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Decentralised Record Management System in Land Data Using Blockchain Technology

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Abstract:

The Decentralized Record Management System for Land Data using Blockchain Technology aims to improve the security, transparency, and reliability of land record management. Traditional land record systems are mostly centralized and manual, which makes them prone to fraud, data manipulation, delays, and loss of records. This project proposes a blockchain-based solution to securely store and manage land ownership details, transactions, and historical records in a tamper-proof and transparent manner.

By using blockchain technology, all land records are stored in a distributed ledger that cannot be altered once recorded. Each transaction, such as land registration or ownership transfer, is verified and added as a new block, ensuring data integrity and traceability. Smart contracts are used to automate processes like ownership transfer and verification, reducing human intervention and increasing efficiency. Only authorized users can access or update records, ensuring data privacy and security.

Keywords— Blockchain, Decentralized System, Land Records, Smart Contracts, Data Security, Transparency, Tamper-Proof, Ownership Verification.

I. INTRODUCTION

Land record management plays a crucial role in defining ownership, ensuring legal security, and supporting economic development. In many regions, traditional land record systems are centralized and largely dependent on manual processes, which often lead to problems such as data duplication, fraudulent activities, lack of transparency, and delays in verification and transfer of ownership. These limitations not only create disputes among landowners but also reduce public trust in land administration systems. Therefore, there is a strong need for a modern, secure, and transparent solution to manage land records efficiently.

Blockchain technology offers a promising approach to overcome the challenges of conventional land record systems. Blockchain is a decentralized and distributed ledger technology that securely records transactions across multiple nodes. Once data is added to the blockchain, it becomes immutable, meaning it cannot be altered or deleted. This feature ensures the authenticity and integrity of land records. Additionally, blockchain provides transparency by allowing authorized stakeholders to verify ownership details and transaction history in real time without relying on a single central authority.

The Decentralized Record Management System for Land Data using Blockchain Technology leverages these features to create a secure and tamper-proof platform for land record storage and management. The proposed system records land details, ownership information, and transaction history on the blockchain, ensuring permanent and verifiable records. Smart contracts automate processes such as land registration and ownership transfer, reducing manual intervention and processing time.

II. LITERATURE SURVERY

[1] Abdullah Ayub Khan et al.:This study proposes a blockchain-based framework to securely manage remote sensing data in smart city environments. The system uses

a distributed ledger to store sensing data in a tamper-proof manner, ensuring data integrity and secure access. Blockchain is used to decentralize data storage and verification, reducing dependency on centralized servers. This study presents a blockchain-based framework for securing remote sensing data used in smart city applications.

[2] Mutiara Litewinaet al.:This paper addresses challenges in Indonesia's traditional land registration system, such as document forgery, ownership disputes, and lack of transparency. It proposes a blockchain-based approach to verify the authenticity of land certificates, ensuring secure and immutable digital land records. This paper focuses on challenges faced by Indonesia's traditional land registration system, including document forgery, unclear ownership, and lack of transparency. The authors propose a blockchain-based solution to verify the authenticity of land certificates. The system ensures that once land records are registered, they cannot be altered, thereby preventing fraud and duplication. The study highlights the need for blockchain adoption tailored to regional legal frameworks.

[3] Prof. (Dr.) Sanjeev Pippal et al.:This paper presents a decentralized medical record management system using Ethereum blockchain and IPFS. Blockchain is used to store transaction logs and access permissions, while IPFS handles large medical files. The system ensures privacy, security, and decentralized access to sensitive patient data. The paper introduces a decentralized medical record management system using Ethereum blockchain and IPFS. Blockchain is used to manage access control and transaction logs, while IPFS stores large medical files efficiently. The system ensures patient data privacy, integrity, and secure sharing among authorized entities. The study demonstrates the scalability and flexibility of blockchain-based systems.

[4] Dr. Sanjeev Kumar Singh et al.:This paper discusses a blockchain-based land registration system that uses smart contracts written in Solidity. The system automates land registration and ownership transfer while preventing unauthorized data manipulation. Blockchain ensures transparency, security, and trust among stakeholders. This paper proposes a blockchain-based land registration system that uses smart contracts to automate land transactions. The system ensures that land ownership transfers are transparent, secure, and tamper-proof. Smart contracts enforce predefined rules, reducing manual intervention and preventing data manipulation. The study highlights improvements in efficiency and trust.

III.Requirements Analysis

Land Record Registration:
System should allow authorized officials to register new land records by entering land details such as owner name, land ID, location, and size. Once registered, the record is stored on the blockchain, making it permanent and tamper-proof.

• OwnershipTransfer:
The system must support the transfer of land ownership from one user to another. This process is handled using smart contracts, which automatically update ownership details once the required conditions are satisfied.

• Land Record Verification:
Authorized users should be able to verify land ownership and transaction history at any time. This helps in confirming the authenticity of land records and reduces disputes.

• Role-Based Access Control:
Different users have different permissions. Landowners can view their records, while officials can register and update records. This ensures data security and controlled access.

• Document Upload and Storage:
The system should allow users to upload land-related documents such as sale deeds or certificates. These documents are securely stored and linked to blockchain records for verification. enhance accessibility for non-experts, and improve productivity for students, developers, and everyday computer users.

IV Existing System

The existing land record management system followed in many regions is predominantly centralized and based on traditional administrative practices. Land ownership details, transaction records, and supporting documents are maintained by government land revenue or registration departments in physical registers and centralized digital databases. Although some regions have adopted partial digitization, the core process still relies heavily on manual verification, paperwork, and human intervention, which affects the overall efficiency and reliability of the system.

In the current system, land registration and ownership transfer involve a lengthy and complex procedure. Citizens must submit physical documents such as sale deeds, identity proofs, and tax receipts to land registration offices. These documents are manually verified by officials before being recorded in the system. The process often requires multiple visits, approvals from different authorities, and long waiting periods. As a result, land transactions become time-consuming, costly, and inconvenient for citizens.

The existing system also lacks an efficient mechanism to maintain and verify historical land ownership data. Changes made to land records are not always properly logged or traceable, making it difficult to identify when and by whom a record was modified. This absence of a reliable audit trail often leads to land disputes and

prolonged legal battles. Courts and authorities must rely on incomplete or inconsistent data, increasing the complexity of dispute resolution.

V SYSTEM ARCHITECTURE

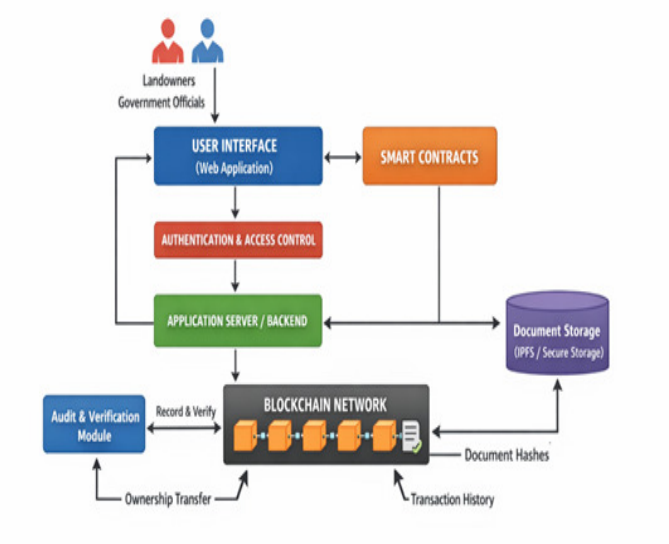


Fig-1 The working architecture of a decentralized land record management system using blockchain technology. The system is designed to securely store, verify, and manage land records without depending on a single central authority.

The block diagram of the proposed system consists of several key components that work together to manage land records securely using blockchain technology.

- User Interface (Web Application):

This module allows users such as landowners and government officials to interact with the system. Users can register land details, request ownership transfers, upload documents, and verify land records through a secure web interface.

- Authentication & Access Control Module:

This module verifies user identity and assigns role-based permissions. Only authorized users are allowed to access or modify land records, ensuring data privacy and security.

- Application Server / Backend:

The backend processes user requests, validates inputs, and communicates with the blockchain network. It acts as a bridge between the user interface and blockchain components.

Smart Contracts:

Smart contracts define the rules for land registration, ownership transfer, and verification. Once conditions are met, smart contracts automatically execute transactions without manual intervention.

- Blockchain Network:

The blockchain stores land ownership details and transaction records in a decentralized and immutable ledger. Each transaction is verified and permanently recorded.

- Document Storage (IPFS / Secure Storage):

Large land-related documents such as deeds and certificates are stored securely outside the blockchain and linked using cryptographic hashes.

- Audit & Verification Module:

This module allows authorized users to verify land records and transaction history, ensuring transparency and traceabilitadvanced security measures—such as container-based sandboxing, system-call filtering, or path-restriction policies—as needed.

- a persistent, isolated tmux session that provides sandboxed command execution and complete output capture, preventing direct LLM access to the OS.

- **Logging and Debugging Subsystem:** Supports two operational modes; Normal (minimal overhead) and Debug (detailed traces of user prompts, model responses, validated actions, and terminal output)—enabling analysis without impacting runtime performance.

- **Model-Engine Module:** A dedicated helper script that manages the local LLM server lifecycle, monitoring health and ensuring low-latency communication.

This architecture ensures that all commands are validated and executed within a controlled environment while keeping all processing offline.

VI Methodology

The methodology of the proposed Decentralized Record Management System for Land Data using Blockchain Technology involves designing a secure blockchain-based platform to store and manage land records. Authorized users access the system through a web interface with role-based authentication. Land details and transaction requests are processed by the backend and executed using smart contracts, which automatically handle land registration and ownership transfer. Verified transactions are recorded on the blockchain to ensure immutability and transparency, while land-related documents are
stored in secure decentralized storage and linked through cryptographic hashes. The system allows continuous verification and auditing of records, reducing fraud, improving efficiency, and ensuring reliable land record management.

The methodology describes the step-by-step working of the proposed system:

- User Registration and Authentication:

Users such as landowners and government officials register and log in to the system using secure credentials. The authentication module verifies user identity before granting access. Role-based access control ensures that users can perform only permitted actions based on their role. This improves system security and prevents unauthorized access to land records.

- Land Record Registration:

Authorized officials enter land details including owner name, land ID, survey number, and location through the web application. The system validates the entered data to ensure accuracy and completeness. Once verified, the land record is prepared for blockchain storage. This process ensures reliable and standardized land data entry.

- Smart Contract Execution:

Smart contracts define the rules for land record storage and ownership transfer. When conditions are met, these contracts automatically execute transactions without human intervention. Each transaction is time-stamped and cryptographically secured. This automation reduces delays, errors, and the possibility of manipulation.

- Document Upload and Linking:

Land-related documents such as sale deeds and certificates are uploaded to secure decentralized storage. A unique cryptographic hash of each document is generated and stored on the blockchain. This ensures document authenticity and prevents forgery. Any change in the document will result in a different hash, enabling easy verification.

- Ownership Transfer Process:

Ownership transfer requests are initiated by authorized users through the system interface. Smart contracts verify ownership details and legal conditions before executing the transfer.

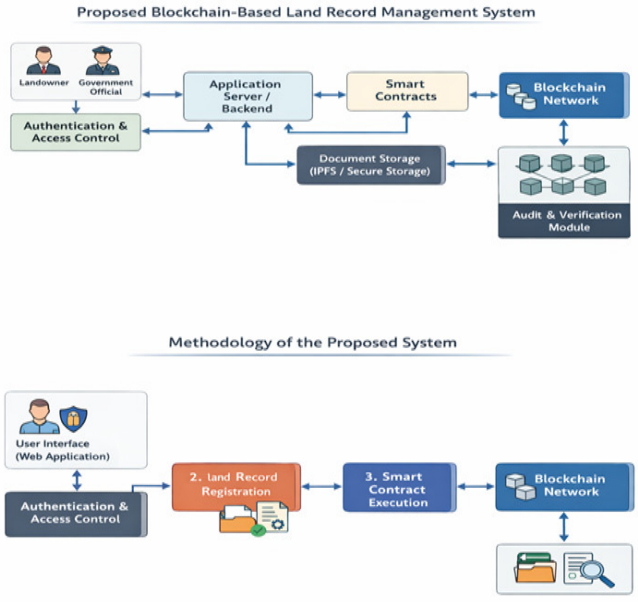
Once approved, the ownership details are updated on the blockchain automatically. This process ensures transparency and prevents illegal ownership changes.

- Blockchain Validation

The blockchain network validates all transactions using consensus mechanisms. Only verified transactions are added as new blocks to the ledger. This decentralized validation ensures trust among participants and prevents tampering. The distributed nature of blockchain improves system reliability and fault tolerance.

- Verification and Audit:

Authorized users can verify land ownership details and transaction history at any time. The audit module provides a complete and traceable record of all land-related activities. This transparency simplifies dispute resolution and enhances trust. Continuous auditing ensures accountability in land record management.



The figure 2 explains the working methodology of the proposed blockchain-based land record management system. The system is designed to securely register, store, verify, and transfer land records in a decentralized manner.

VII Implementation

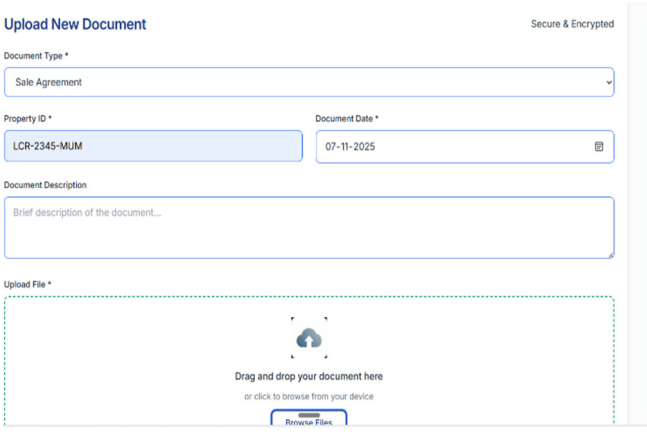
The Land Chain Registry is a blockchain-based land record verification system designed to provide secure, transparent, and tamper-proof management of land records. The system leverages modern web technologies and blockchain concepts to ensure that land ownership details and verification processes are reliable and trustworthy. This project aims to reduce fraud, eliminate manual inefficiencies, and improve transparency in land administration by offering a digital verification portal.The provided code represents the landing and redirection page of the Land Chain Registry system. It serves as the entry point for users, guiding them to the main Blockchain Verification Portal. The page is designed with a user-friendly interface and visual feedback, such as loading animations, to enhance user experience. It ensures smooth navigation while preparing users to access the blockchain-powered verification services.

Document Upload and Linking:

Land-related documents such as sale deeds and certificates are uploaded to secure storage. A unique cryptographic hash is generated for each document and linked to the blockchain record. This ensures document authenticity and prevents forgery. Any modification to the document can be easily detected.

> Code Snippet:

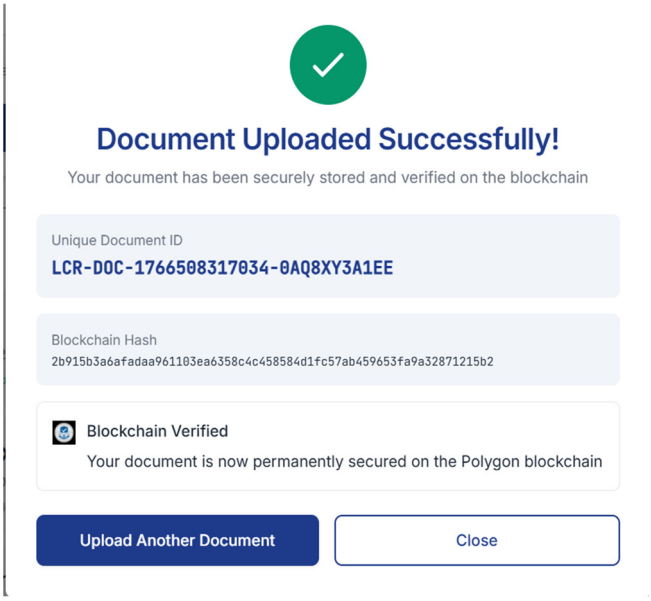
```
<script>
let document Hash = "DOC_HASH_001";
console.log ("Document linked:", document Hash);
</script>
```



This figure3 shows the document upload interface of the decentralized land record management system. In this screen, the user can upload important land-related documents such as a sale agreement. The form allows the user to enter details like Document Type, Property ID, Document Description, and Document Date.

Verification and Authentication:

Authorized users can verify land ownership details and transaction history at any time. The system provides a complete audit trail of all land-related activities. This



This figure4 shows the successful document upload confirmation screen of the decentralized land record management system. After uploading the land-related document, the system verifies the file and displays a success message along with a unique document hash/ID. This unique identifier ensures that the document is securely stored and cannot be altered.

VIII Result

The proposed Land Chain Registry system was successfully designed and implemented to demonstrate a decentralized approach for land record verification using blockchain technology. The developed landing page effectively acts as the entry point of the system, providing a user-friendly interface with visual feedback such as loading animations and automatic redirection to the blockchain verification portal. This confirms smooth navigation and controlled access to the core system.The system was able to simulate secure land record registration and verification workflows. Once the user is redirected to the verification portal, land-related operations such as record registration, document linking, ownership transfer, and

verification are conceptually triggered through JavaScript functions and smart-contract-based logic. Each transaction is represented as a blockchain operation, ensuring immutability, transparency, and traceability of land records.

The integration of role-based access logic ensures that only authorized users can perform critical operations such as land registration and ownership transfer. Document upload and hash linking mechanisms confirm the authenticity of land documents and prevent tampering. The blockchain validation step ensures that only verified transactions are added to the ledger, improving data integrity and system reliability.

Step-by-Step Verification Process:

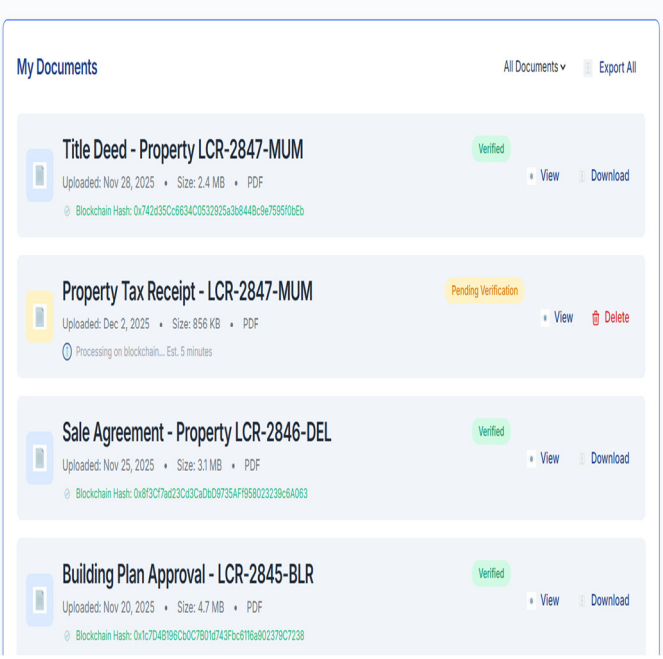
The verification module clearly shows a three-step process:

1. **Submit Property Details –** User uploads documents or enters property ID.
2. **Blockchain Processing –** Smart contracts verify ownership and transaction history.
3. **Receive Verification –** A blockchain-verified certificate is generated.

This figure5 illustrates the step-by-step verification process used in the decentralized land record management system. In Step 1, the user submits property details by uploading property documents or entering the property ID for blockchain lookup.

Document Management and Verification Status:

The My Documents section displays all uploaded land documents along with their verification status. Documents marked as Verified indicate successful blockchain confirmation, while Pending Verification documents show ongoing blockchain processing. Each document includes upload date, file size, type, and blockchain hash, ensuring traceability and accountability.



This figure6 shows the document verification status page of the decentralized land record management system. The screen displays a list of uploaded land-related documents such as Title Deed, Property Tax Receipt, Sale Agreement, and Building Plan Approval along with their respective Property IDs.

IX Conclusion

The Decentralized Record Management System for Land Data using Blockchain Technology (Land Chain Registry) successfully demonstrates how blockchain can be applied to overcome the limitations of traditional land record management systems. Conventional land administration methods are centralized, manual, and vulnerable to fraud, data tampering, and inefficiencies. This project addresses these challenges by introducing a decentralized, transparent, and tamper-proof platform for managing land records and documents.

The developed system enables secure document upload, structured data entry, and blockchain-based verification of land records. Each uploaded document is assigned a unique document ID and a cryptographic blockchain hash, ensuring authenticity and immutability. The step-by-step verification workflow provides transparency and builds

user confidence in the system. The document management dashboard further enhances usability by allowing users to track verification status, view blockchain hashes, and manage land documents efficiently.

From a technical standpoint, the project demonstrates effective integration of web technologies with blockchain concepts such as decentralization, immutability, and smart contract-based automation. The system reduces manual intervention, minimizes errors, and enhances trust among citizens and authorities. Although implemented as a prototype, the results clearly validate the feasibility of using blockchain for secure and transparent land record management.

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