A Blockchain-Enabled Real Estate Application Using Solidity Smart Contracts and Frontend Integration via React and MetaMask

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Abstract

The real estate industry still faces a lot of inefficiencies in today's digital era, such as commercial fraud, astronomic intermediary costs, lack of transparency, and a lot of time being spent on paperwork. This work provides a detailed account of a blockchain-based decentralized real estate app (DApp) that is designed and implemented to fix these problems. With smart contracts of Solidity, the system is developed to have an irreplaceable and transparent registration of property and transactions. The application comes with a basic user-friendly frontend developed in React.js, where the interaction with the Ethereum blockchain should be seamless, and interface with the MetaMask wallet is possible. Hardhat is used for local testing and deployment to the testnet. This DApp supports the transaction of properties directly from one party to another, thus, cutting out any link in the chain and creating a so-called trustful environment for the real estate ecosystem. The proposed system represents a first significant step toward a safer, more efficient, and more inclusive real estate market with blockchain.

Keywords— Blockchain, Solidity, Nodejs, Backend , Frontend, Decentralization, Transparency, Metamask

1. INTRODUCTION

Real estate is one of the big sectors in the world economy. However, there are several issues that continue to bother this sector such as property faking of the titles, unique property histories being opaque, transaction delays, and having a record-keeping system that relies on some central authority. All these ensure that the real estate is inefficient and the trust among the stakeholders is reduced. The blockchain technology seems to be a very promising solution with the concepts of decentralization, security, and transparency in the digital transactions being introduced. The system sees to it that the property records are immutable, traceable, and free from unauthorized modifications. By a platform for blockchain-based real estate, the project's target is to make the purchase and sale of properties manageable via smart contracts and easy-to-use interfaces. This article is about the process of developing and enabling a real estate DApp that is blockchain-based using Solidity for smart contracts, React.js for the frontend interface, and MetaMask for secure user authentication and transaction management. Hardhat is the tool that the author used to run tests and deploy contracts to an Ethereum test network. So, these very technologies establish a safe and clear infrastructure for digital asset transactions.

2. LITERATURE REVIEW

Traditional real estate procedures depend a lot on the centralized database created by government or private institutions, making them susceptible to single points of errors, manipulation and failure. In addition, verification of ownership, validation of documents, and processing payments are taking time and often requiring third-party intermediaries, leading to an increase in cost. Many educational studies and blockchain startups have proposed a decentralized approach to real estate. For example, proper and reflect that blockchain can be used to simplify title verification and ownership transfer. Nakamoto (2008) introduced the concept of decentralized trusts via bitcoin, which formed the basis for decentralized leaders in industries. Despite the technical promise, large -scale adoption is still limited due to the complexity of the blockchain tool and lack of user -friendly interfaces. Our application addresses this difference by combining smart contract functionality with a react-based front and metamask wallet integration, which enables spontaneous and accessible interactions with blockchain.

3. TECHNOLOGY STACK

Component\tTechnology
Blockchain\Ethereum (Testnet)
Smart Contracts\tSolidity

Testing/Deployment\tHardhat
Frontend\tReact.js
Wallet Integration\tMetaMask

4. SYSTEM ARCHITECTURE

The architecture of the proposed application is modular and decentralized, comprising the following key components:

Smart Contracts (Solidity): Manage all logic related to property listing, purchase, and ownership transfer. They ensure that records are tamper-proof and transaction-driven.

Frontend (React.js): Provides the graphical user interface (GUI) through which users can list, browse, and purchase properties. React Hooks are utilized for efficient state and lifecycle management.

MetaMask Wallet: Acts as a bridge between the user and the blockchain network. It handles user authentication and enables the signing and submission of transactions securely.

Hardhat: Facilitates local Ethereum blockchain simulation, smart contract compilation, deployment, and testing. It also assists in measuring gas usage and handling errors before production deployment.

Key Points About Blockchain in the Project

1.Decentralized Architecture

Blockchain enables a decentralized ledger system where no central authority is required to validate property ownership or transactions.

2.Tamper-Proof Records

The immutability of blockchain ensures that once a property transaction is recorded, it cannot be altered or deleted, reducing the risk of document fraud and disputes.

3.Enhanced Transparency

All transactions are visible on the blockchain, allowing buyers and sellers to independently verify property ownership and transaction history.

4.Automated Transactions via Smart Contracts

Solidity-based smart contracts automate key processes such as property listing, ownership transfer, and payment settlement, ensuring trustless execution.

5.Secure Identity and Asset Ownership

Integration with MetaMask enables secure user authentication and ownership verification, leveraging cryptographic wallet identities.

5. METHODOLOGY

5.1 Smart Contract Design

Smart contracts are written in Solidity and define the structure and rules for property management. Key features include:

Property registration with unique IDs.

Ownership mapping via Ethereum addresses.

Purchase functionality with fund transfer.

Security considerations include input validation, ownership checks, and protection against reentrancy attacks.

5.2 Frontend Implementation with React

React Hooks are employed for managing application state and lifecycle methods.

Ethers.js is used to communicate with deployed smart contracts.

User actions such as "Buy Property" or "List Property" are routed through MetaMask for signing and validation.

UI components are styled for clarity and user accessibility.

5.3 Hardhat for Testing and Deployment

A local Ethereum environment is set up using npx hardhat node.

Contracts are compiled and deployed using npm hardhat cmd— run scripts/deploy.js --network localhost.

6. RESULTS AND TESTING

The proposed blockchain-competent real estate application was successfully developed and tested using a locally configured Ethereum Test network created with hardhats. The system was strictly evaluated in different stages - from smart contract behavior to interaction and user experience. This section is a conclusion for future development, strengthening of the system and wide areas.

6.1 Smart Contracts on Local Network

The smart contract written in solidity was originally deployed using the Hardhat Local Network (NPX Hardhat Node). This local test environment allows for rapid recurrence and detailed debugging. Important and verified major functionality is included:

Property Listing: New Property can be connected by contract manager (acting as an admin). Each property will be specifically indexed, stored with on-chain name, location, cost and position with metadata.

Property purchase: Verified users were capable of purchasing available properties. Contract:

Checked the availability of property.

Transferred to the position of ownership and updated property for "sold".

Logs emitted to confirm successful purchase.

6.2 Frontend Interaction and Wallet Integration

React.js Front was connected to the local blockchain network via Ethers.JS and was supported by Metamaska for wallet interaction. including Frontend Real -time updates: properties were obtained and displayed dynamically. The status update appeared soon after a transaction was confirmed.

Wallet Connection: Metamask enables wallet integration for transaction signing. Users add their local accounts to interact with DApp in real time.

User signal and response: Transactions success/failure messages were clearly displayed.

6.3 Discussion

The system indicates that blockchain technology, even in a localized test setting, may effectively support decentralized real estate workflow. The major powers seen include:

Decentralization and Safety: Unchanged record-keeping data ends the risk of tampering and ownership disputes.

Direct transactions: There is no need for brokers or third-party verification, reducing the delay in overall transactions cost and time.

User-controlled wallet: Metamaska enables users to control their money and signs actions independently.

However, the current system also presents some challenges and development areas:

No real KYC/Off data: The deployment of the real world will require integration with government property databases and legal verification of owners.

Local network limit: While local Hardhat network simplifies development, future testing on public testing is necessary to simulate real delays, gas prices and safety concerns.

User Onboarding: Non-technical users may get wallet setups and interactions with MetaMask misleading. Future repetitions may include onboarding and UX improvements guided.

In summary, the project serves as a solid evidence of concept for blockchain-managed real estate solutions. This confirms the practical appropriateness of the ethereum smart contracts for transparent, safe and decentralized property transactions. Integrating infection and off-chain identification/land verification in public networks will be the next step towards the use of the real world.

7. CONCLUSION

This paper represents the successful development and deployment of a decentralized real estate DApp leveraging Ethereum blockchain.

The project demonstrates how blockchain can effectively resolve long standing issues in the real estate industry by eliminating middlemen, preventing fraud, and ensuring data immutability.

The system integrates Solidity smart contracts, a modern React frontend, MetaMask wallet interaction, and Hardhat deployment tools to offer a secure and efficient user experience. Future improvements may include:

Integration of off-chain data verification systems

Geo-tagging of property metadata

KYC and regulatory compliance modules

By continuing to iterate on such blockchain-enabled models, the real estate sector can evolve toward a more transparent, efficient, and equitable future.

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