Secure Land Registry System using Blockchain Technology

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Abstract*—This research paper presents a decentralized land registry system utilizing blockchain technology to offer a secure, transparent, and tamper-proof solution for managing land records. The proposed system leverages smart contracts to automate the verification and transfer of land ownership, eliminating the need for intermediaries and thereby reducing the risk of fraud and data manipulation. By ensuring that all transactions are immutable and accessible only to authorized parties, the system aims to address the longstanding issues of trust, transparency, and security in traditional land registry processes. The implementation uses Solidity for developing smart contracts, integrated with MetaMask for secure wallet interactions, and is deployed on the Ethereum test network. Preliminary results indicate a robust framework capable of streamlining land registration, providing an efficient and secure alternative to conventional methods while safeguarding landowner rights and enhancing the integrity of property transactions.

***Index Terms*—Blockchain, Decentralized Registry, Immutable Ledger, Land Records, Smart Contracts**

I. INTRODUCTION

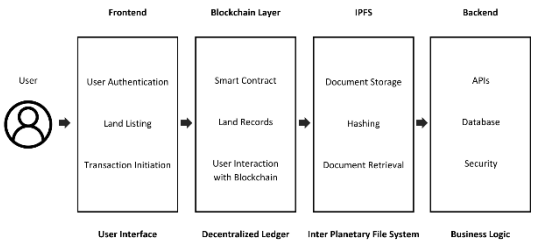
Traditional land registry systems are plagued by issues such as fraud, lack of transparency, manual errors, and inefficient processes. These challenges often lead to disputes over land ownership, data manipulation, and unauthorized changes to property records. To address these issues, blockchain technology offers a decentralized solution, providing a secure and transparent framework for managing land records without the need for intermediaries.

This research paper introduces a secure land registry system using blockchain technology to modernize the process of land ownership and registration. By leveraging smart contracts, the system ensures that transactions, including land transfers and ownership verification, are transparent, tamper-proof, and immutable. These smart contracts autonomously validate and execute transactions, significantly reducing the potential for fraudulent activity while enhancing trust and data integrity within the land registry process.

II. SYSTEM ARCHITECTURE AND DESIGN

A. Overview

The proposed solution for the Secure Land Registry System utilizes blockchain technology to ensure a transparent, secure, and tamper-proof platform for land registration and transactions. The system is structured with five distinct layers: User, Frontend, Blockchain Layer, IPFS, and Backend as shown in Figure 1.1 below. The User layer serves as the interface for landowners, buyers, and sellers to interact with the system. The Frontend layer, built using web technologies, allows users to initiate and manage transactions, view land details, and access their account. The Blockchain Layer, based on Ethereum, ensures the immutability and transparency of land records by utilizing smart contracts written in Solidity. The IPFS layer is used for securely storing documents related to land ownership, while the Backend layer manages the business logic and ensures smooth communication between the system's components.



B. Smart Contract Functionality

Smart contracts play a crucial role in automating land transactions by ensuring the conditions of each exchange are met before executing the transfer. These contracts autonomously trigger when predefined conditions are satisfied, thus enforcing the integrity of the transaction process. For example, once a user uploads land-related documents and a transaction is initiated, the smart contract verifies the authenticity of the data and ensures that the land transfer process follows the legal requirements. Upon validation, the smart contract automatically executes the transfer,

updating the blockchain with the new ownership details. This not only reduces the potential for fraud but also ensures that all parties involved in the transaction comply with the agreed terms.

III. IMPLEMENTATION

A. Technologies Used

Solidity: Used to write the smart contracts that govern land transactions and ensure the immutability and transparency of the land registry system.
Metamask: Integrated for managing user transactions and enabling secure wallet functionality, allowing users to interact with the blockchain network seamlessly.
Ethereum Blockchain: Deployed for storing and managing land ownership records, ensuring that all transactions are decentralized and secure.
IPFS: Used for decentralized storage of land-related documents such as title deeds and agreements, ensuring tamper-proof data management.

B. Development Process

The development of the Secure Land Registry System began with the creation of smart contracts in Solidity, which automate the land transfer process by verifying predefined conditions, such as payment validation and document authenticity. Metamask was integrated to ensure secure, user-friendly interactions with the blockchain network. To ensure the integrity and security of the system, the Ethereum test network was initially used to deploy and test the smart contracts, allowing us to simulate real-world scenarios without the risks of deploying on the main network. IPFS was implemented for document storage, ensuring that all land-related records are securely stored and easily accessible by authorized users. After thorough testing, the system is ready for deployment on the Ethereum mainnet for real-world usage.

IV. RESULTS AND ANALYSIS

The decentralized nature of the blockchain ensures the immutability and transparency of land transactions, providing a tamper-proof system for the land registry. All land ownership transfers are securely recorded on the blockchain, creating a transparent ledger that is accessible by authorized parties, thereby preventing unauthorized alterations. The system was tested on the Ethereum test network to assess its performance regarding transaction speed, gas costs, and overall reliability. The results indicate that the system performs efficiently under typical usage, with minimal delays and acceptable transaction costs, ensuring a seamless experience for users when interacting with the blockchain network.

V. CONCLUSION

This paper highlights the potential of blockchain technology in revolutionizing land registry systems by enhancing security, transparency, and efficiency. By utilizing smart contracts, the proposed system automates land transfer processes, ensuring that transactions are secure, immutable, and transparent. The system provides a reliable solution to the challenges faced by traditional land registries, such as fraud and data manipulation. Future work may focus on optimizing the system for scalability and deploying it on the Ethereum mainnet for broader adoption, further enhancing its impact in land management.

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