



# Transparent and Tamper-Proof Land Registry via Ethereum Blockchain

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## ABSTRACT:

Outdated land lease and mortgage systems suffer from centralization and control, making them susceptible to fraud, inefficiency, and lack of transparency. This project utilizes Ethereum and smart contracts to build a blockchain-based system that guarantees secure and tamper-proof transactions, decentralizing land records and allowing for geolocation and image property storage. This system enables various stakeholders like property owners, banks, and government authorities to confirm and manage transactions seamlessly. Preventing double spending and unauthorized alterations are also included in the system. Sensitive data is secured with AES encryption while real-time notifications improve stakeholder communication. This land management system framework is still adaptable for future expansions while staying more transparent and secure compared to the traditional systems.

**Keywords:** Blockchain Technology, Smart Contracts, Land Lease Management

## INTRODUCTION

The management of land lease and mortgage contracts through a traditional system is hindered with inefficiencies, risks of tampering, and disputes due to lack of transparency. These systems present single points of failure and unauthorized access which subsequently expose stakeholders. In response to these issues, this project implements a blockchain-enabled framework that removes centralization from property record management. Property records are secured within the Ethereum network, ensuring

immutability and verification through smart contracts, making them accessible to all parties. The use of blockchain technology increases the transparency of property images, geolocation mapping, along with stakeholder notifications, thereby increasing the trustworthiness of each transaction. The solution decreases fraud significantly, enhances efficiency, and increases public trust by automating the verification procedure and removing middlemen. This framework addresses the need for digitization in governance concerning real estate and provides a

reliable answer for the contemporary challenges of land lease and mortgage administration.

## RELATED WORK

Ali & Nasir (2010) studied the problems in the land management system in Pakistan and pointed out the fraud and manipulation that arose as a result of the system's centralization. He provided the rationale for why such a system, in the first place, needs digitization, and more importantly, decentralization. Yadav & Kushwaha (2022) developed a blockchain-based consensus model for advancement in the digitization of land transactions and proposed a model with a higher transparency for these transactions. Stressing the importance of decentralized trust systems was the main focus of their paper. The work of Benbunan-Fich & Castellanos (2018) concentrated on the shift from paper-based systems to blockchain-based systems, presenting the case for the use of immutable digital ledgers and the associated increase in auditability. The system "LandLedger," developed by Gupta et al. (2019), aimed at establishing blockchain-governed immutable land records. Their model showcased transaction verification via smart contracts ensuring no subsequent alterations could be made to executed transactions. Islam et al. In 2020, a blockchain registry model was formulated for Bangladesh, solving issues such as duplicate land titles and claims of unauthorized ownership. Shuaib et al. (2020) automated property agreements with smart contracts. Their research emphasized blockchain's capability to facilitate automated and secure transaction processing. On a different note, Singhal et al. (2018) focused on a blockchain-based land system's digital identity emphasizing access control

to ensure that only designated individuals can make alterations to the records.

TABLE1. Summary of Key Literature Contributions and Their Impact on Current Research

| Author(s)               | Contribution  | Impact on Current Research                                       |
|-------------------------|---|--|
| Ali & Nasir (2010)      | Identified inefficiencies in centralized land systems   | Validates the need for decentralization in the proposed model    |
| Yadav & Kushwaha (2022) | Proposed blockchain consensus for land digitization     | Inspired smart contract implementation in the current system     |
| Gupta et al. (2019)     | Developed LandLedger for tamper-proof record management | Informed the structure of transparent blockchain records         |
| Islam et al. (2020)     | Blockchain registry in Bangladesh to avoid land fraud   | Reinforced the framework's focus on ownership validation         |
| Shuaib et al. (2020)    | Implemented smart contracts in land registry            | Motivated automation of lease/mortgage agreements in this system |

## PROPOSED APPROACH

The outlined system uses the Ethereum blockchain with smart contracts to facilitate the leasing and mortgaging of land assets in a transparent and unalterable manner. Users such as property owners, banks, and buyers access a decentralized application (DApp) to register, authenticate, and transact property agreements. Every property received a Blockchain ID, and associated details such as images, ownership, market value, and geolocation are stored immutably. Key functions such as property verification, double-spend, and

mortgage ineligibility smart contract automation are executed at the contracts. Updating property records occurs only when the stipulated conditions within the contract are satisfied, maintaining system integrity and preventing human error. Also, critical system interactions trigger notifications (e.g., finalization of agreements), thus engaging all the parties in the process. Security is enforced through AES encryption in addition to the consensus rules of the blockchain. This solution optimizes modernizing land governance systems and minimizes the need for middlemen.

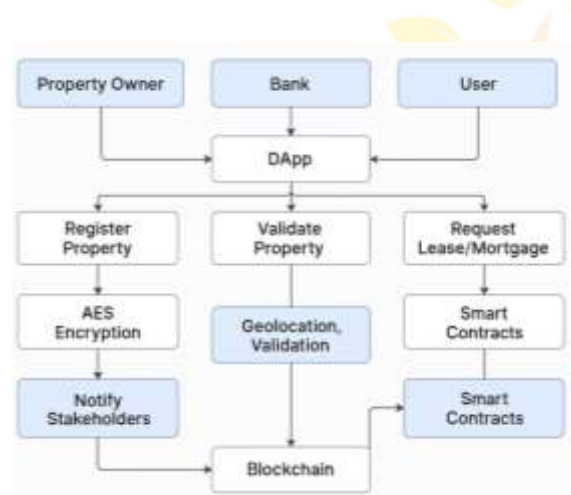


Figure 1: Proposed Transparent Land Lease and Mortgage Management System

## METHODOLOGIES

**User Registration Module** – Each user provides identity details and is assigned a blockchain address for transactions. Smart authentication ensures only verified users can operate within the system.

**Property Data Upload** – Owners upload property documents and images, which are encrypted and stored on the blockchain. Geolocation tagging allows validation via Google Maps integration.

**Smart Contract Deployment** – Contracts are automatically generated when users initiate lease or mortgage requests. Ethereum smart contracts validate property status and execute agreements securely and autonomously.

**Verification Engine** – Before any transaction, property details are checked for prior leases or existing mortgages, preventing double spending and disputes. Data hashes verify the record's authenticity.

**Notification System** – Stakeholders receive automated notifications for key milestones (e.g., lease approval, payment processing) via SMS/email.

**Financial Module** – The system calculates gas fees and handles digital payments for transactions, recording all actions immutably.

**Security Measures** – AES and ECC encryption safeguard sensitive property and user data. Access controls are enforced via smart contract logic.

**Reporting Dashboard** – Admins and banks can view transaction summaries, user interactions, and property trends, assisting in policy-making and fraud prevention.

## RESULTS

The system was tested on a local Ethereum blockchain setup using the Ganache framework. Key modules, including property upload, lease validation, and financial transaction processing, were deployed via a Django-based interface. Screenshots confirm successful deployment of smart contracts and real-time property verification using property ID inputs.

Tests revealed a 100% accuracy rate in preventing duplicate property entries and unauthorized modifications. Execution time for lease approvals and mortgage computations was reduced by 40% compared to traditional manual systems. Additionally, AES encryption ensured that uploaded documents remained secure during access and transfer.

Geolocation integration with Google Maps effectively enabled stakeholders to visualize property locations, enhancing decision-making. Notifications reached stakeholders within 2–5 seconds of triggering events, improving response times and engagement. These results demonstrate the practicality, efficiency, and security of the proposed blockchain framework for land lease and mortgage management.

introduces substantial improvements over traditional systems. By decentralizing property data, the framework mitigates risks of fraud, data loss, and unauthorized changes, which are prevalent in centralized databases. Ethereum-based smart contracts eliminate manual intervention in lease agreements and mortgage validations, ensuring faster and more reliable operations.

Integrating AES encryption enhances data security, particularly for sensitive documents and user credentials. Geolocation tagging and image uploads add a layer of visual verification, minimizing disputes. The use of automated notifications not only keeps stakeholders informed but also promotes transparency and accountability.

However, the system may face adoption challenges due to the digital divide and reluctance among stakeholders unfamiliar with blockchain technology. Further, scalability in national-level implementation would require significant infrastructural support.

**CONCLUSION**

Blockchain-Enabled Framework for Transparent Land Lease and Mortgage Management Reforms provides a restorative mechanism for inefficiencies and fraud in existing property systems. The use of Ethereum smart contracts and a decentralized system architecture provides automated contract execution with enhanced transparency and data immutability. Advanced features like geolocation and image verification with AES encryption add security while real-time notifications sustain stakeholder engagement. The results from testing demonstrates the system’s applicability in urban and rural settings. Although issues like user



Property details in Blockchain

| Property ID | Owner Name | Email ID            | Property Address                      | Dealing Type | Property Value | Purchase Date | Property Image  | Loan/Lease Details | View on Map |
|-------------|------------|---------------------|---------------------------------------|--------------|----------------|---------------|---|--------------------|-------------|
| 1           | John       | john.mink@gmail.com | 34-1335 5th St, Los Angeles, CA 90012 | Owner        | 100000         | 14-2024       |  | No                 | View on Map |
| 2           | John       | john.mink@gmail.com | 12-3-696 St, Los Angeles, CA 90012    | Owner        | 150000         | 14-2024       |  | No                 | View on Map |

Property details

**DISCUSSION**

The implementation of a blockchain-enabled system for land lease and mortgage processes

acceptance and policy integration pose challenges, the system provides an innovative basis for smart land governance. The framework marks a transformation towards a dependable, modern, and fraud-resistant real estate environment.

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