FRAUD PREVENTION IN REAL ESTATE USING BLOCKCHAIN

Major Project Report

Submitted in partial fulfillment of the requirements for the degree of

Bachelor of Engineering (Computer Engineering)

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(2023-2024)

Internal Approval Sheet

TERNA ENGINEERING COLLEGE, NERUL

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Academic Year 2023-24

CERTIFICATE

This is to certify that the major project entitled **"FRAUD PREVENTION IN REAL ESTATE USING BLOCKCHAIN"** is a bonafide work of

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Place: ----------

Declaration

We declare that this written submission represents our ideas in our own words and where others' ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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We take the privilege to express our sincere thanks **to Dr. L. K. Ragha** our Principal for providing the encouragement and much support throughout our work.

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Abstract

Fraud in the real estate sector poses significant challenges, including identity theft, property flipping schemes, and double-selling, undermining trust and transparency in transactions. To address these issues, this project introduces a novel approach leveraging blockchain technology for fraud prevention in real estate transactions. The primary aim of this project is to enhance security, transparency, and efficiency within the real estate sector by implementing a blockchain-based system. Key objectives include strengthening security measures, ensuring transparent and auditable transactions, improving operational efficiency, and empowering stakeholders. The scope of the project encompasses user authentication and authorization, property tokenization using Non-Fungible Tokens (NFTs), transaction verification, and regulatory compliance. By integrating Aadhaar authentication, NFT-based property tokenization, smart contract-based transaction workflows, and adherence to regulatory frameworks, the project aims to create a robust and reliable platform for real estate transactions. This report provides a comprehensive overview of the project, including its aim, objectives, scope, and organizational framework. Through detailed exploration and analysis, it offers insights into the potential of blockchain technology to transform fraud prevention in the real estate sector, fostering trust, transparency, and efficiency in transactions.

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CHAPTER - 1

Introduction

The real estate industry, while lucrative and essential for economic growth, is plagued by various forms of fraud that compromise its integrity and trustworthiness. From identity theft to property flipping schemes, fraudulent activities undermine confidence in transactions and pose significant challenges for stakeholders. Traditional methods of fraud prevention often fall short in addressing these issues, highlighting the need for innovative solutions that can enhance security, transparency, and efficiency within the sector.

In response to these challenges, this project proposes the utilization of blockchain technology as a transformative tool for fraud prevention in real estate transactions. Blockchain, known for its decentralized and immutable ledger system, offers unique capabilities that can revolutionize how property transactions are conducted and verified. By leveraging blockchain's inherent features, such as transparency, immutability, and cryptographic security, this project aims to establish a secure and trustworthy environment for real estate transactions.

The primary objective of this project is to develop a blockchain-based system that addresses the multifaceted challenges of fraud in the real estate sector. Specifically, the project seeks to enhance security measures, ensure transparent and auditable transactions, improve operational efficiency, and empower stakeholders involved in property transactions. Through a combination of innovative technologies and robust methodologies, the project endeavors to establish a new standard for fraud prevention in the real estate industry.

This report provides a comprehensive overview of the project, outlining its aim, objectives, scope, and organizational framework. Subsequent chapters will delve into the specific components and methodologies employed in the development and implementation of the blockchain-based fraud prevention system. By exploring the potential of blockchain technology to mitigate fraud and

foster trust in real estate transactions, this project aims to contribute to the advancement of the industry and the protection of stakeholders' interests.

1.1 Aim and Objectives of Project

Aim:

The aim of this project is to develop a robust system for preventing fraud in real estate transactions using blockchain technology. By leveraging the inherent features of blockchain, the project seeks to enhance security, transparency, and efficiency in property transactions, thereby fostering trust and confidence among stakeholders.

Objective:

- **Enhancing Security:** Implement robust authentication mechanisms and cryptographic techniques to prevent identity theft, unauthorized access, and fraudulent activities in real estate transactions.
- **Ensuring Transparency:** Utilize blockchain's immutable ledger to provide transparent and auditable records of property ownership, transaction histories, and contract agreements, thereby enhancing transparency and accountability in real estate transactions.
- **Improving Efficiency:** Streamline and automate processes related to property transactions, including listing, verification, and transfer, through the use of smart contracts and decentralized applications (DApps), reducing administrative overheads and transactional friction.
- **Empowering Stakeholders:** Empower stakeholders, including buyers, sellers, inspectors, and regulators, by providing them with access to a secure and user-friendly platform that facilitates informed decision-making and ensures fair and transparent transactions.
- **Preventing Fraud:** Mitigate the risk of fraudulent activities such as property flipping, double-selling, and misrepresentation by tokenizing properties as Non-Fungible Tokens (NFTs), implementing multi-signature authentication, and enforcing rigorous verification processes.

1.2 Scope

The scope of this project encompasses the design, development, and implementation of a comprehensive system for fraud prevention in real estate transactions using blockchain technology. Key components and functionalities within the scope of the project include:

- User Authentication and Authorization: Implementing secure authentication mechanisms to verify the identities of users participating in the platform. This may involve integration with Aadhaar or other identity verification systems to ensure the authenticity of user credentials.
- Property Tokenization with NFTs: Tokenizing properties as Non-Fungible Tokens (NFTs) to provide unique digital representations of ownership. This allows for the creation of verifiable and immutable records of property ownership on the blockchain, reducing the risk of fraudulent property listings and double-selling.
- Transaction Verification and Approval: Implementing smart contracts to automate transaction verification processes. Inspectors or designated authorities may be involved in approving transactions, ensuring the authenticity and legality of property transfers before they are finalized on the blockchain.
- User Interface and Experience: Developing intuitive and user-friendly interfaces for stakeholders to interact with the platform. This may include web-based portals, mobile applications, and other digital interfaces that facilitate property listing, transaction monitoring, and communication between users.
- System Scalability and Performance: Designing the system to accommodate growing volumes of property transactions and user interactions. This includes optimizing system architecture, database structures, and network protocols to ensure scalability, reliability, and high performance under varying load conditions.
- Security and Data Integrity: Implementing robust security measures to protect user data, transaction records, and system infrastructure from unauthorized access, tampering, or manipulation. This may involve encryption, multi-factor authentication, and other security mechanisms to safeguard sensitive information.

By addressing these aspects within the scope of the project, the aim is to develop a comprehensive solution that enhances security, transparency, and efficiency in real estate transactions while

ensuring compliance with regulatory requirements and industry standards. Through collaboration with stakeholders and adherence to best practices in blockchain development, the project seeks to establish a trusted and reliable platform for conducting property transactions in the digital age.

1.3 Organization of the report

1. Introduction: Provides an overview of the project, its objectives, scope, and significance in addressing fraud in real estate transactions using blockchain technology.
2. Literature Survey: Reviews existing literature, research, and best practices related to fraud prevention in real estate, blockchain technology, and relevant methodologies.
3. Software Analysis: Analyzes and evaluates various software tools, platforms, and frameworks suitable for developing a blockchain-based fraud prevention system in real estate.
4. Design and Implementation: Details the design architecture, components, and methodologies used in developing the blockchain-based fraud prevention system.
5. Methodology: Describes the approach, techniques, and strategies employed in the project's execution, including research methods, data collection, and analysis.
6. Implementation Detail: Provides in-depth insights into the technical implementation, coding aspects, integration of blockchain features, and deployment processes.
7. Performance Evaluation: Evaluates the performance metrics, efficiency, security measures, and effectiveness of the blockchain-based fraud prevention system through testing and analysis.
8. Problem Timeline: Charts the timeline of fraud-related issues and challenges in the real estate industry, highlighting the significance and urgency of implementing fraud prevention measures.
9. Results and Conclusion: Presents the findings, outcomes, and conclusions drawn from the project's implementation, including the impact on fraud mitigation and stakeholder empowerment.
10.Conclusion: Summarizes the key findings, implications, recommendations, and future directions for further research or improvements in blockchain-based fraud prevention in real estate transactions.

CHAPTER - 2

Literature Survey

The literature survey chapter serves as a foundational exploration of existing research, technologies, and methodologies relevant to the project. It aims to provide insights into the current state-of-the-art in real estate fraud prevention and blockchain technology. Through an extensive review of academic papers, industry reports, and case studies, this chapter will identify key trends, challenges, and opportunities in the field.

2.1 Existing System

The existing system within the real estate industry is primarily characterized by conventional methods and technologies for property transactions. While these systems have been in place for decades, they are often susceptible to various forms of fraud and inefficiencies. Some common features of the existing system include:

- Centralized Property Listings: Property listings are typically centralized on platforms operated by real estate agents, brokers, or listing services. This centralized approach can lead to issues such as inaccurate or outdated listings, lack of transparency, and potential manipulation by intermediaries.
- Manual Verification Processes: Verification processes, such as property inspections and title searches, are often conducted manually by inspectors and legal professionals. This can result in delays, errors, and inconsistencies in the verification process, leaving room for fraudulent activities to go undetected.
- Paper-based Documentation: Property transactions involve extensive paperwork, including contracts, deeds, and legal documents. These documents are often stored and managed in physical form, making them susceptible to loss, damage, and tampering.

- Limited Transparency: Information asymmetry is common in real estate transactions, with buyers and sellers often lacking access to comprehensive and transparent information about properties and transaction histories. This lack of transparency can lead to misunderstandings, disputes, and potential fraud.
- Risk of Fraud: The decentralized nature of the real estate market, coupled with the complexity of property transactions, creates opportunities for fraudsters to exploit loopholes and vulnerabilities in the system. Common types of fraud include identity theft, property flipping, and double-selling.

Overall, the existing system is characterized by inefficiencies, lack of transparency, and susceptibility to fraud, highlighting the need for innovative solutions to address these challenges. Blockchain technology offers promising opportunities to revolutionize the real estate industry by providing secure, transparent, and efficient solutions for property transactions.

Year	Title	Author	Problems
2020	Real Estate Management via Decentralized Blockchain platform.	Iftikhar Ahmad, Mohammed A. Alaqarni, Laiba Alam	Dependent on Email verification for user registration.
2020	Real Estate Management System based on Blockchain	Ankit Mittal, Bhavyansh Sharma, Pinku Ranjan	They have involved too many departments, so centralizing all of them is difficult.
2019	A Blockchain Based Framework for Fraud Detection	Pankaj Joshi, Sachin Kumar, Divya Kumar, Anil Kumar Singh.	Only gives assurance that the transaction done by the government will be done through blockchain. It will visible to all.
2021	The Use of Blockchain in Real Estate	Irabaruta Jules	Dependent only on blockchain, ignores human and organizational changes.
2022	Blockchain in real estate: Recent developments and empirical applications	Anniina Saari , Jussi Vimpari, Seppo Junnila	Underrepresentation of real estate management category and exclusion of smart city and IoT blockchain literature, impacting the comprehensiveness of the study.

2020	BCERT – A Decentralized Academic Certificate system distribution using Blockchain	Elva Leka, Besnik Selimi	The paper lacks detailed information on authorization aspects in the proposed solution. SmartCert claims to provide authorization but lacks technical details, raising concerns.The confidentiality theme is not adequately addressed in the discussed solutions.
2020	The blockchain technology in real estate sector: Experience and prospects	Evgeny Pankratov, Vladimir Grigoryev and Oleg Pankratov	The paper discusses the challenges faced by blockchain technology in the real estate sector, such as the motivation for criminals to exploit the system, opportunities for fraud due to transaction complexity, and risks associated with using the internet for transactions.
2016	Blockchain-based sharing services: What blockchain technology can contribute to smart cities	Jianjun Sun1 , Jiaqi Yan1 and Kem Z. K. Zhang	The paper highlights the challenges faced by cities in improving the quality of life for their citizens due to factors like increased traffic congestion, greenhouse gas emissions, and waste disposal resulting from urban concentration.

Table 2.1 – Literature Survey

CHAPTER - 3

Software Analysis

3.1 Waterfall Model

The Waterfall Model is a traditional software development methodology characterized by a sequential and linear approach to project management. It consists of several distinct phases, each building upon the outcomes of the previous phase. The phases of the Waterfall Model include:

3.1.1 Phases of waterfall model

- **Requirements Gathering:** In this initial phase, project requirements are gathered and documented in detail. This involves consultation with stakeholders to identify their needs, expectations, and desired features for the software system. The requirements are typically documented in a Software Requirements Specification (SRS) document.
- **System Design:** Once the requirements are finalized, the system design phase begins. During this phase, system architecture, data models, and software components are designed based on the gathered requirements. The design phase may include the creation of architectural diagrams, database schemas, and user interface mockups.
- **Implementation:** In the implementation phase, the actual coding and programming of the software system take place. Developers translate the design specifications into executable code using programming languages and development frameworks. This phase involves writing, testing, and debugging code to ensure that it meets the specified requirements.
- **Testing:** After the implementation phase, the software undergoes rigorous testing to identify and fix any defects or issues. Different types of testing, such as unit testing, integration testing, and system testing, are conducted to verify the functionality, reliability, and performance of the software system.

- **Deployment:** Once testing is complete and the software is deemed ready for release, it is deployed to the production environment. This involves installing the software on servers, configuring it for use, and making it accessible to end-users. Deployment may also involve data migration, user training, and system documentation.
- **Maintenance:** The final phase of the Waterfall Model is maintenance, where the software system is monitored, updated, and maintained over time. This includes addressing user feedback, fixing bugs, adding new features, and ensuring the long-term viability and sustainability of the software system.

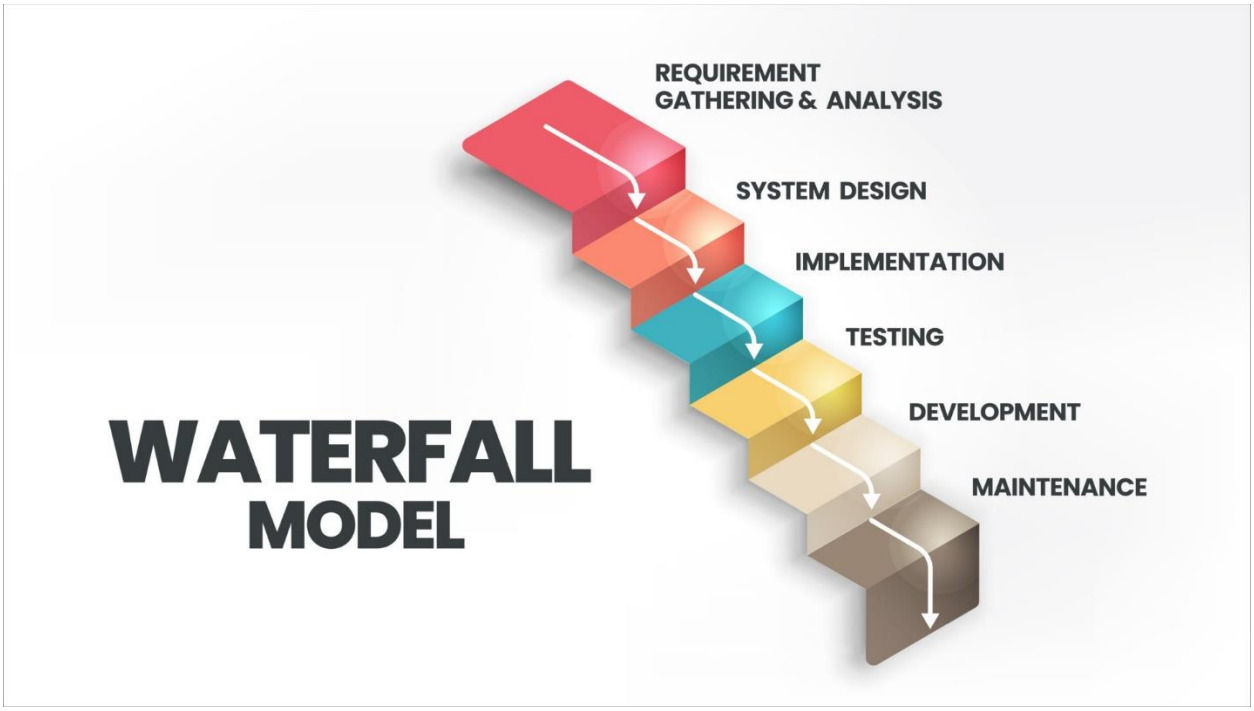


Fig 3.1 Waterfall model

3.2 Proposed System

In contrast to the Waterfall Model, the proposed system adopts an iterative and incremental approach to software development, allowing for flexibility, adaptability, and continuous improvement throughout the project lifecycle. This approach is better suited to the dynamic and evolving nature of blockchain technology and real estate transactions.

The proposed system aims to leverage blockchain technology to address the challenges of fraud prevention in real estate transactions. Key components of the proposed system include:

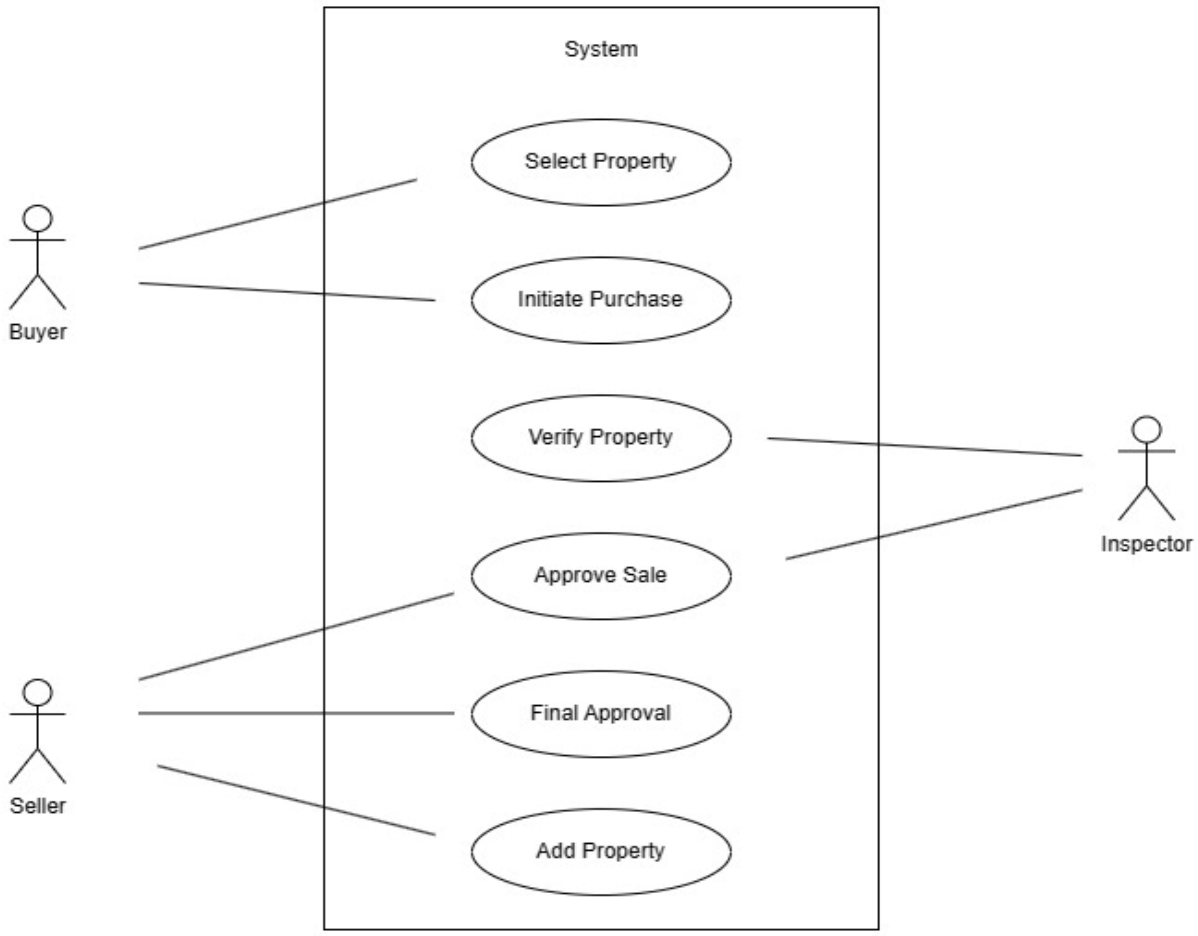
- **User Authentication and Authorization:** Implementing robust authentication mechanisms, including Aadhaar integration, to verify the identities of users accessing the platform.
- **Property Tokenization with NFTs:** Tokenizing properties as Non-Fungible Tokens (NFTs) to provide unique digital representations of ownership, ensuring transparency and immutability of property records
- **Transaction Verification and Approval:** Utilizing smart contracts to automate transaction verification processes and enforce validation rules, with approval from designated inspectors or authorities.

By adopting an iterative development approach and leveraging blockchain technology, the proposed system aims to create a secure, transparent, and efficient platform for real estate transactions, thereby mitigating fraud and enhancing trust among stakeholders.

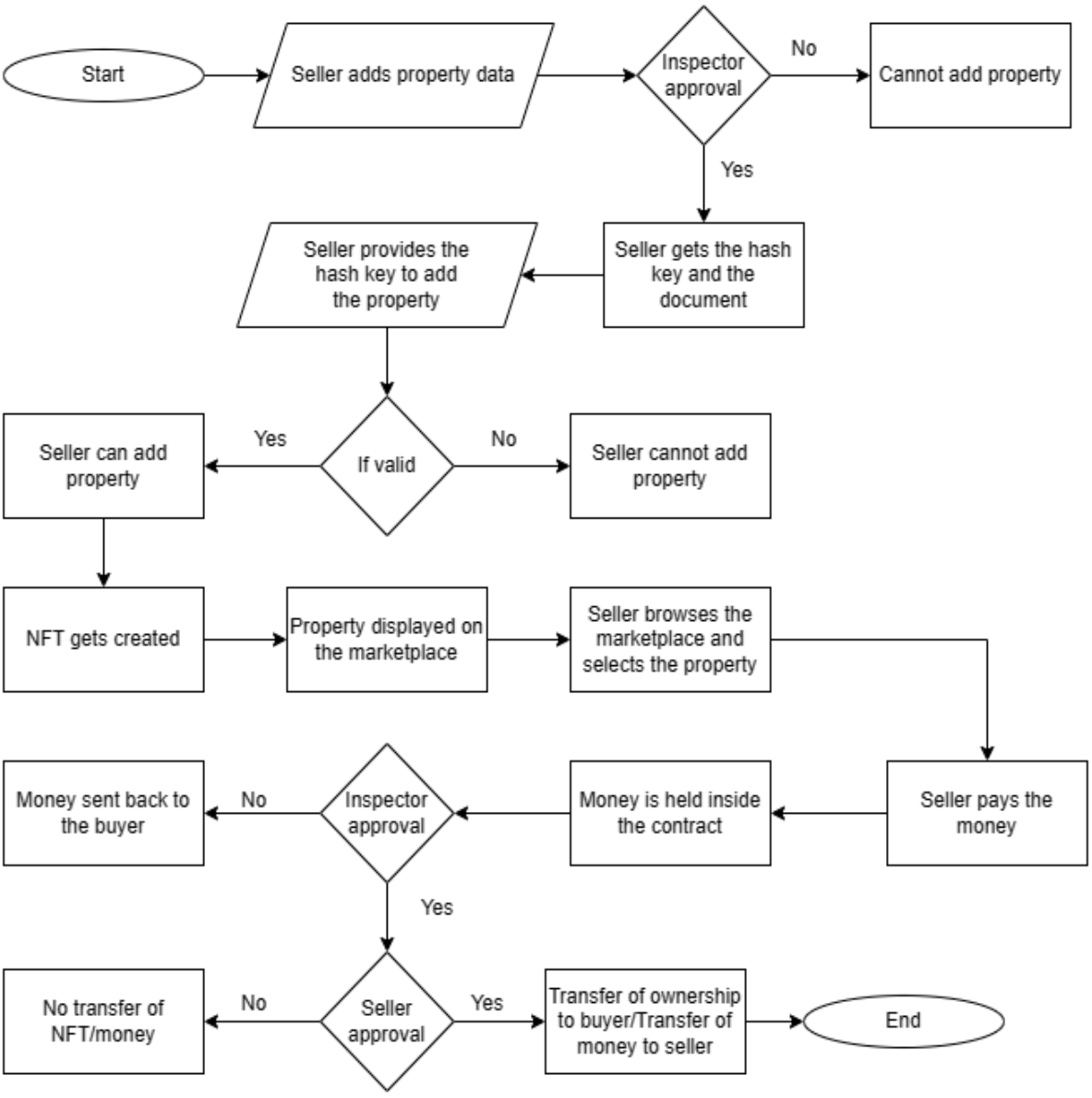
CHAPTER - 4

Design and Implementation

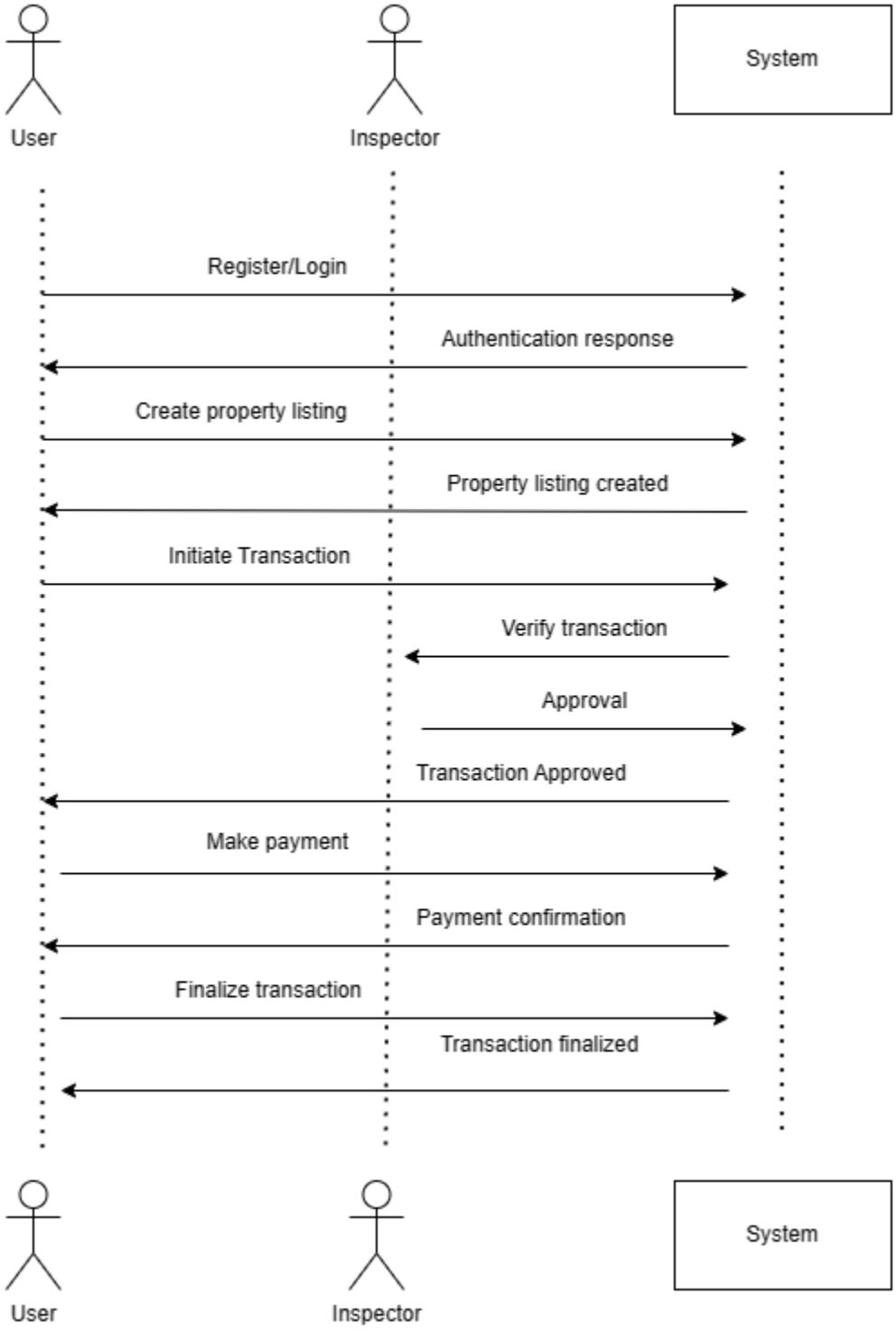
4.1 Use Case



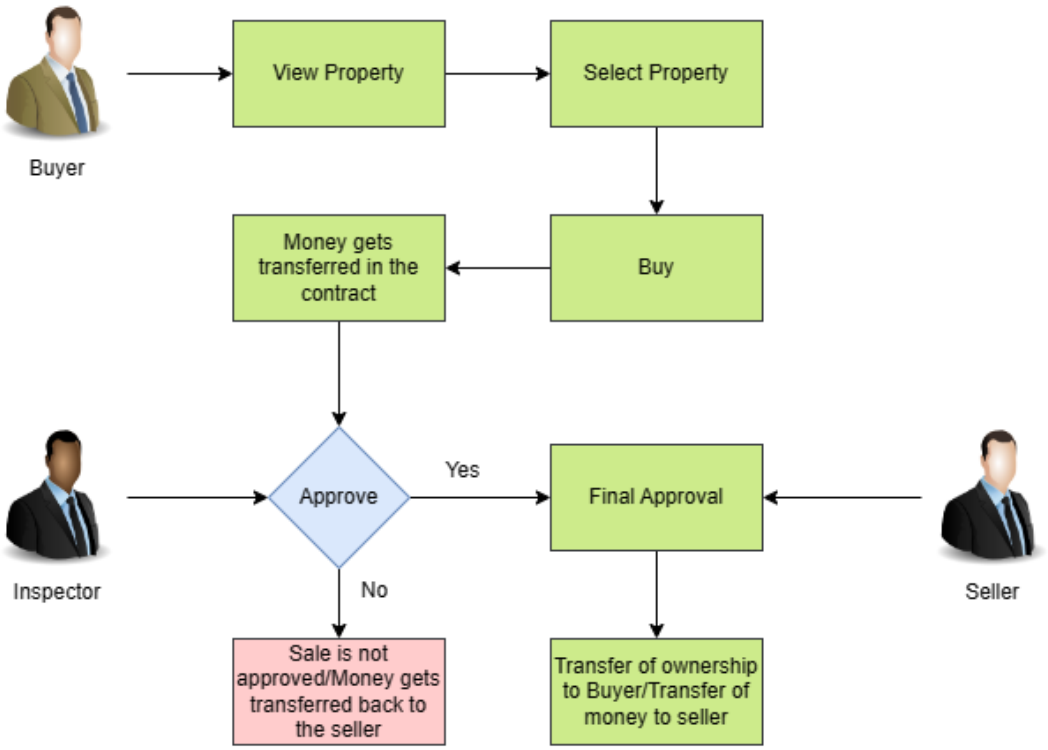
4.2 Flow chart diagram



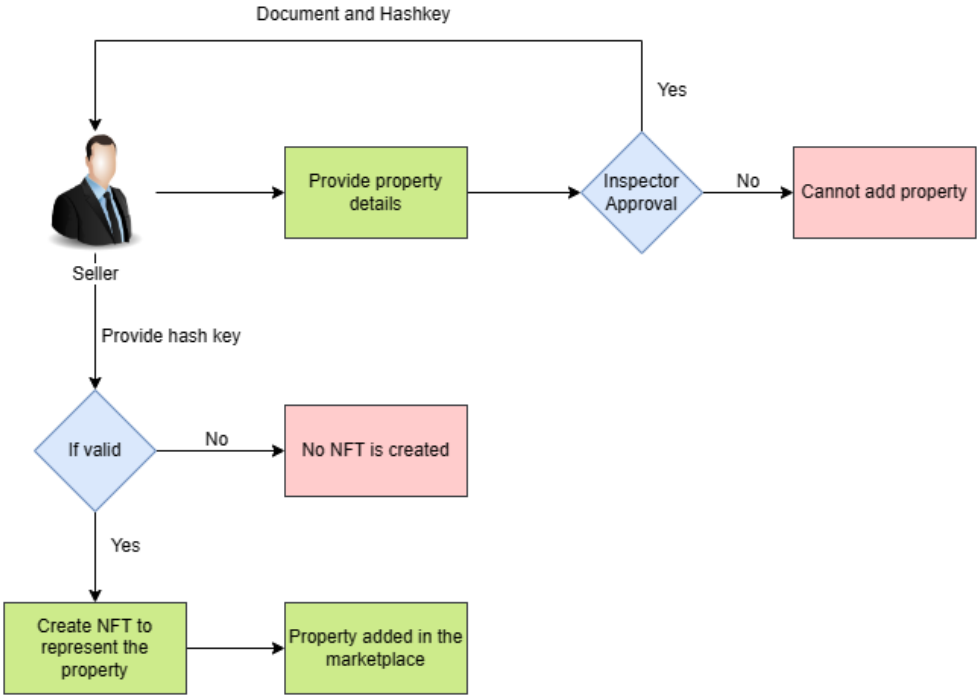
4.3 Sequence diagram



4.4 Buyer Process flow



4.5 Seller Process flow



4.6 Hardware and Software requirements

Hardware Requirements	Software Requirements
Ram : 4 GB	Language : JS , Solidity
Graphics : Nvidia	Database : Realtime DB, Firebase
Disk : 50 GB	Tech : Ethereum, Blockchain

4.7 Software components

The software components of the system architecture encompass various modules and components that work together to facilitate real estate transactions and fraud prevention mechanisms. These components include:

- User Interface (UI): The user interface component provides interactive interfaces for users to interact with the system. This includes web-based portals, mobile applications, and desktop clients that enable users to perform actions such as property listing, transaction verification, and account management.
- Blockchain Node: The blockchain node component consists of nodes that participate in the blockchain network, storing a copy of the blockchain ledger and validating transactions. Nodes may include full nodes, which store the entire blockchain history, and light nodes, which rely on other nodes for blockchain data.
- Smart Contracts: Smart contracts are self-executing contracts with predefined rules and conditions encoded on the blockchain. They automate transaction processes and enforce validation rules, ensuring the integrity and transparency of property transactions. Smart contracts are written in programming languages such as Solidity and deployed on the blockchain platform.
- Database Management System (DBMS): The DBMS component manages the storage and retrieval of data related to user profiles, property listings, transaction records, and system configurations. It ensures data consistency, reliability, and security, supporting efficient data querying and manipulation operations.
- Application Programming Interfaces (APIs): APIs enable communication and data exchange between different system components, allowing for seamless integration and interoperability.

They provide endpoints for accessing blockchain data, executing smart contracts, and performing authentication and authorization tasks.

- External Integrations: External integrations involve connecting the system with external services, such as identity verification systems, payment gateways, and regulatory compliance platforms. These integrations enhance the functionality and usability of the system, enabling users to perform additional actions and access additional features.

By integrating these software components into a cohesive architecture, the system aims to provide a secure, transparent, and efficient platform for real estate transactions while mitigating the risk of fraud and enhancing trust among stakeholders.

CHAPTER - 5

Methodology

5.1 Project Module

The project module outlines the key components and functionalities of the system, organized into distinct modules to facilitate the development and implementation process. Each module serves specific purposes and interacts with other modules to achieve the overall objectives of the project. The project modules include:

- **User Authentication and Authorization Module:** This module is responsible for authenticating users and managing their access privileges within the system. It includes functionalities for user registration, login, password management, and role-based access control (RBAC). User authentication may involve Aadhaar integration or other identity verification mechanisms to ensure the security and integrity of user accounts.
- **Property Listing Module:** The property listing module enables users to list their properties for sale or rent on the platform. It includes functionalities for creating property listings, uploading property details and images, specifying pricing and terms, and managing property availability. Property listings may be tokenized as Non-Fungible Tokens (NFTs) to provide unique digital representations of ownership on the blockchain.
- **Transaction Management Module:** The transaction management module facilitates the execution and management of property transactions on the platform. It includes functionalities for initiating, verifying, and finalizing property transactions, as well as handling payment processing and escrow services. Transactions are executed using smart contracts deployed on the blockchain, ensuring transparency, security, and immutability.
- **Inspector Approval Module:** This module involves designated inspectors or authorities who verify the authenticity and legality of property transactions before they are finalized. Inspectors review transaction details, property documentation, and compliance with regulatory

requirements to approve or reject transactions. Inspector approval is a crucial step in preventing fraud and ensuring the integrity of property transactions.

- **User Interface (UI) Module:** The user interface module provides interactive interfaces for users to interact with the system. It includes web-based portals, mobile applications, and desktop clients that enable users to perform actions such as property listing, transaction management, and account administration. The UI module ensures a seamless and intuitive user experience, enhancing user engagement and satisfaction.

By organizing the project into these modular components, the development team can focus on specific functionalities and interactions, ensuring clarity, efficiency, and maintainability throughout the development process. Each module is designed to address specific aspects of the real estate transaction lifecycle, contributing to the overall success and effectiveness of the system in preventing fraud and enhancing trust among stakeholders.

CHAPTER - 6

Implementation Details

6.1 Working of the system

The working of the system involves the seamless integration and interaction of various components and modules to facilitate real estate transactions while preventing fraud. The following steps outline the functioning of the system:

- User Registration and Authentication: Users register on the platform using their Aadhaar number or other authentication mechanisms. The system verifies the user's identity and creates a unique user profile.
- Property Listing: Sellers list their properties on the platform, providing details such as location, size, price, and images. Each property listing is tokenized as a Non-Fungible Token (NFT) on the blockchain, ensuring uniqueness and immutability.
- Property Discovery: Buyers browse through the available property listings on the platform, using search filters and criteria to find suitable properties. The system displays property listings based on user preferences and search criteria.
- Transaction Initiation: Buyers express interest in a property and initiate a transaction by submitting a purchase request. The system creates a transaction record and notifies the seller and inspector for further verification.
- Transaction Verification: Inspectors review the transaction details, property documentation, and compliance with regulatory requirements. Upon approval, the inspector validates the transaction, confirming the authenticity and legality of the property transfer.
- Transaction Approval and Execution: With inspector approval, the transaction proceeds to the execution phase. Smart contracts on the blockchain facilitate the execution of the transaction, transferring ownership of the property from the seller to the buyer.

- Payment Processing: Buyers make payments for the property through secure payment gateways integrated into the platform. Funds are transferred to escrow accounts until the transaction is finalized, ensuring security and transparency.
- Transaction Finalization: Once all conditions and requirements are met, the transaction is finalized, and ownership of the property is transferred to the buyer. The system updates property records, transaction histories, and user profiles to reflect the completed transaction.

By following this workflow, the system enables secure, transparent, and efficient real estate transactions while mitigating the risk of fraud and ensuring compliance with regulatory requirements. Through the seamless integration of blockchain technology, smart contracts, and authentication mechanisms, the system fosters trust and confidence among stakeholders, empowering them to engage in property transactions with peace of mind.

CHAPTER - 7

Problem Timeline

7.1 Gantt Chart

(July 2023 - October 2023)

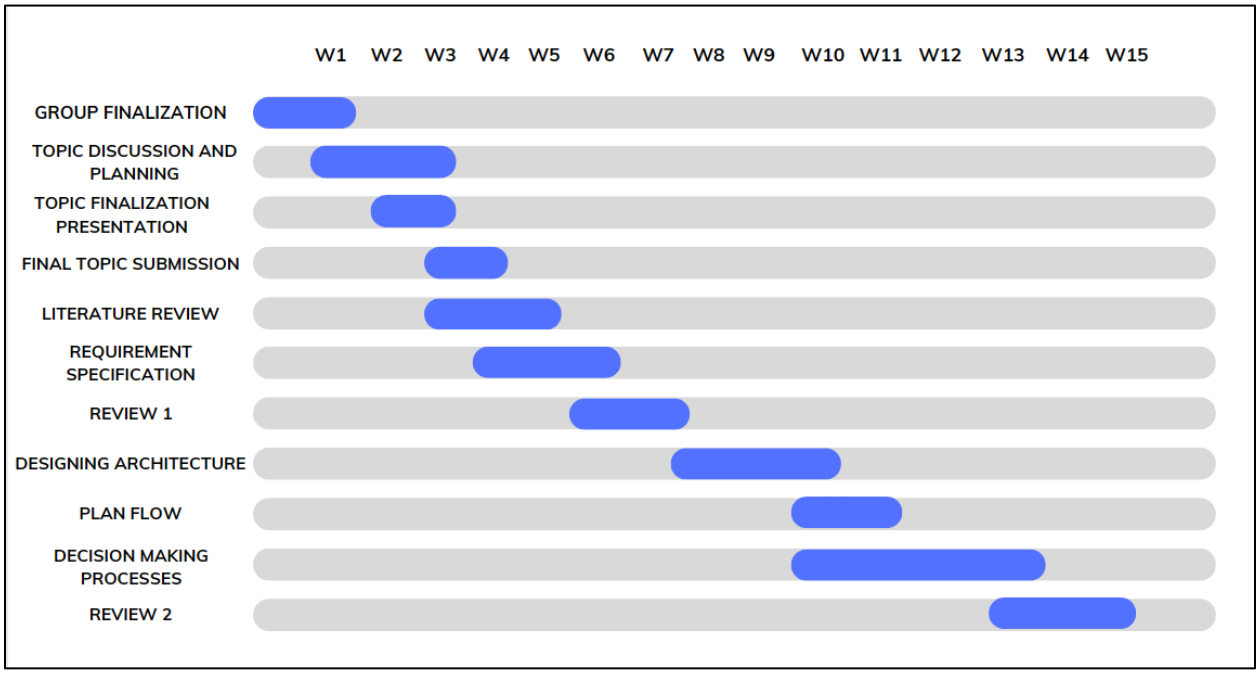


Fig 7.1 – Gantt Chart(July 2023 – October 2023)

Fig 7.2 – Gantt Chart(Jan 2024 – April 2024)

CHAPTER – 8

Results and Conclusion

8.1 Project Screenshots

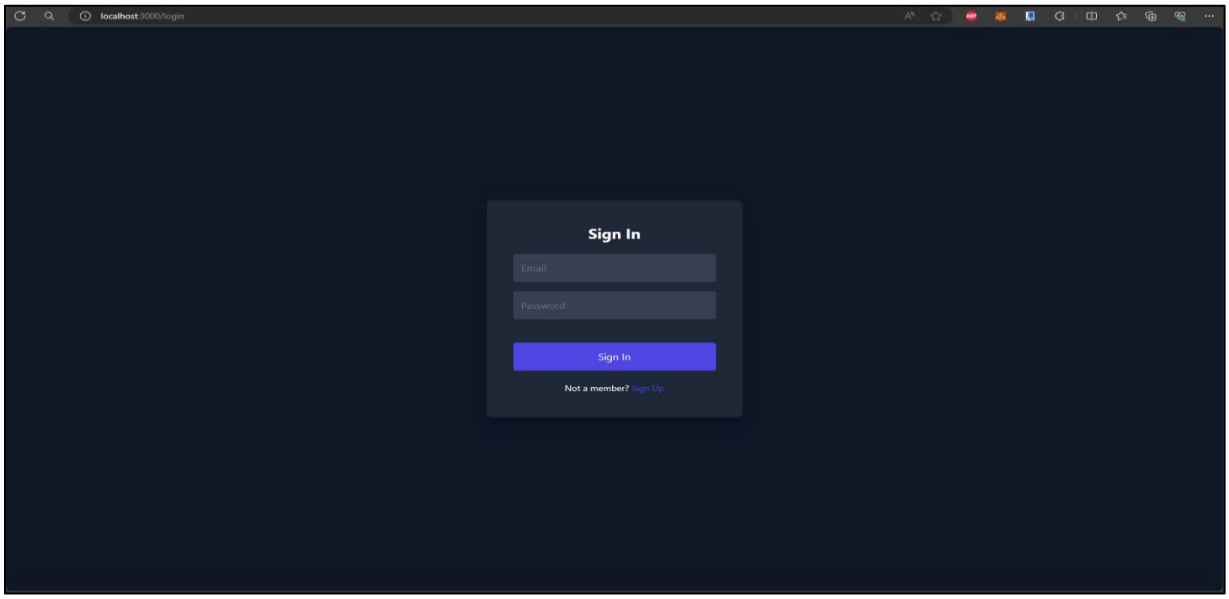


Fig 8.1 – Sign In page

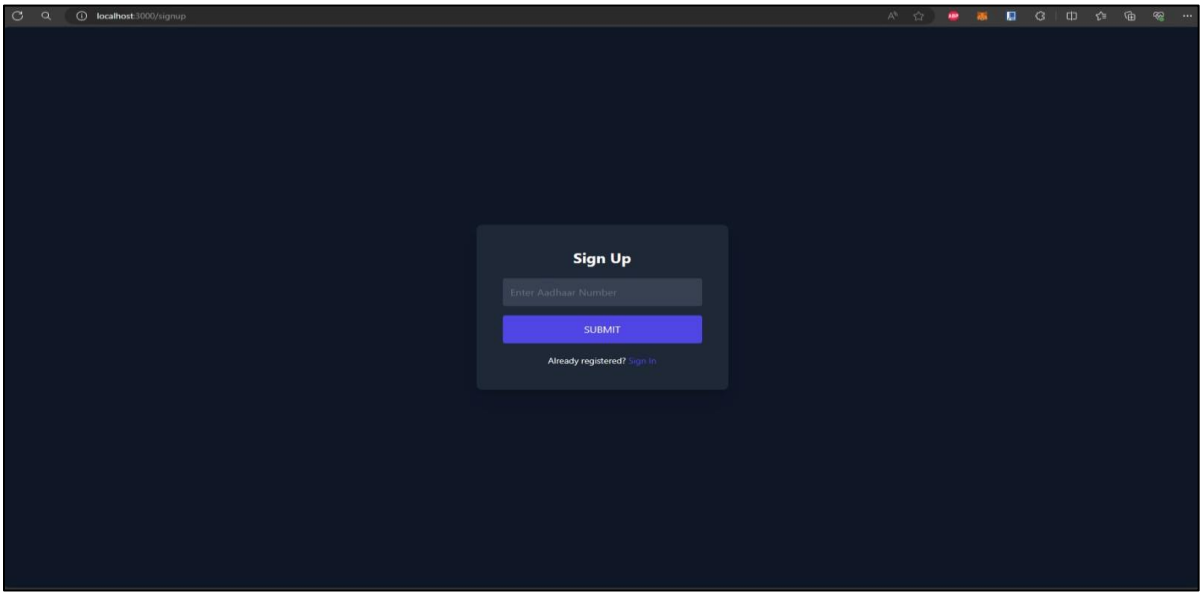


Fig 8.2 – Sign Up page

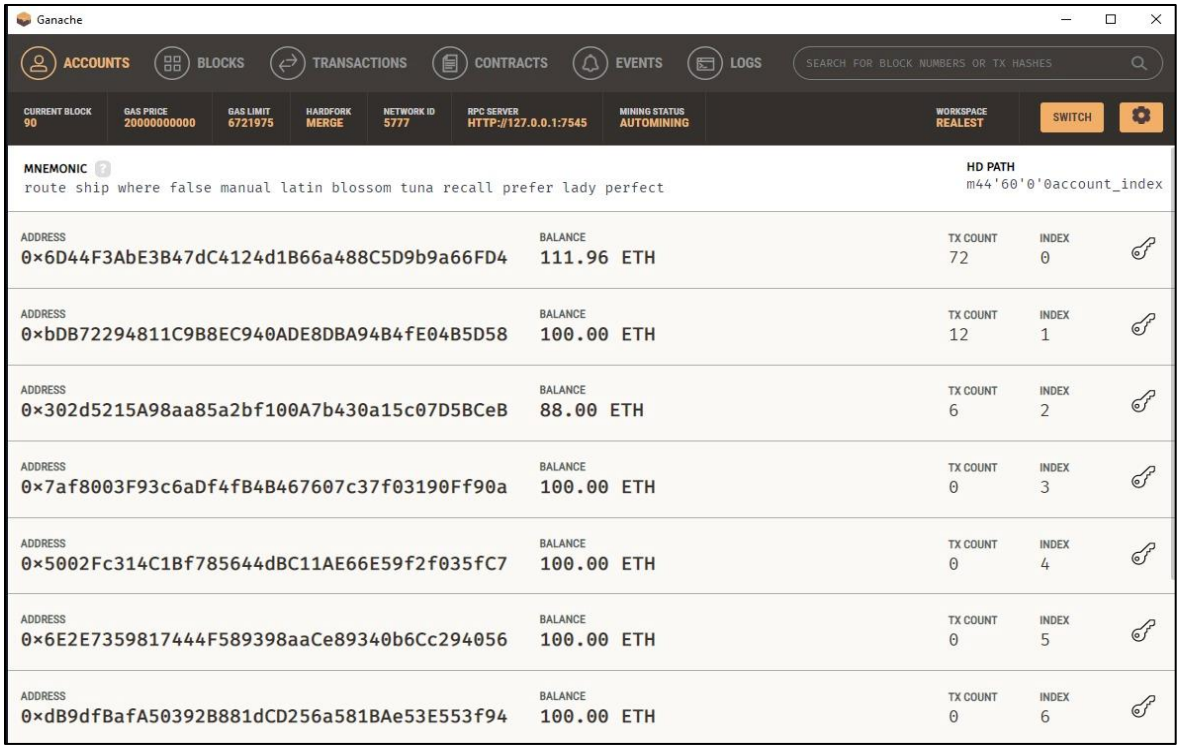


Fig 8.3 – Truffle Accounts

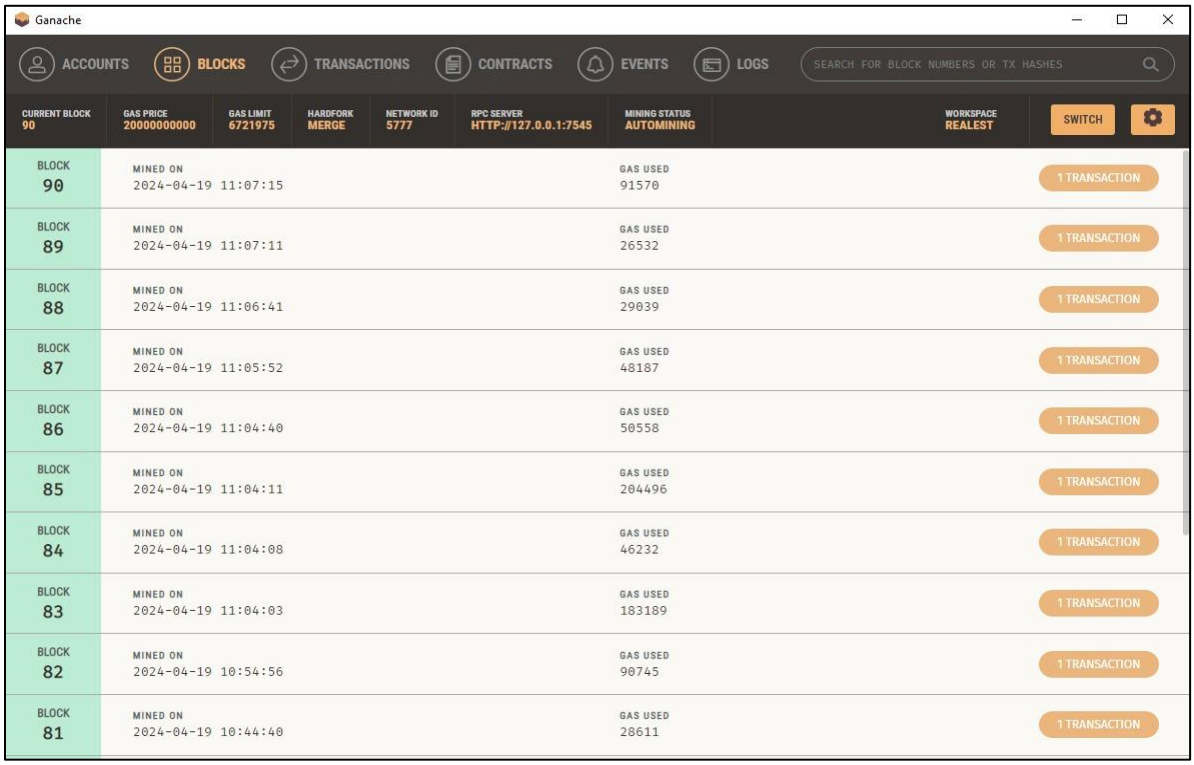


Fig 8.4 – Transaction blocks

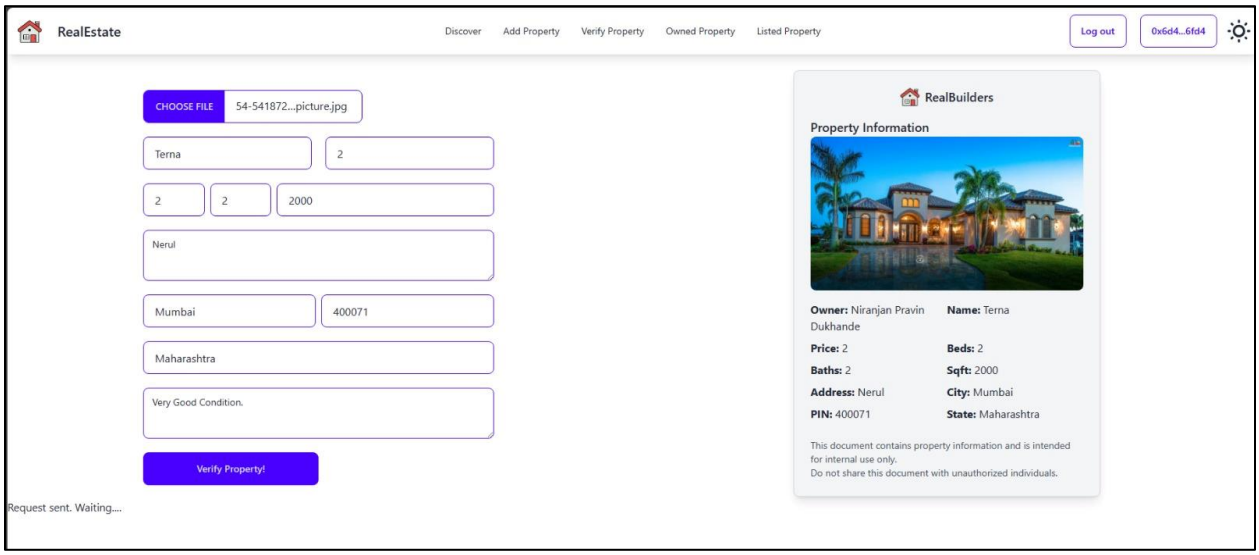


Fig 8.5 – Seller Adds property details

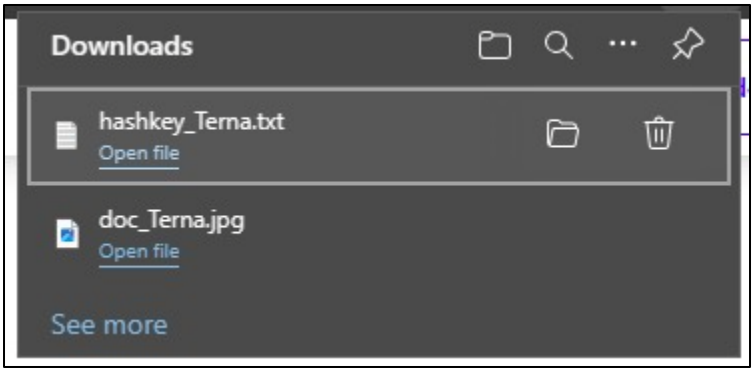


Fig 8.6 – Seller receives hash key and document

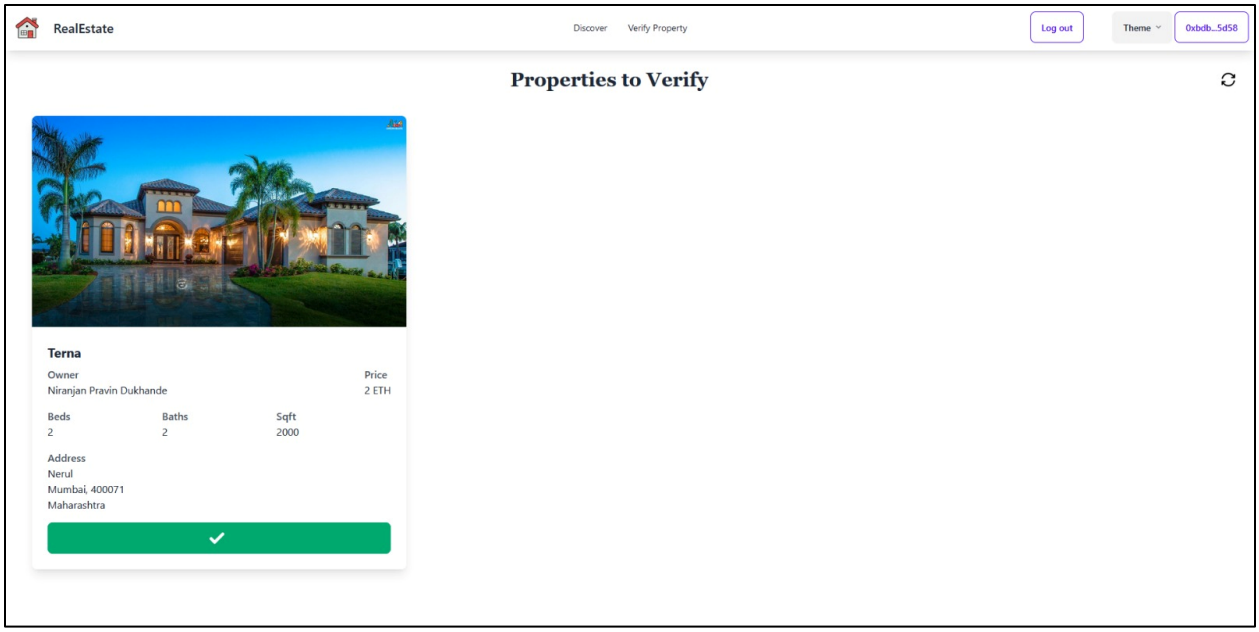


Fig 8.7 – Inspector checks and approves the sellers property

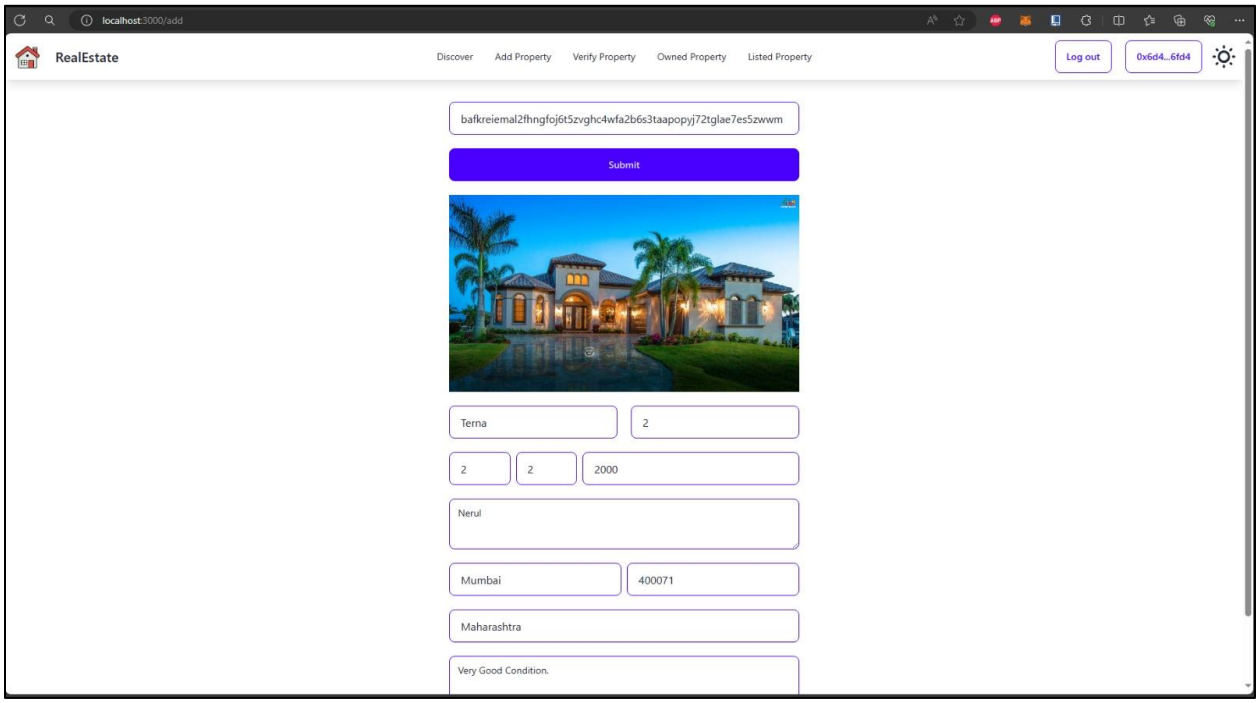


Fig 8.8 – Seller provides hash key and adds the property into the system

Fig 8.9 – Seller lists the property

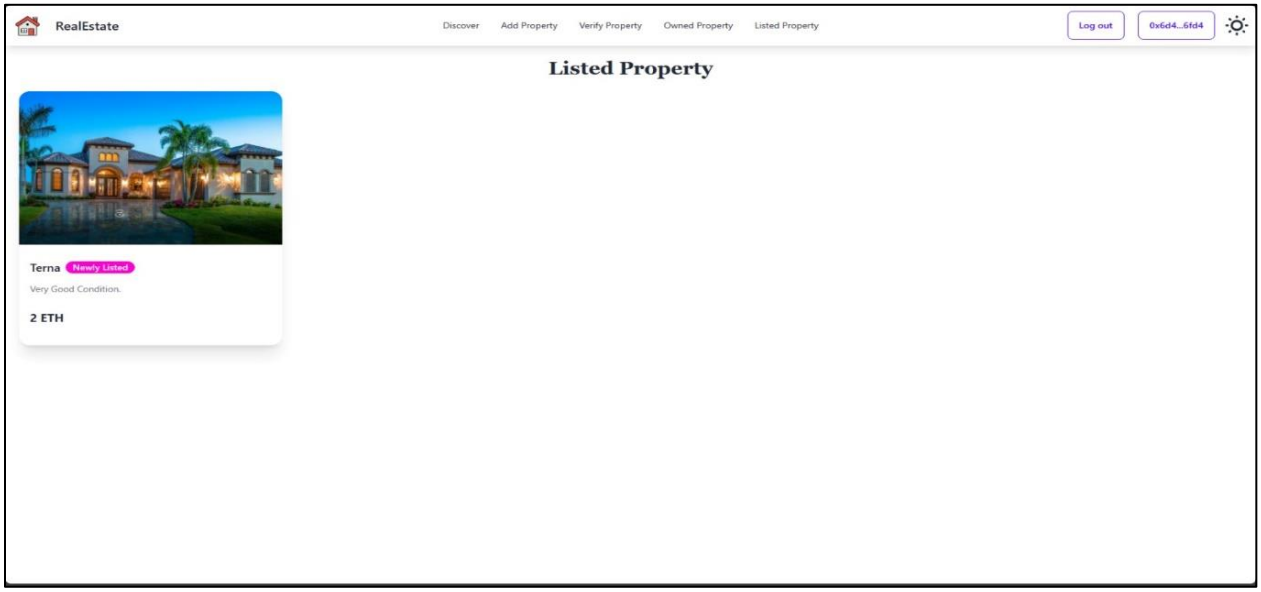


Fig 8.10 – Property Listed

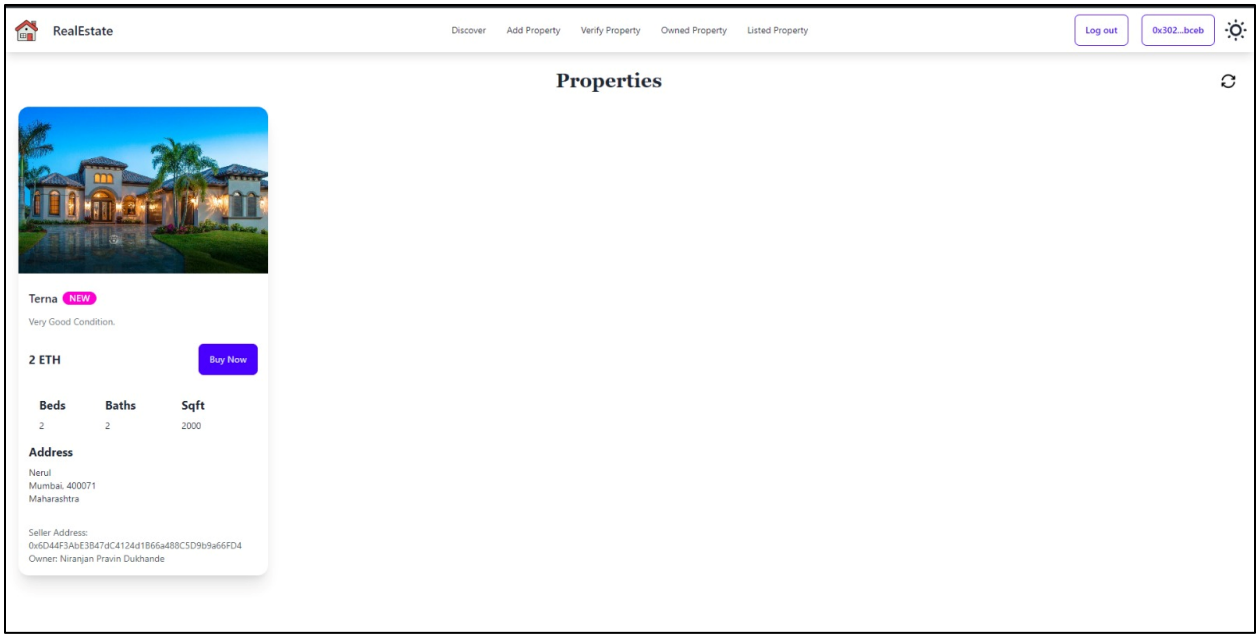


Fig 8.11 – Buyer views and purchases the property

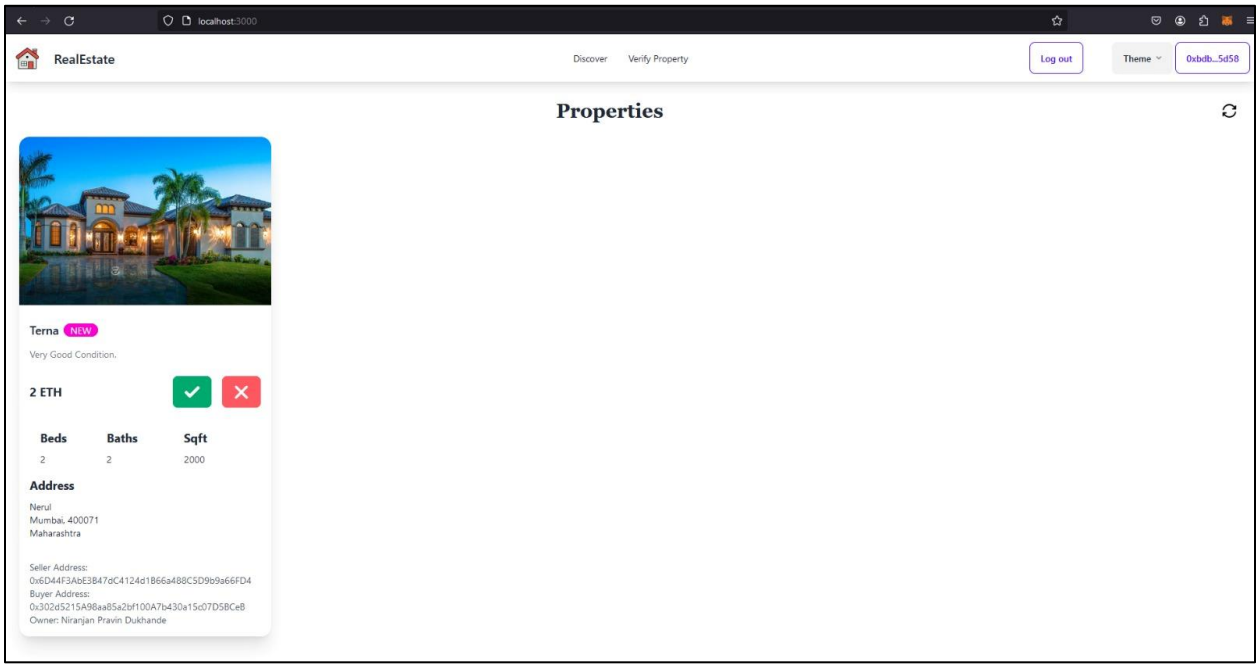


Fig 8.12 – Inspector approves the sale

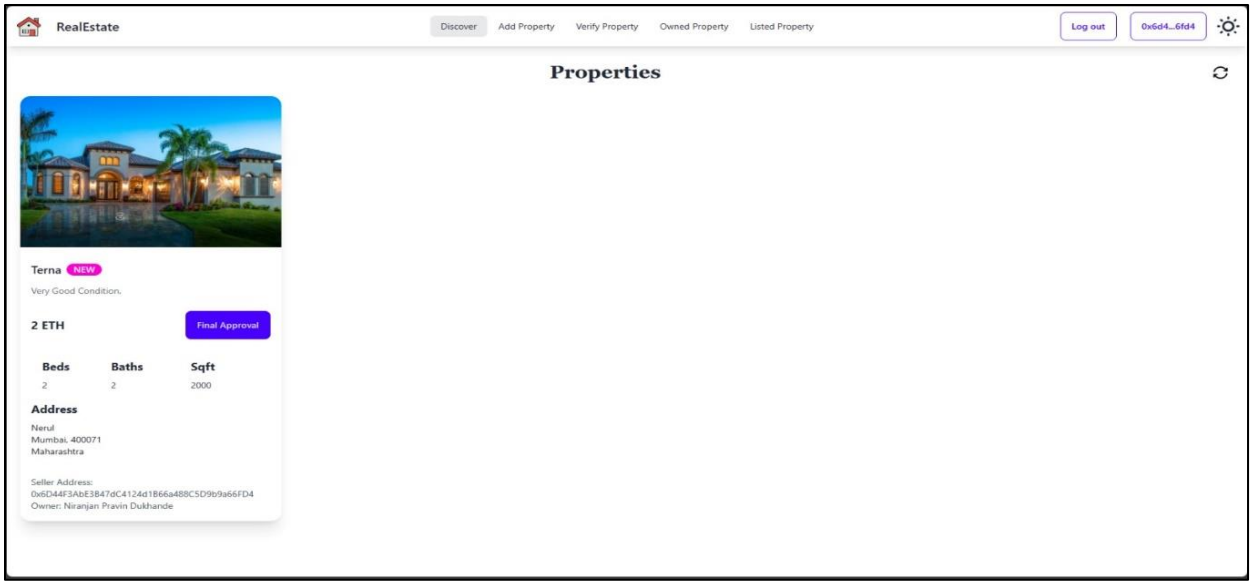


Fig 8.13 – Seller Gives final approval

Fig 8.14 – Buyer acquires property (Ownership transferred)

CHAPTER - 9

Conclusion

In conclusion, the project represents a significant milestone in the ongoing efforts to revolutionize the real estate industry through the adoption of blockchain technology. By addressing the pervasive issue of fraud prevention, the system offers a robust framework for enhancing security, transparency, and efficiency in property transactions. Through the integration of innovative features and mechanisms, the project seeks to establish a new standard for trust and reliability in real estate transactions.

The implementation of blockchain technology introduces a paradigm shift in the way property transactions are conducted, leveraging decentralized consensus mechanisms, cryptographic security, and immutable ledger technology. By tokenizing properties as Non-Fungible Tokens (NFTs), the system provides unique digital representations of ownership, ensuring transparency and traceability throughout the transaction lifecycle. Smart contracts automate transaction processes, enforce validation rules, and facilitate secure, tamper-proof property transfers, reducing the risk of fraud and dispute resolution.

Furthermore, the integration of user authentication mechanisms, regulatory compliance measures, and inspector approval workflows enhances the integrity and legality of property transactions. Users can confidently engage in transactions knowing that their identities are verified, transactions are compliant with regulatory requirements, and property documentation is thoroughly inspected and validated.

The project's impact extends beyond the realm of fraud prevention, fostering trust and confidence among stakeholders and empowering them to participate in property transactions with greater transparency and security. By providing a user-friendly interface, seamless user experience, and comprehensive post-transaction services, the system aims to streamline the entire property transaction process, from listing to finalization.

Looking ahead, the project opens up exciting possibilities for further innovation and development in the real estate industry. As blockchain technology continues to evolve and mature, opportunities for enhancing the system's capabilities, scalability, and interoperability abound. Collaborative efforts with industry stakeholders, regulatory bodies, and technology experts will be essential in driving widespread adoption and realizing the full potential of blockchain-based solutions in real estate.

In conclusion, the project represents a transformative step towards a more secure, transparent, and efficient real estate ecosystem. Through the convergence of blockchain technology, regulatory compliance, and user-centric design principles, the system sets a new standard for trust and integrity in property transactions, laying the foundation for a future where fraud prevention is not just a goal but a reality.

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Publications

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FRAUD PREVENTION IN REAL ESTATE USING BLOCKCHAIN

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ABSTRACT

The real estate industry is crucial sector of the world economy Buying and selling properties usually takes a long time, is complicated, and can be expensive. There's also a risk of mistakes and fraud, which might cause big financial losses and legal problems. This research paper delves into the innovative use of blockchain technology to address the pervasive issue of fraud within the real estate industry. By introducing a comprehensive system where user authentication is conducted through Aadhaar numbers, properties are represented as Non-Fungible Tokens (NFTs), and transactions involve the crucial oversight of designated inspectors, this paper aims to provide a robust framework for fraud prevention. Additionally, it explores how blockchain's inherent properties prevent instances of double selling, thus bolstering the integrity of real estate transactions. The research demonstrates the effective utilization of blockchain technology and Ethereum's smart contracts. The immutability nature of the blockchain ledger and transactions can provide a safe environment for the real estate sector. The project also identified some challenges and opportunities for blockchain adoption in the real estate industry. One of the challenges is the lack of awareness and understanding of blockchain technology. Another challenge is the regulatory environment, which is currently unclear. However, there are many opportunities for blockchain adoption in the real estate industry, such as streamlining the real estate transaction process, reducing fraud, and improving transparency.

Keywords: Blockchain, Fraud Prevention, NFT, Real Estate.

I. INTRODUCTION

Real estate assets, including land, buildings, and infrastructure, frequently make up the majority of individual and institutional portfolios [1]. The real estate industry encompasses the buying, selling, and development of properties, including land, residential and commercial buildings. It plays a crucial role in the economy, influencing sectors like construction, finance, and various related services. Real estate is characterized by its tangible nature, long-term investment potential, and its impact on both urban and rural landscapes.

Real estate transactions are susceptible to various types of fraud like title fraud, identity theft, and double-selling of properties. These fraudulent activities not only result in financial losses but also undermine trust in the real estate market. Traditional methods of preventing fraud often fall short due to their reliance on centralized authorities and paper-based documentation, which are susceptible to manipulation and falsification. A blockchain is a distributed ledger which stores all transactions in a transparent and immutable manner [6].

Blockchain is an emerging technology that has changed many aspects of modern finance; however, its use cases are not limited to financial systems [2]. Blockchain technology offers a decentralized and tamper-proof solution to address these challenges by providing a secure and transparent platform for recording and verifying property transactions. Blockchain is a distributed ledger technology that is characterized by its decentralized and immutable nature. It has several key features that make it appealing for various applications, such as the ability to ensure data integrity, security, transparency and privacy [3], [4].

Blockchain technology is used extensively throughout smart cities around the world to address various data related challenges. These include blockchains in the smart economy [7], transparency in the global supply chain [8], equity crowdfunding and smart elections [9,10].

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II. METHODOLOGY

Our system for fraud prevention in real estate uses blockchain technology to maintain transparency, security, and trust in real estate transactions. The architecture comprises the following components:

- User Registration and Authentication: Users register and log into the system using Aadhaar numbers, providing a secure and verifiable identity authentication mechanism.
- Property Representation with NFTs: Each property is represented as a Non-Fungible Token (NFT) on the blockchain. When a new property is added, a new NFT is minted, ensuring uniqueness and authenticity.
- Ownership and Marketplace Integration: The added property is recorded in the user's owned property section. Users can list their properties on the marketplace, where other users can discover and potentially purchase them.
- Transaction Verification by Inspectors: Before a transaction is finalized, it undergoes verification by designated inspectors. Transactions cannot proceed without the inspector's approval, adding an additional layer of security and trust.
- Smart Contracts for Transaction Execution: Transactions are facilitated through smart contracts, which automate and enforce the terms of the transaction. Once verified by the inspector, the transaction is executed, completing the trade securely and efficiently.

Common Frauds in Real Estate Business and Solutions Provided by Our System:

Title Fraud:

Problem: Title fraud occurs when a fraudster illegally transfers ownership of a property by falsifying documents or forging signatures.

Solution: Our system leverages blockchain technology to maintain a transparent and immutable record of property ownership. Each property is represented by a unique Non-Fungible Token (NFT), with ownership recorded on the blockchain. This ensures that only legitimate owners can transfer property ownership, mitigating the risk of title fraud.

Phantom Listings:

Problem: Phantom listings involve fake properties being advertised for sale or rent by scammers to deceive unsuspecting buyers or tenants.

Solution: Our system verifies property listings by cross-referencing them with authenticated data stored on the blockchain. This ensures that only genuine properties are listed on the platform, reducing the likelihood of users falling victim to phantom listings.

Wire Fraud:

Problem: Wire fraud occurs when fraudsters intercept communication between buyers, sellers, and real estate agents to deceive them into wiring funds to fraudulent accounts.

Solution: Our system employs secure communication channels and smart contracts to facilitate property transactions. Smart contracts automatically execute transactions only when predefined conditions are met, reducing the risk of wire fraud by eliminating the need for manual fund transfers.

Forgery and Identity Theft:

Problem: Forgery and identity theft involve fraudsters impersonating property owners or legitimate buyers to illegally transfer property ownership or obtain loans.

Solution: Our system utilizes advanced identity verification mechanisms, such as Aadhaar login validation and decentralized identity solutions. Users' identities are securely verified through Aadhaar authentication before they can participate in property transactions, reducing the risk of forgery and identity theft.

Double Selling of Properties:

Problem: Double selling occurs when a fraudster sells the same property to multiple buyers, leading to disputes over ownership and financial losses.

Solution: Our system prevents double selling by recording property ownership on the blockchain and enforcing rules that prohibit multiple sales of the same property. Once a property is sold, its ownership status is updated on the blockchain, preventing further transactions involving the same property.

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Preventing Double-Selling with Blockchain:

One of the key challenges in real estate transactions is the risk of double-selling, where a property is sold to multiple buyers simultaneously. Our system addresses this challenge by utilizing blockchain technology to maintain an immutable record of property ownership. When a property is listed on the marketplace, ownership of the property is temporarily transferred to the marketplace itself. This prevents the original owner from selling the property to multiple buyers simultaneously, as the property remains under the control of the marketplace until a legitimate transaction is completed.

Technology Stack:

Our project uses a carefully chosen technology stack to ensure the effectiveness and security of our fraud prevention system. This stack comprises of blockchain platforms, smart contract languages, and frontend frameworks, each selected to address specific project requirements. and challenges

- Blockchain Platform: For the foundation of our system, we opted for the Ethereum blockchain platform, renowned for its widespread adoption, robust infrastructure, and support for smart contracts. Ethereum provides a decentralized and immutable ledger that serves as the backbone for recording property transactions securely and transparently. Leveraging Ethereum's network, we ensure trust and integrity in every transaction executed within our system. Blockchain technology, according to the authors of study [5], makes real estate transactions faster, safer, and more low-cost.
- Smart Contract Language: To implement the logic governing property transactions and user interactions, we used Solidity as the primary language. Solidity is designed to write smart contracts on the Ethereum platform. With Solidity, we developed smart contracts that enforces the rules and conditions of property transactions, ensuring prevention of fraudulent activities.
- Frontend Framework: For crafting intuitive and responsive user interfaces, we chose Next.js as the frontend framework for our web and mobile applications. Next.js is a popular React framework that adds server-side rendering, static site generation, and other performance optimizations out of the box. By leveraging Next.js, we designed user-friendly interfaces that empower users to effortlessly interact with the system, from property listing and discovery to transaction management and authentication.

Additional Components:

In addition to the core components mentioned above, our technology stack incorporates several complementary tools and frameworks to enhance system functionality and performance. These include:

- Truffle Suite: For development, testing, and deployment of smart contracts, providing a comprehensive suite of tools and utilities.
- Web3.js: A JavaScript library for interacting with Ethereum nodes and smart contracts, enabling seamless integration of blockchain functionality into our frontend applications.
- IPFS (InterPlanetary File System): For decentralized storage of property-related data and metadata, ensuring resilience and accessibility while minimizing reliance on centralized servers.

By leveraging this comprehensive technology stack, we have built a robust and efficient fraud prevention system in real estate that leverages the capabilities of blockchain technology while providing a seamless and user-friendly experience for all stakeholders involved.

```
function mint(string memory tokenURI) public returns (uint256) {
    _tokenIds.increment();
    uint256 newTokenId = _tokenIds.current();
    _safeMint(msg.sender, newTokenId);
    _setTokenURI(newTokenId, tokenURI);

    return newTokenId;
}
```

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- This function mint is responsible for creating and minting a new Non-Fungible Token (NFT) with the given tokenURI, which represents the metadata of the token.
- It takes the tokenURI as input parameter and returns the ID of the newly minted token.
- Inside the function, the _tokenIds counter is incremented to generate a new unique token ID for the newly minted token.
- The _safeMint function is called to mint the new token and assign ownership to the address of the message sender (i.e., the caller of the function).
- Then, the _setTokenURI function is used to set the token URI for the newly minted token, associating it with its metadata.
- Finally, the ID of the newly minted token is returned as the output of the function.

```
function nftTransferToContract(uint _propId, uint _newPrice) external nonReentrant {
    require(_newPrice > 0, "Price must be greater than zero");
    require(_propId > 0 && _propId <= _propIds.current(), "Item does not exist");
    Property storage prop = props[_propId];
    require(prop.nft.ownerOf(prop.tokenId) == address(msg.sender), "You does not own the NFT");
    IERC721 nft = prop.nft;
    prop.price = _newPrice;
    // transfer nft
    nft.transferFrom(msg.sender, address(this), prop.tokenId);
    resetDetails(_propId, false, false);
    //call listProperty() after this fucntion in frontend
}
```

- This function nftTransferToContract allows a user to transfer an NFT representing a property to the contract and update its price.
- It takes two parameters: _propId, which is the ID of the property, and _newPrice, which is the new price set for the property.
- The function first ensures that the new price is greater than zero and that the property ID exists.
- It then retrieves the property details based on the provided ID and verifies that the caller owns the NFT representing the property.
- After updating the price of the property, the function transfers the NFT from the caller to the contract address.
- Finally, it resets the details of the property and suggests calling listProperty() after this function in the frontend to update the property listing.

```
function makeItem(IERC721 _nft, uint _tokenId, uint _price) external nonReentrant {
    require(_price > 0, "Price must be greater than zero");
    // increment itemCount
    _propIds.increment();
    uint256 currPropId = _propIds.current();
    // transfer nft
    _nft.transferFrom(msg.sender, address(this), _tokenId);
    // add new property to Property mapping
    props[currPropId] = Property (
        currPropId, //propertyId
        _nft, //nft address
        _tokenId, //nft Id
        _price,
        payable(msg.sender), //seller
        payable(address(0)), //buyer
        false, //sold
        // Price(_purchasePrice, _depositPrice, _purchasePrice+_depositPrice), // purchasePrice, depositPrice, totalPrice
        Property_info(false, false, false) // isListed, isInspected, isApproved
    );
    //emit event
    emit Offered(
        currPropId,
        address(_nft),
        _tokenId,
        _price,
        msg.sender
    );
}
```

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- This function makeItem creates a new property item and lists it for sale.
- It takes three parameters: _nft, which is the address of the NFT contract, _tokenId, which is the ID of the NFT token, and _price, which is the price set for the property.
- The function first ensures that the price is greater than zero.
- It then increments the property ID counter and retrieves the current property ID.
- The NFT token is transferred from the caller to the contract.
- The details of the new property, including its ID, NFT address, NFT ID, price, seller, buyer (initialized as address(0)), and sale status, are stored in the Property mapping.
- An event Offered is emitted to indicate that the property has been offered for sale, including details such as the property ID, NFT address, NFT ID, price, and seller address.

III. MODELING AND ANALYSIS

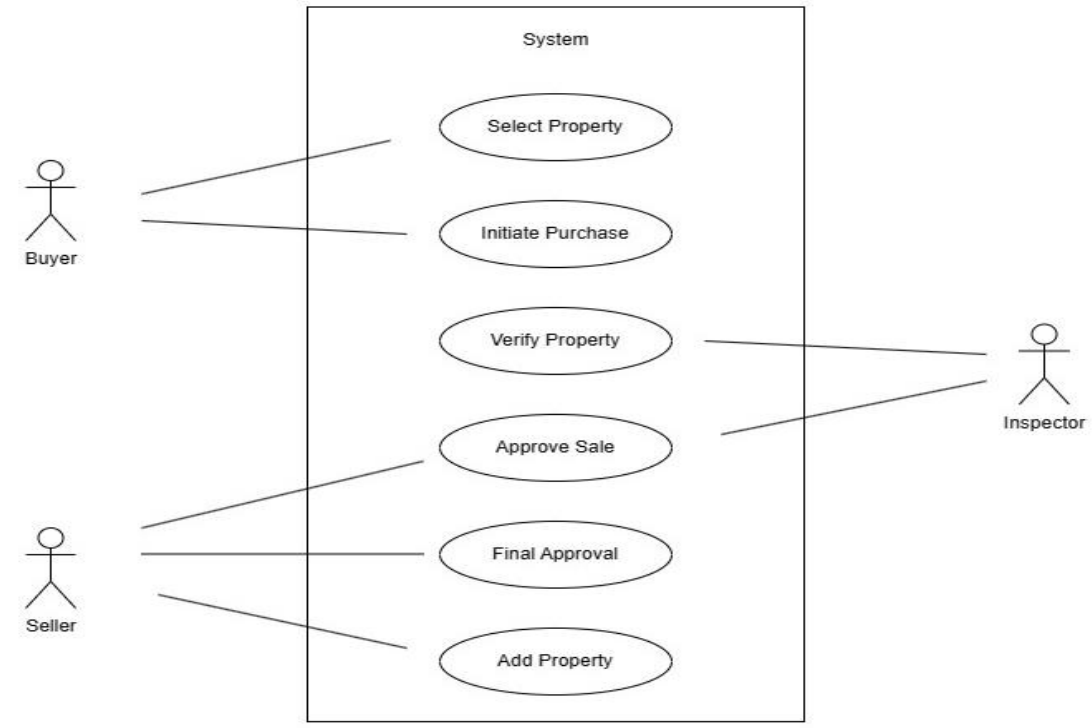

Figure 1: Use Case Diagram.

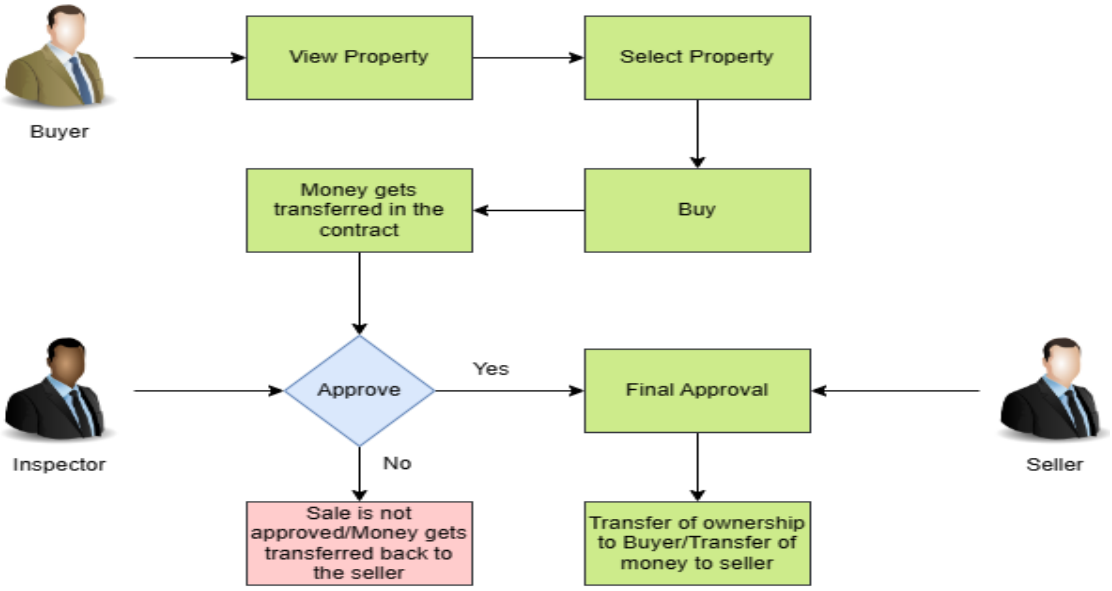

Figure 2: Buyer process flow

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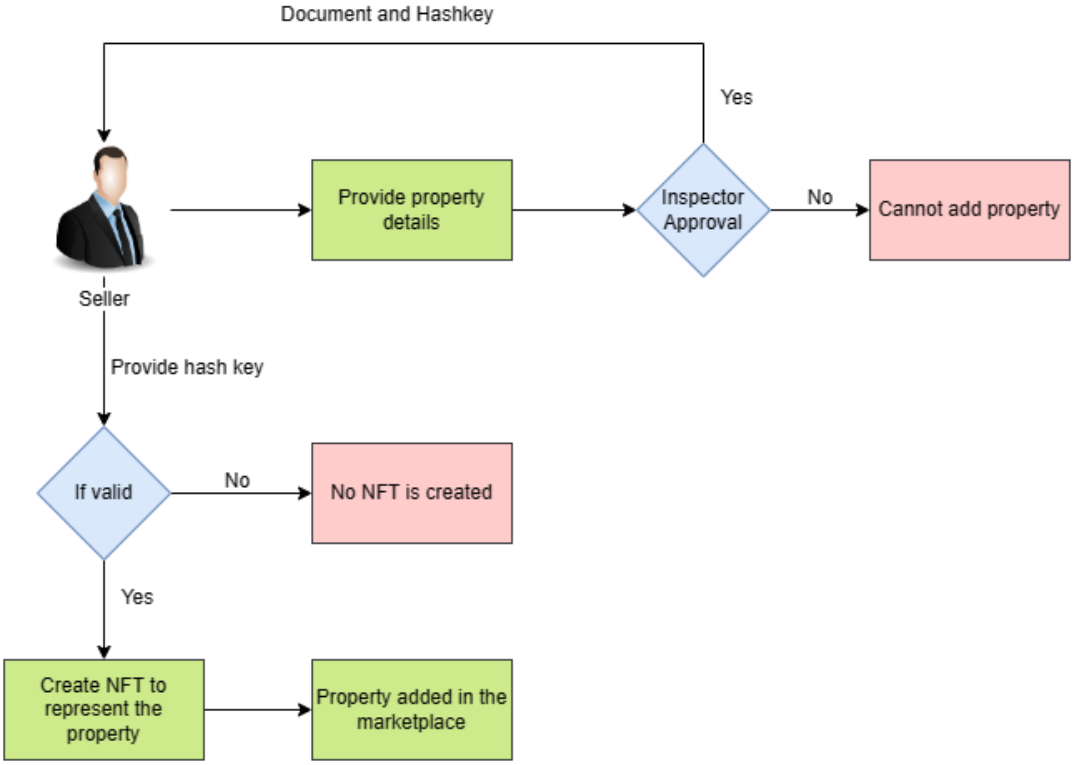

Figure 3: Seller process flow

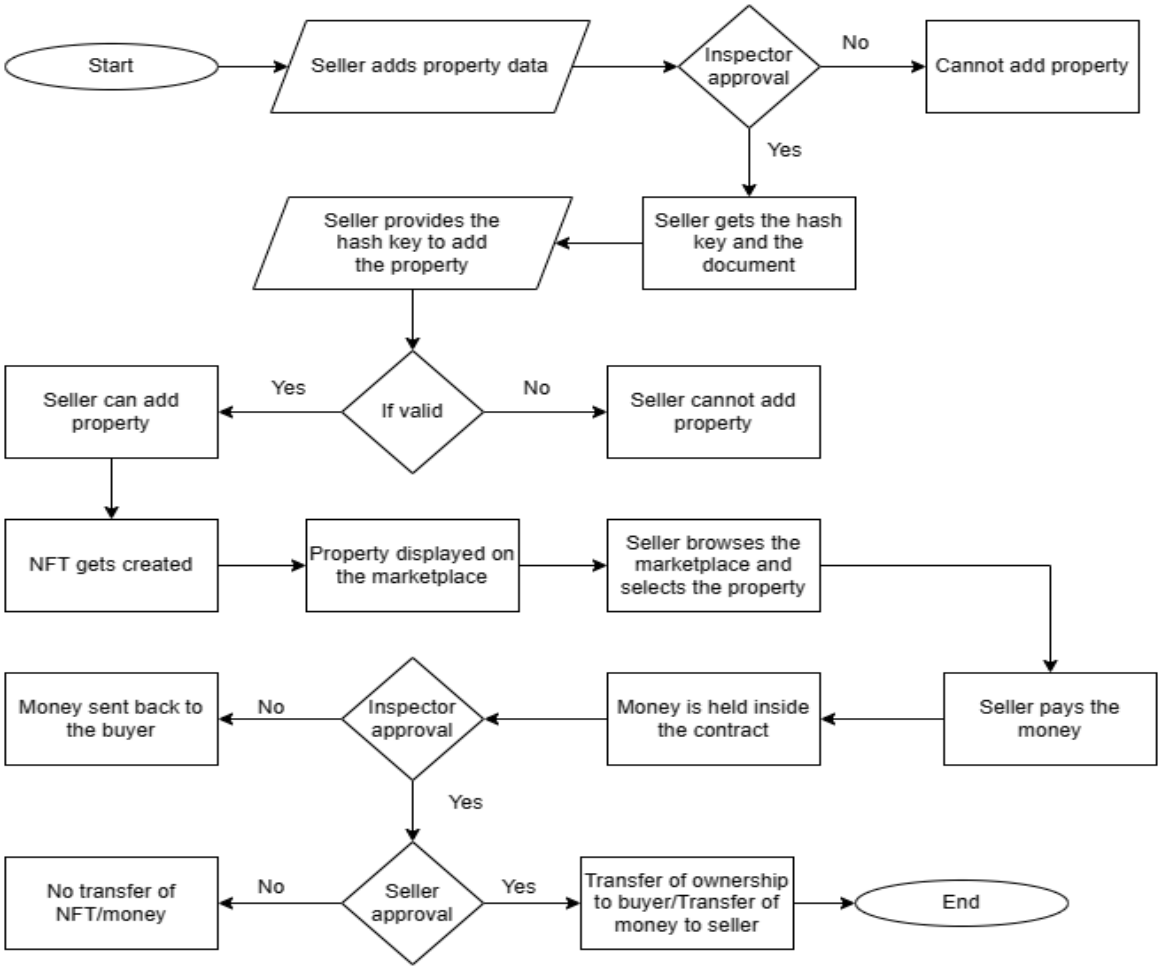

Figure 4: Flow Chart

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IV. CONCLUSION

Fraud prevention in real estate is a critical issue that demands innovative solutions. By harnessing the power of blockchain technology, our system provides a robust framework for ensuring transparency, security, and trust in property transactions. Through features such as Aadhaar-based authentication, NFT representation of properties, inspector verification, and smart contracts, we offer a comprehensive approach to mitigating fraud in the real estate market. Overall, our solution has the potential to significantly reduce the incidence of fraud in real estate transactions, fostering a more trustworthy and efficient marketplace for buyers and sellers alike.

V. FUTURE SCOPE

- Enhanced Authentication Mechanisms: Implement advanced authentication mechanisms, such as biometric authentication or multi-factor authentication (MFA), to further strengthen user identity verification and prevent unauthorized access to the system.
- Expansion of Property Verification Features: Extend the capabilities of the system to include comprehensive property verification features, such as automated property title verification and verification of property ownership history. This would provide users with greater confidence in the legitimacy of properties listed on the platform.
- Development of Mobile Applications: Develop dedicated mobile applications for iOS and Android platforms to offer users the convenience of accessing the fraud prevention system on their smartphones and tablets. Mobile applications would enable users to perform property transactions on the go, further enhancing user engagement and accessibility.
- Expansion into Global Markets: Explore opportunities to expand the reach of the fraud prevention system into global markets, collaborating with local real estate agencies and regulatory bodies to tailor the system to the unique requirements and regulations of different regions. This would facilitate cross-border property transactions and broaden the user base of the platform.

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