

Figure 4.10: Admin Dashboard Page.
GUI for ArtEcho Admin Dashboard page.

4.9.1 ER Diagram

The ER Diagram is given in the figure 4.11

4.9.2 Data Dictionary

Table 4.16 provides the database Metadata.

Table 4.16: Data Dictionary Table

Entity	Attribute	Data Type	Nullable	Description
User	userID	Int	No	Id created for user.(primary key)
	firstName	varchar(255)	No	First Name of User
	lastName	varchar(255)	No	Last Name of User
	email	varchar(255)	No	Email of the user
	Password	varchar(255)	No	Password of the user, hashed for security purposes
	picturePath	varchar(255)	Yes	Profile Photo of the user.

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Table 4.16 – continued from previous page

Entity	Attribute	Data Type	Nullable	Description
	roleType	varchar(255)	No	Indicates whether the user is an admin, simple user or artist.
Post	postID	Int	No	Id created for post.(primary key)
	userID	Int	No	Id of the user who made the post (foreign key)
	description	varchar(255)	Yes	Text written by the user in the post
	picturePath	varchar(255)	Yes	picture(s)/video(s) uploaded by the user in the post
	likes	int	Yes	No. of likes that the post received
	comments	varchar(255)	Yes	Comments left by other users under the post.
	postDateTime	DateTime	No	Time indicating how long ago was the post made.
Artwork	artworkID	Int	No	Id created for artwork (primary key)
	userID	Int	No	Id of the user who made and uploaded the artwork (foreign key)
	description	varchar(255)	Yes	description written by the user who uploaded the artwork

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Table 4.16 – continued from previous page

Entity	Attribute	Data Type	Nullable	Description
	dateOfCreation	date	No	Time indicating how long ago was the artwork made.
Market Item	itemID	Int	No	Id created for market item(primary key)
	userID	Int	No	Id of the user who uploaded the item for sale (foreign key)
	title	varchar(255)	No	Title of the market product
	description	varchar(255)	No	description written by the user who uploaded the artwork
	picturePath	varchar(255)	No	picture(s)/video(s) uploaded by the user for the item
	price	float	No	Price of the item
	availability	boolean	No	is the item available or has it been sold.
Event	eventID	Int	No	Id created for the event(primary key)
	name	varchar(255)	No	Name of the event
	description	varchar(255)	No	description written by the user who created the event
	participantIDs	Int	No	Id of the users participating in the event (foreign key)

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Table 4.16 – continued from previous page

Entity	Attribute	Data Type	Nullable	Description
	eventDate	date	No	Starting date of the event
	availability	date	No	Time indicating how long ago the event started
Friendship	friendshipID	Int	No	Id created for the friendship relation(primary key)
	user1ID	Int	No	Id of the first user in the relation. (foreign key)
	user2ID	Int	No	Id of the second user in the relation. (foreign key)
Like	likeID	Int	No	Id created for the like relation(primary key)
	userID	Int	No	Id of the user liking the post (foreign key)
	postID	Int	No	Id of the post being liked (foreign key)
comment	commentID	Int	No	Id created for the comment(primary key)
	userID	Int	No	Id of the user commenting on the post (foreign key)
	postID	Int	No	Id of the post being commented on(foreign key)

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Table 4.16 – continued from previous page

Entity	Attribute	Data Type	Nullable	Description
	description	varchar(255)	No	The comment text
	cmntTime	date	No	How long ago was the comment left on the post
Vote	voteID	Int	No	Id created for the vote in an event(primary key)
	userID	Int	No	Id of the user voting for the participant (foreign key)
	artworkID	Int	No	id of the artwork being voted for (foreign key)
	eventID	Int	No	Id of the event in which the vote is being cast (foreign key)
Sale	saleID	Int	No	Id created for the sale of a market item(primary key)
	userID	Int	No	Id of the user voting for the participant (foreign key)
	artworkID	Int	No	id of the artwork being voted for (foreign key)
	eventID	Int	No	Id of the event in which the vote is being cast (foreign key)

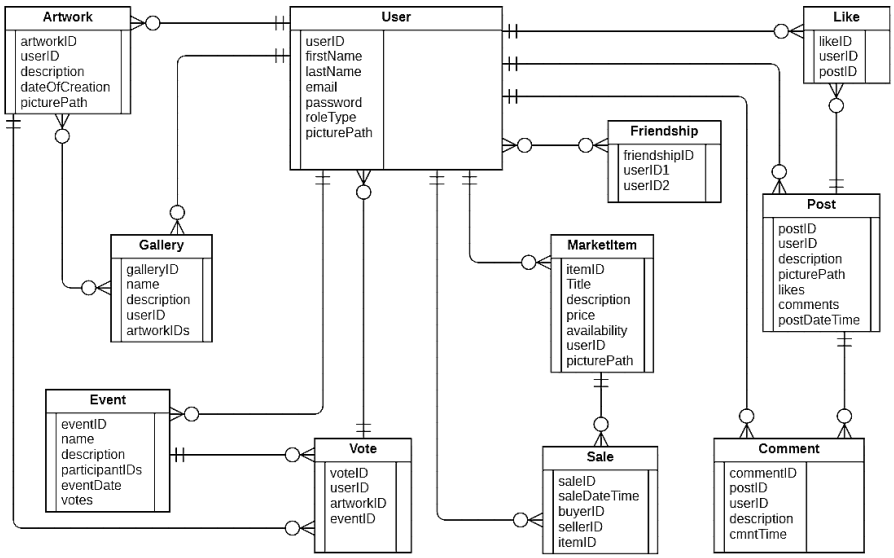

Figure 4.11: ER Diagram

The figure above shows entities and the relationship between them

4.10 Risk Analysis

A web project's risk analysis entails locating, evaluating, and minimizing any hazards that might compromise the project's success. Risks to ArtEcho's business and technical operations are described below.

4.10.1 Technical Risks

The risk of technical obsolescence, when the infrastructure or technology stack of the website becomes antiquated or unsupported and causes compatibility problems or security flaws, could apply to our project. However, new technologies or standards, such as new web browsers, gadgets, or programming languages, may potentially pose a danger to ArtEcho and need upgrading or modifying the website's infrastructure or code.

4.10.2 Business Risks

The website might find it difficult to keep up with changing user expectations, trends, or technology, resulting in lower user engagement or satisfaction. ArtEcho may potentially risk altering client preferences and behavior.

4.11 Conclusion

This chapter has discussed the criteria for developing ArtEcho, including both functional and non-functional requirements, as well as software and hardware specifications. A list of features has also

been supplied, illustrating the numerous user-accessible functions. Use cases illustrate the many ways in which users will interact with the system. To provide a user-friendly experience, the desired appearance and feel of the software have been conveyed in UI designs. A database architecture has also been established, which comprises a data dictionary table with descriptions of each entity's properties and an ERD with relationships and cardinalities between distinct entities. Last but not least, we've carried out a risk analysis to pinpoint any dangers the system might encounter, enabling us to put mitigation techniques in place to guarantee the security and safety of the program and its users.

Chapter 5 High-Level and Low-Level Design

5.1 System Overview

The system will be developed in such a way that it allows the user to upload their artistic creations, easily convert them into NFTs, engage with other artists within the ArtEcho network, and integrate their MetaMask wallet for the facilitation of NFT transactions, both in terms of purchases and sales.

The user interface will offer a user-friendly experience, guiding both new and existing users through the login and signup processes. Artist verification involves a series of steps to ensure the legitimacy of individuals as artists, while straightforward signup procedures are available for general users, eliminating the need for extensive verification hassles.

The business layer encompasses the core functionalities of key classes, managing tasks such as user data recording and data sharing operations. Operations conducted after the interactions with the user interface are handled within this layer. User-inputted data from the UI is directed to be securely stored through this layer. Upon a user's login and subsequent artwork upload, the artwork is stored within the storage layer. Furthermore, when an artist lists their artwork on the marketplace, this layer facilitates the generation of the corresponding NFT, making the NFT available for purchase on the marketplace.

The third layer of the system is the storage system, it plays a crucial role in managing and preserving data. The business layer receives data inputs from both users and administrators, awaits the necessary actions from each, and subsequently transfers the data to this layer. The storage layer not only holds the data but also maintains a comprehensive record of it, ensuring a seamless retrieval process, contributing to the overall robustness and reliability of the system.

5.2 Design Considerations

We now put focus on design considerations of ArtEcho in this section.

5.2.1 Assumptions and Dependencies

Primarily the system will operate on the following assumptions:

- All users have modern web browser with standard compatibility.
- For accessing the website users should have reliable and reasonably high-speed internet connections.
- For accessing the VR gallery we assume that the user has a VR headset.

- Proper digitization of artwork that exists in physical form.

Following dependencies will govern the working of this system:

- The dependence on MetaMask for transactions implies that any changes in its API may have impact on buying and selling of NFTs.
- Dependence on scalable server infrastructure to accommodate potential increases in user activity and data storage.
- Dependence on tools that ensure automated deployment processes, minimizing downtime during updates.

5.2.2 General Constraints

The constraints that need to be followed for good design

5.2.2.1 Hardware and Software Environment

- Internet not connected
- Browser version not supported
- Website is overflowed with traffic and may not run for certain users

5.2.2.2 Security Requirements

- The system will ensure to make the passwords of users strong.
- All the data will be backed up regularly.

5.2.2.3 Third Party Tools

- The usage of some features might require installation of additional software on a user's device.

5.2.2.4 Data repository and Distribution requirements

- MS-SQL will be used for data repository and distribution requirements.
- The user information must be kept secure and avoid breach of data.
- The database must be kept secure to avoid data leakage.

5.2.2.5 Performance Requirements

- There should be stable internet for smooth performance.

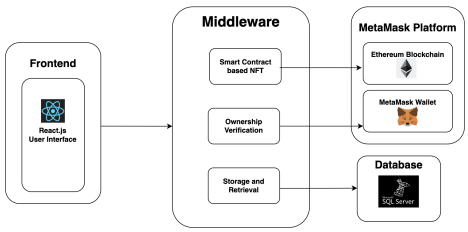

Figure 5.1: High-Level Architecture Diagram of The System

- The code should be optimized for best performance.
- The system must be able to handle large amount of user load simultaneously

5.2.3 Goals and Guidelines

5.2.3.1 Modifiability

Ensure that the system remains adaptable to changing requirements and technological advancements, which will make the modifiablity of the system possible.

5.2.3.2 User-Friendly

The system will have a user interface that is visually appealing, easy to navigate, and intuitive for artists and art enthusiasts.

5.2.4 Development Methods

The method considered for the development of this system is scrum, an agile software development method. It is well suited to this system as there is a need of continuous need of refinement and adaptation. fashion. This allows the system to be tested and developed easily. Moreover, this design has some flexibility, which will increase its extensibility and allow us to enhance it by adding new features.

5.3 System Architecture

The system's core functionalities are storing and retrieving files to and from the database, verifying the ownership of a NFT and using MetaMask wallet to securely sign transactions on the blockchain. Keeping these functionalities in mind, the architecture of the system was divided into three main modules which reside in the middleware of the application, as can be seen in the high-level architecture diagram in figure 5.1

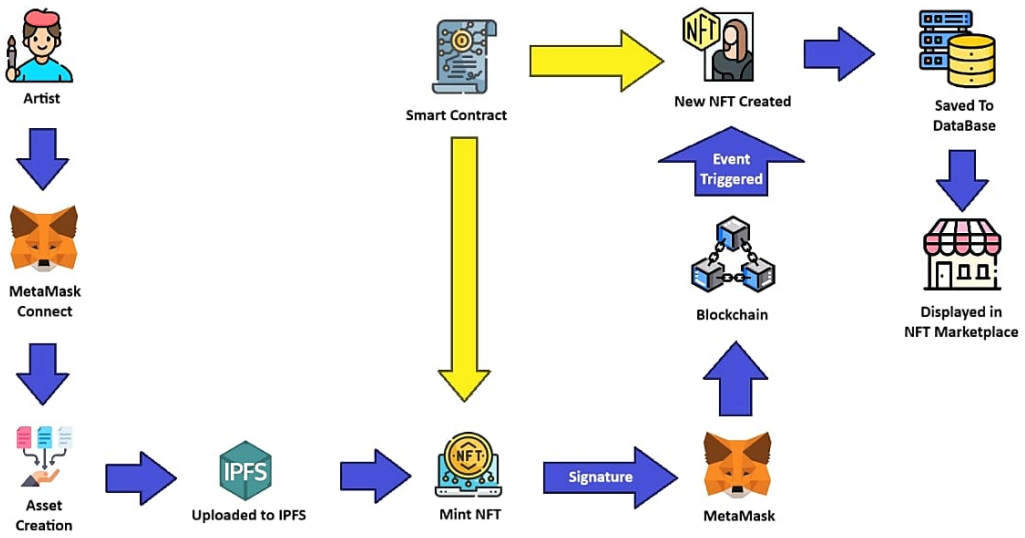

Figure 5.2: Low-level Diagram of Creation, Storage, and Retrieval of Smart Contract based NFT
The above diagram shows a Low-level Diagram of Creation, Storage, and Retrieval of Smart Contract based NFT within ArtEcho.

5.3.1 Subsystem Architecture

The detailed discussions of the modules residing in the middleware is presented as follows.

5.3.1.1 Storage and Retrieval of Smart Contract based NFT

The artist connects to their MetaMask wallet, then creates a digital artwork or selects and existing artwork to be tokenized. The actual digital files are uploaded on IFPS decentralised storage. The process of NFT creation begins for the artwork. A smart contract is generated which holds the rules and details of the NFT, including ownership rights. The generated smart contract mints a unique token representing the NFT, the signature of this token is sent to the MetaMask wallet, from which ownership can be authenticated when needed. Then the smart contract is deployed to the ethereum blockchain network. The NFT has been generated and saved to the ArtEcho database from this database it will be retrieved and displayed in the NFT marketplace of ArtEcho.

5.3.2 Ownership Verification

Since a user will be buying NFTs from the NFT marketplace using MetaMask, the ownership authentication process involves using MetaMask wallet to securely sign transactions on the blockchain. As the user initiates a purchase, a MetaMask popup appears, requesting permission to connect with the ArtEcho platform. The user approves the connection. After the transaction is verified, a blockchain confirmation is necessary in which the transaction is broadcasted to the Ethereum network and validated and included in a block by network miners. Based on a validated transaction, the ownership details of the NFT is

updated on the blockchain. MetaMask confirms the successful execution of the transaction, providing users with a transaction hash and details.

5.4 Architectural Strategies

The strategies used for the design of the architecture of the system are as follows.

5.4.1 Use of the MERN Stack

The MERN stack comprises of the following technologies:

- MS-SQL
- Express.js
- React.js
- Node.js

The MERN framework is a web development stack that employs JavaScript for all of the application's components. The stack is based on the MVC model. MS-SQL is a SQL database that is used to store data related to the users and their creations on the network. The view is developed using React.js which is a component-based JavaScript front-end development library that makes use of a virtual DOM for rendering elements on the browser. The controller part is implemented using Express.js, which is a middleware framework used to create the business logic of an application.

The most important reason to go with the MERN stack was the ease that comes with this stack, which is the development of the complete application using a single language, as all of these, Express, Node, and React, are based on JavaScript. Along with that the use of MS-SQL offers scalability options to accommodate the growing data and it is a reliable relational database management system known for its performance in handling structured data. This is crucial for managing user profiles, artwork details, and other structured data in our system.

5.4.2 Ethereum Blockchain

Ethereum is a decentralized blockchain with smart contract functionality which is cruicial to our process of creating NFTs. Even though there are alternatives to the Ethereum blockchain such as Binance Smart Chain and Solana, but we chose ethereum as it supports NFT standards like ERC-721 or ERC-1155.

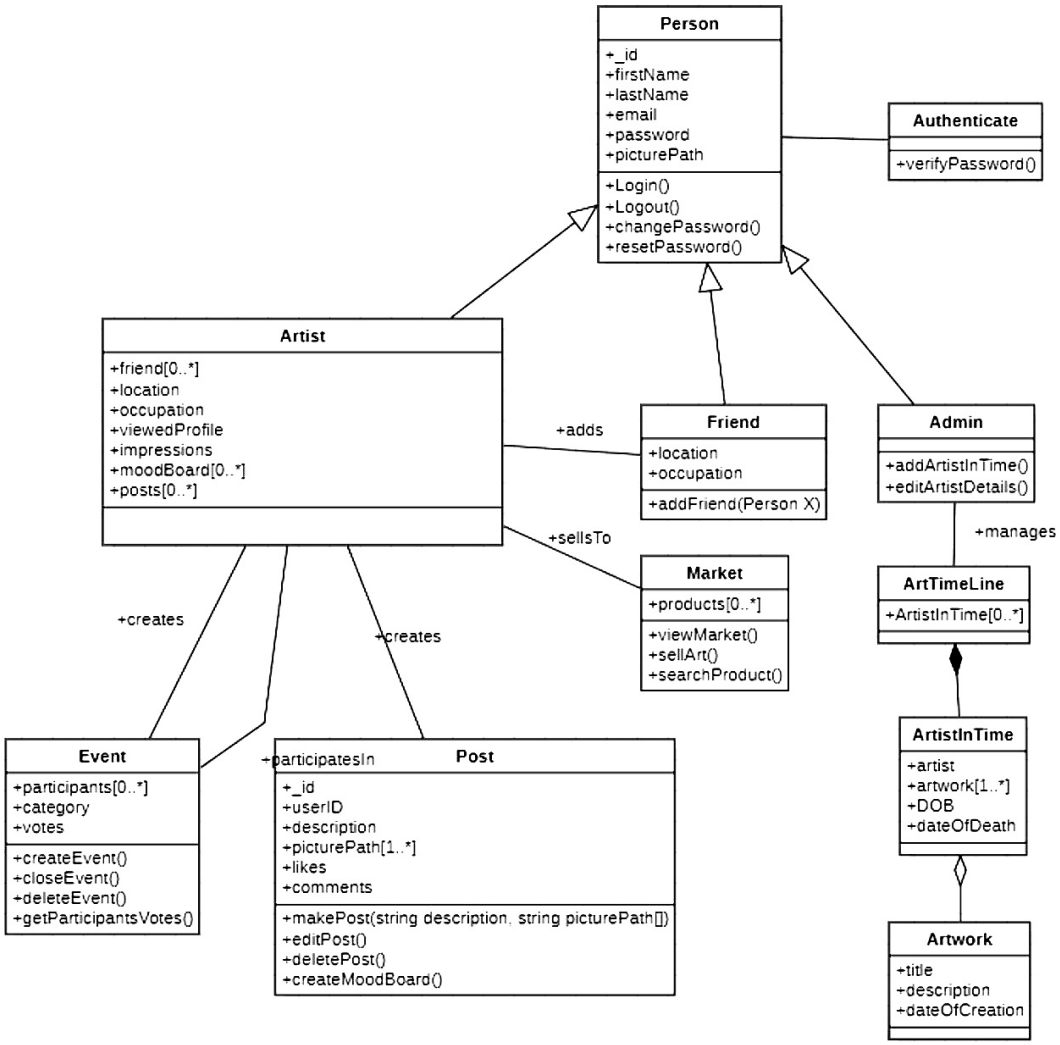

Figure 5.3: Class Diagram of the System

The above diagram is the class diagram for ArtEcho

5.5 Domain Model/Class Diagram

ArtEcho Class Diagram is show in figure 5.3

5.6 Sequence Diagrams

The following diagrams represent sequential working of ArtEcho use cases:

5.7 Policies and Tactics

Following are the policies and tactics that will be used in this project:

Register

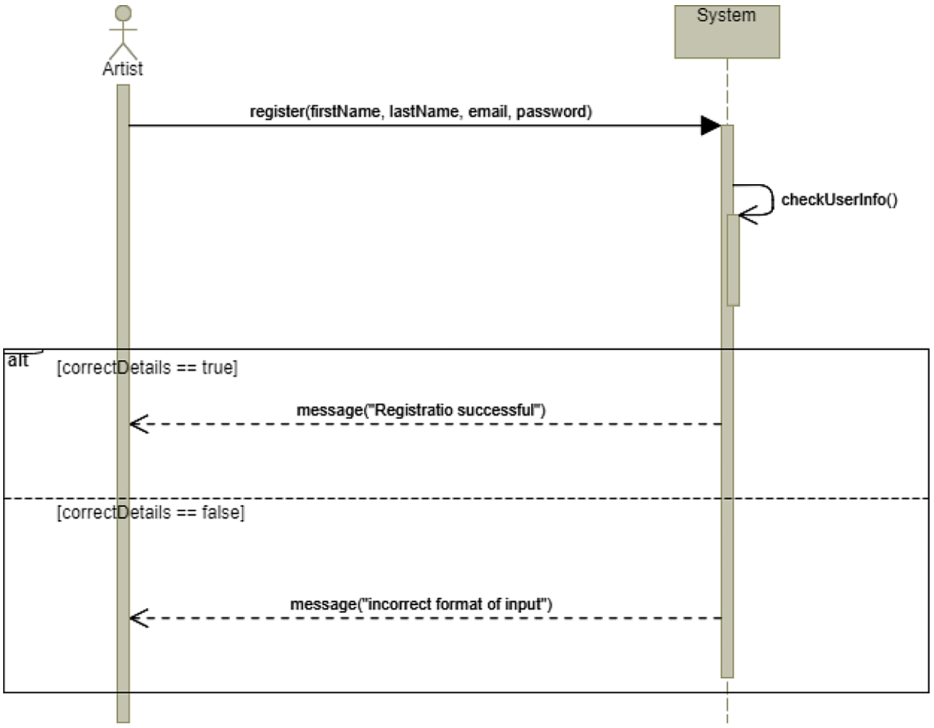

Figure 5.4: Sequence Diagram for Register

The above figure is a sequence diagram for the Register Use Case

Login

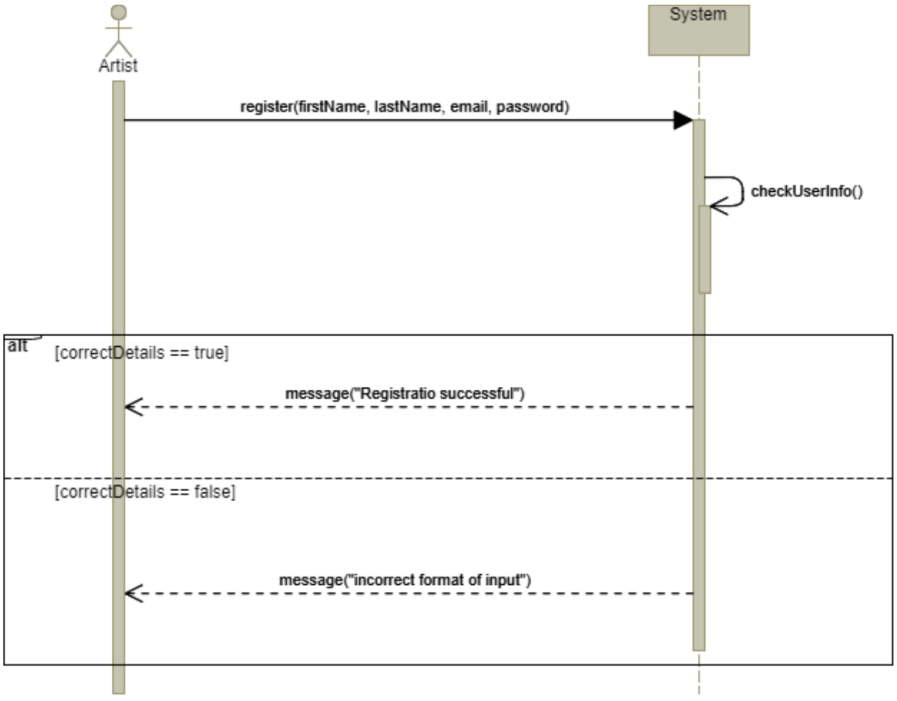

Figure 5.5: Sequence Diagram for Login

The above figure is a sequence diagram for the Login Use Case

Make Post

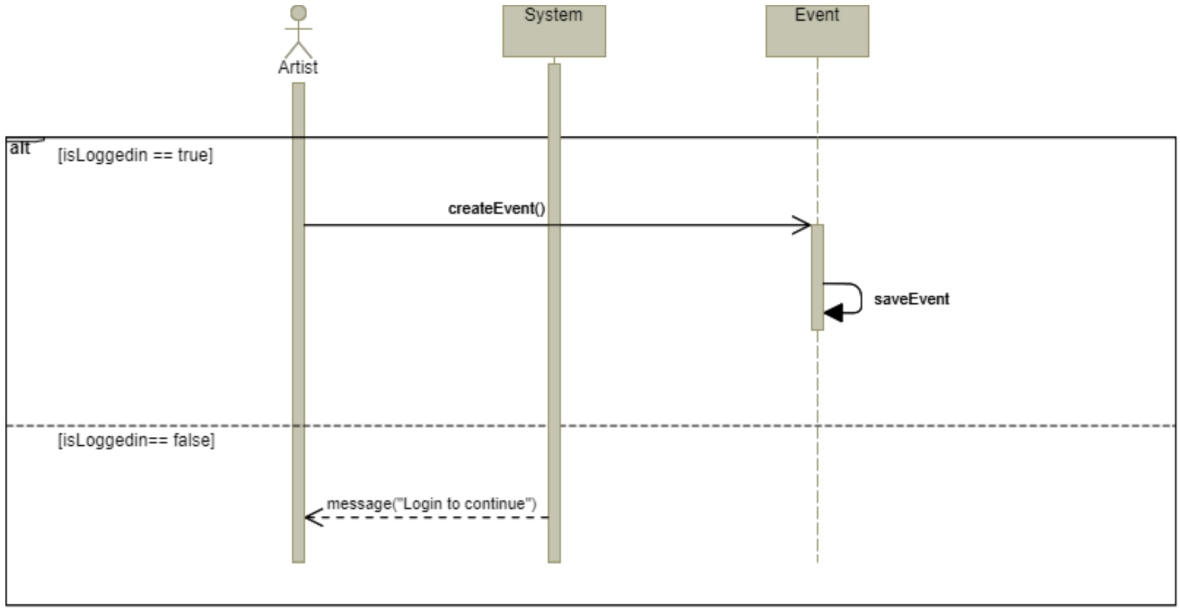

Figure 5.6: Sequence Diagram for Make Post

The above figure is a sequence diagram for the Make Post Use Case

Create Event

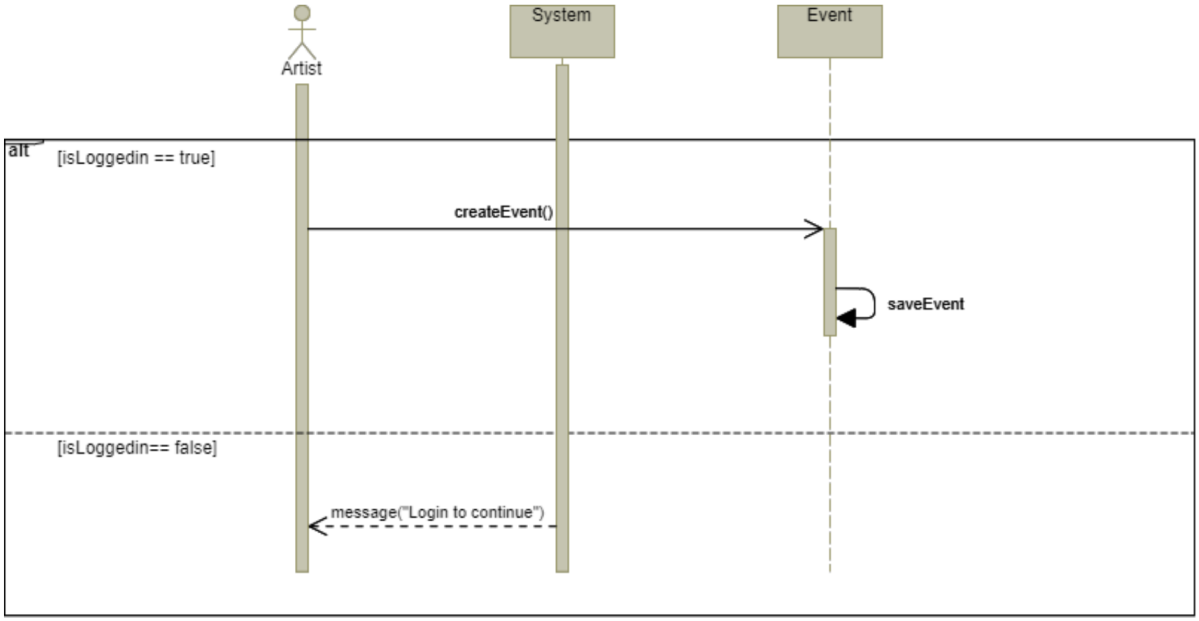

Figure 5.7: Sequence Diagram for Create Event

The above figure is a sequence diagram for the Create Event Use Case

Sell Art

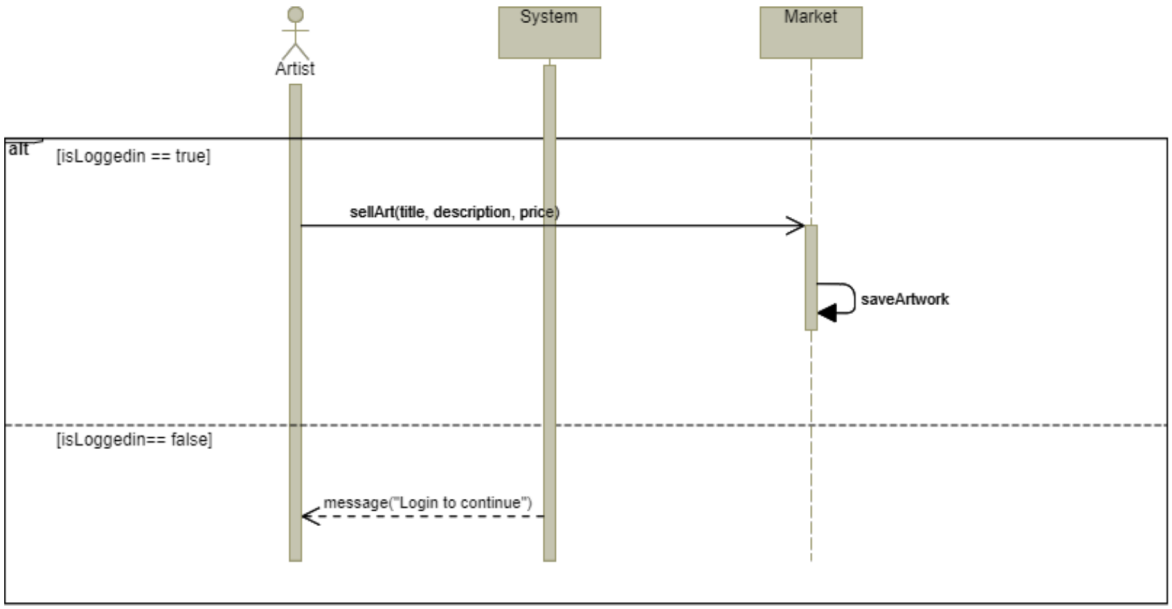

Figure 5.8: Sequence Diagram for Sell Art

The above figure is a sequence diagram for the Sell Art Use Case

View Market

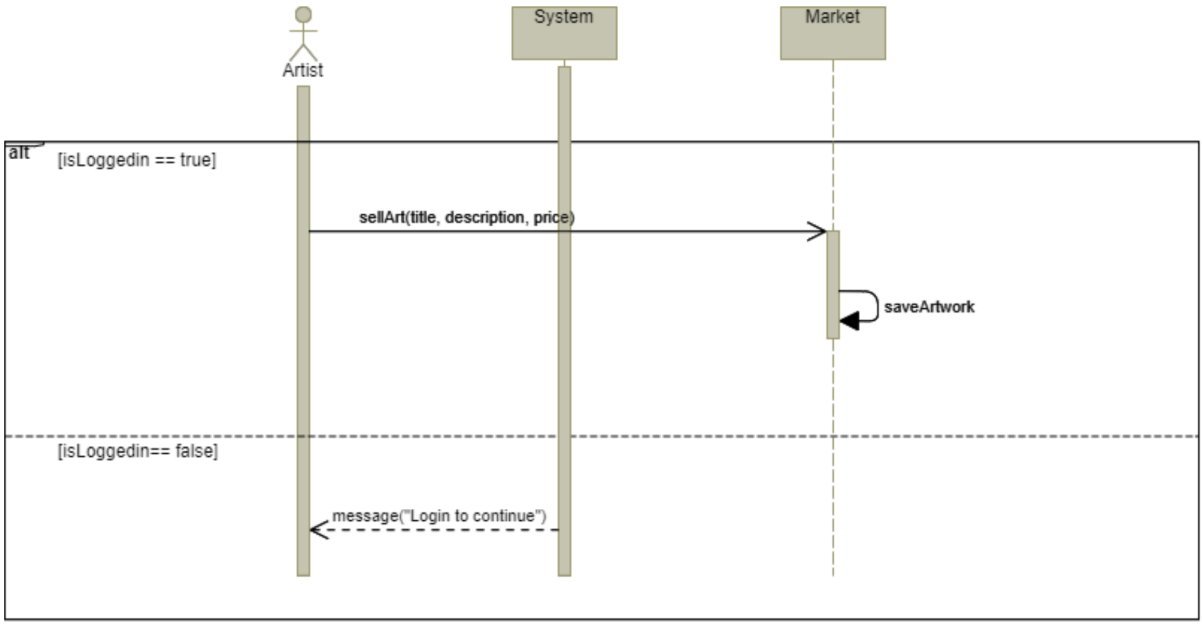

Figure 5.9: Sequence Diagram for View Market

The above figure is a sequence diagram for the View Market Use Case

5.7.1 User Data Privacy

Policy: ArtEcho is committed to safeguarding user data privacy. All personal and transactional information will be handled with the utmost confidentiality and in compliance with relevant data protection regulations.
Tactics:

- Implementation of end-to-end encryption.
- Providing users with transparent policies and terms of service.

5.7.2 Content Moderation and Curation

Policy: ArtEcho aims to maintain a positive and respectful environment for users. Content moderation and curation policies ensure that uploaded artworks and user interactions align with community standards.
Tactics:

- Establish clear guidelines for acceptable content.
- Encourage user reporting of inappropriate content.

5.7.3 Blockchain and Smart Contract Security

Policy: Security measures will be implemented to mitigate the risks associated with blockchain technology.
Tactics:

- Regularly update and patch smart contracts to address vulnerabilities.
- Employ secure coding practices for smart contract development.
- Implement multi-signature wallets for enhanced security.

5.7.4 Accessibility and Inclusivity

Policy: ArtEcho is committed to providing an inclusive platform accessible to users of all abilities.
Tactics:

- Proper use of semantic HTML, so people using assistive technologies can access the website
- Provide alternative text for images to assist users with visual impairments.
- Support keyboard navigation and screen reader compatibility.

Chapter 6 Implementation and Test Cases

The following chapter explains all the implementation details that have been done by far. Also, the description of all the test cases will be included in the following section.

6.1 Implementation

The implementation details of the components and algorithms of the prototype designed are given below.

6.1.1 Prototype Description

The prototype for ArtEcho is a simplified version of the final platform that showcases its core functionalities and user interactions. It serves as a demonstration of the application's key features and provides stakeholders with a visual representation of how the platform will function.

The prototype of our project will include these key components given below:

- Users can set up accounts and use their credentials to access ArtEcho. This guarantees safe access and customized user experiences.
- Artists can create their profiles by providing relevant information about themselves, such as their background, art portfolio, and motivation behind joining our platform.
- The artist accesses the home screen, clicks the make post box, types words, or uploads pictures, videos, or moodboards. After clicking the upload button, the system adds the post to the artist's feed and uploads the post details to the database. If no details are added and the upload button is clicked, the system responds with an error message.
- The user, either an artist or an administrator, presses the logout button. The system terminates the user session and sends the user to the login page. If there is a server error, the system tells the user.
- The user likes the posts made by artists in the ArtEcho community by clicking the Like Button and can comment as well. The system displays the like and places the comment(s) under the particular post.

The prototype aims to provide stakeholders with a tangible demonstration of ArtEcho's functionalities and user experience. It allows for feedback and validation of the platform's core features before proceeding to full-scale development.

6.1.2 MERN Stack

We will be using the MERN stack to develop the web application/platform of ArtEcho. It consists of the following technologies:

6.1.2.1 MySQL

We use MySQL as the database to store information about computer components, user preferences, and system configurations. It provides a flexible and scalable solution for data storage.

6.1.2.2 Express.js

We use Express.js as the web application framework to handle server-side operations and API endpoints. It simplifies the development of RESTful APIs for data retrieval and manipulation.

6.1.2.3 React.js

We use React to build the user interface of ArtEcho. It enables the creation of interactive and dynamic UI components, allowing users to navigate through different sections, view recommendations, and interact with the system.

6.1.2.4 Node.js

We use Node.js as the server-side runtime environment. It enables the execution of JavaScript on the server and helps the communication between the client and server components of the application.

6.1.3 Virtual Reality VR for Virtual Art Gallery

We will use Spatial to develop a virtual art exhibition that will leverage VR technology to provide consumers with an aesthetically pleasant experience.

6.1.4 NFTs for Marketplace

We will use Metamask for the integration of the blockchain wallet in ArtEcho, which will enable our users to purchase, sell, and transfer NFTs.

6.1.5 Firebase Integration

We will incorporate Firebase into our project's prototype which will provide additional functions and features such as authentication, real-time database, and hosting to improve the user experience and check the responsiveness of our application.

Chapter 7 Conclusion and Future Works

ArtEcho is an artistic and innovative online platform built using cutting-edge digital technology. Our initiative intends to establish an engaging and user-friendly environment for artists and art enthusiasts to interact, share, and enjoy art in a modern setting. ArtEcho introduces a new method of creative expression by merging technology such as virtual reality (VR) and NFTs.

Our research looked at ArtEcho's beginnings, aims, planning approach, framework needs, structural and comprehensive planning, implementation details, and testing procedure. Additionally, we considered the obstacles we faced in the project duration and how we catered to them in the context of the overall scope of the project.

7.1 Findings and Results

According to our observations, we concluded that ArtEcho bridges the gap between traditional art and advanced platforms. By employing the latest web technologies, we can provide users with a seamless and aesthetic experience. This versatile and adaptable system is of great importance to digitalize art.

ArtEcho has achieved its imperative goal by providing an intuitive and user-friendly platform. It not only helps artists showcase their work but also helps users explore and engage with art in a more personalized and interactive way.

7.2 Scope Coverage and Objective Fulfillment

In the development of our project, ArtEcho, we managed to secure a significant portion of the original scope. Our platform addresses the needs of artists and art enthusiasts by offering features such as virtual galleries, NFT creation and trading, and interactive artist timelines. Our project goals have been achieved, as documented by the successful implementation of these features and the positive feedback from its early users.

7.3 Challenges and Exclusions

Our project addresses several challenges, including real-time upgrades of artwork, maintaining a user-friendly interface, and seamlessly integrating advanced technologies such as VR and NFTs. These were challenging, but through careful planning and iterative testing, we were able to address them. However, certain aspects have not yet been fully explored at this project stage. For example, other art forms such as music and writing were ignored and the focus was primarily on the visual arts.

7.4 Recommendations for Future Works

To further improve ArtEcho, we suggest some possibilities for future development:

- We can expand the platform to include other art forms such as music, writing, and performing arts.
- Moreover, we can integrate more advanced AI algorithms for personalized art recommendations and curation.
- Our focus will be to create a mobile application for ArtEcho to reach larger audiences and increase availability.
- We could implement features in our app that enables collaboration between artists and enthusiasts, including online workshops and co-creation rooms.
- We can look forward to integrating practices into our app, specifically NFT transactions.

7.5 Conclusion

In summary, ArtEcho leaps towards the union of art and innovation, facilitating new dimensions in the way art is created, shared, and experienced. By implementing the proposed future improvements, ArtEcho can truly become a more flexible online social platform, securing its place at the forefront of a progressive art revolution.

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