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Blockchain Driven Land Ownership Verification System

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ABSTRACT: Land registration is a vital process for legally recording property ownership and transfer of land rights, yet traditional systems in many countries still suffer from corruption, delays, lack of transparency and heavy involvement of intermediaries. Managing large volumes of land records across regions further increases the risk of errors and manipulation. This paper proposes a blockchain based land registration system using Ethereum smart contracts to overcome these limitations by decentralizing the process, reducing middlemen, minimizing fraud and improving efficiency. In the proposed model, landowners submit property details, proof documents and market value, which are verified by a designated land inspector responsible for a specific village or locality. The smart contract ensures that land transfer occurs only as a complete transaction, preventing partial ownership transfers. Although a government authority validates the records and the entire workflow remains transparent, secure and traceable through blockchain, enabling direct buyer–seller transactions and providing a more reliable alternative to conventional land registration systems.

I. INTRODUCTION

A blockchain is a continuously expandable list (chain) of records, known as blocks, that are connected through encrypted data exchange. Each block typically contains a reference to the previous block, a timestamp and transaction data. One of the most popular applications of blockchain technology is the cryptocurrency Bitcoin. Since the transaction data on all nodes (clients) is visible to everyone and stored in a traceable manner and the system is considered tamper-proof and transparent.

With the use of blockchain, it is possible to maintain a continuously expandable list of records in a decentralized manner and the correct state of the ledger must be documented as many participants are involved in the bookkeeping. This concept is referred to as Distributed Ledger Technology (DLT). The type of information recorded on the blockchain is not limited to financial transactions. it can also include formal confirmations, such as validation of the documents required for a notarized land purchase agreement. By recording such information on the blockchain, individual steps of the ownership transfer process can be accelerated and made more transparent, allowing stakeholders to have real-time visibility of the transaction status at any stage. Blockchain has emerged as a promising solution for land ownership verification and property management. Traditional land registration systems often suffer from inefficiencies, lack of transparency and the risk of data manipulation or fraud. Blockchain offers a decentralized, tamper proof and transparent alternative by recording every land transaction securely and permanently. Each property record becomes a verifiable digital asset that cannot be altered without the consensus of the network.

The “Blockchain Driven Land Ownership Verification,” aims to apply blockchain and smart contract technologies to automate property registration, ownership validation and transfer processes. By eliminating intermediaries and manual paperwork the system enhances data integrity, minimizes human error and builds trust among all stakeholders. It serves as a step toward creating a secure, transparent and corruption free land management framework through the adoption of modern decentralized technology.

II. LITERATURE REVIEW

The paper [1] explores the application of blockchain technology to secure land registration systems by addressing long standing issues of fraud, tampering and inefficiency in traditional methods. The authors highlight how blockchain’s decentralized and immutable ledger can enhance transparency, trust and reducing the reliance on intermediaries. Their

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proposed framework leverages smart contracts to automate transactions, ensuring faster and more reliable verification of ownership. The study also emphasizes the role of cryptographic techniques in safeguarding sensitive property data from unauthorized access. By comparing blockchain with conventional systems. The paper demonstrates significant improvements in security, traceability and efficiency. It provides a strong case for adopting blockchain in land governance while also acknowledging implementation challenges such as scalability and regulatory adaptation. The author [2] highlights the inefficiencies, corruption risks and lack of transparency in traditional land registry systems particularly in developing countries. By leveraging blockchain's decentralized and immutable ledger. The authors propose a framework that ensures tamper-proof storage of land records and automates transactions through smart contracts. Their work emphasizes how such a system can reduce fraudulent practices, speed up verification and build public trust. The study also discusses scalability interoperability and legal challenges that must be addressed for real world adoption. The research provides a strong foundation for integrating blockchain into e-governance solutions for secure land management. The paper [3] highlights challenges in traditional land registries such as fraud, manipulation & lack of trust and demonstrates how blockchain's decentralized ledger can eliminate these issues. Their model leverages smart contracts to automate ownership exchange while maintaining secure and verifiable records. The paper emphasizes efficiency in reducing intermediaries and the risk of disputes. It concludes that blockchain supported land registry systems can significantly improve trust and accountability in property transactions.

The paper [4] explores the use of blockchain for securely storing land related documents with an emphasis on the SHA-256 cryptographic hashing algorithm. The authors argue that traditional land management systems are prone to forgery, data loss and corruption which can be mitigated through blockchain's immutable and transparent ledger. By employing SHA-256 the system ensures tamper-proof storage and verification of land documents across multiple nodes. The paper introduces a parallel blockchain approach to enhance processing efficiency and scalability by addressing challenges of storage and access in large scale systems. Their findings suggest that blockchain with SHA-256 provides improved security, reliability and trust in digital land registry management. The author [5] emphasizes that traditional digital signatures face risks of algorithm obsolescence, certificate expiration and compromised trust authorities over time. Their model leverages blockchain's immutability and distributed trust to provide continuous verifiability of digital signatures even beyond the lifespan of cryptographic algorithms or certificate authorities. TrustChain ensures that signature validation data is securely chained and permanently recorded thereby addressing legal and archival requirements for digital documents. The study demonstrates how blockchain can serve as a sustainable infrastructure for digital preservation, ensuring reliability, authenticity and trust in long-term electronic records management.

The paper [6] highlights blockchain's decentralized and immutable ledger as a foundation for secure and tamper-proof land ownership records. It emphasizes the role of smart contracts in automating land transfer processes and reducing reliance on intermediaries. The authors discuss global case studies and pilots by noting blockchain's potential to improve trust and accountability in property transactions. They also identify challenges such as scalability, regulatory compliance, and the need for digital infrastructure. The paper concludes that blockchain provides a promising framework for modernizing land registration while ensuring long-term reliability and trust. The author [7] identifies major flaws in traditional registries such as document tampering, lengthy verification and dependence on centralized authorities. Their model defines roles for buyers, sellers and registry officials with smart contracts automating ownership transfer and verification steps. By recording transactions immutably on the blockchain the system enhances transparency, reduces intermediaries and accelerates the registration process. The authors conclude that while the approach **iroves** trust and efficiency then challenges like infrastructure requirements, legal recognition and scalability remain. The paper [8] explores the storage of records on the Ethereum blockchain in JSON format including details such as buyer/seller information, geolocation, payment and timestamps. Security is reinforced using ECDSA digital signatures and Keccak-256 hashing, ensuring tamper-proof and verifiable data. The system introduces two portals an Admin Portal for government authorities with write access and a User Portal for citizens with read-only access to balance control and transparency. The authors conclude that this framework reduces fraud and increases trust in land transactions though challenges of infrastructure and legal adoption remain. This Paper [9] highlights how Ethereum smart contracts can automate ownership transfer, validate transactions and ensure immutability of records. Their model emphasizes transparency, security and decentralization, reducing dependence on intermediaries such as government officials. The authors also discuss the potential to minimize disputes by providing a tamper-proof record of ownership that is accessible to all stakeholders. The paper demonstrates blockchain's promise in streamlining property registration while enhancing trust and accountability in real estate transactions. The author [10] framework ensures secure storage of property records, immutability of transactions and transparency among stakeholders. By using blockchain the system reduces the need for intermediaries and minimizes the risk of duplicate or forged land documents. The authors highlight

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how smart contracts can automate processes like ownership transfer and verification, making the system more efficient. Their work demonstrates blockchain's potential to create a trustworthy, tamper-proof and decentralized platform for land registration and management.

III. METHODOLOGY

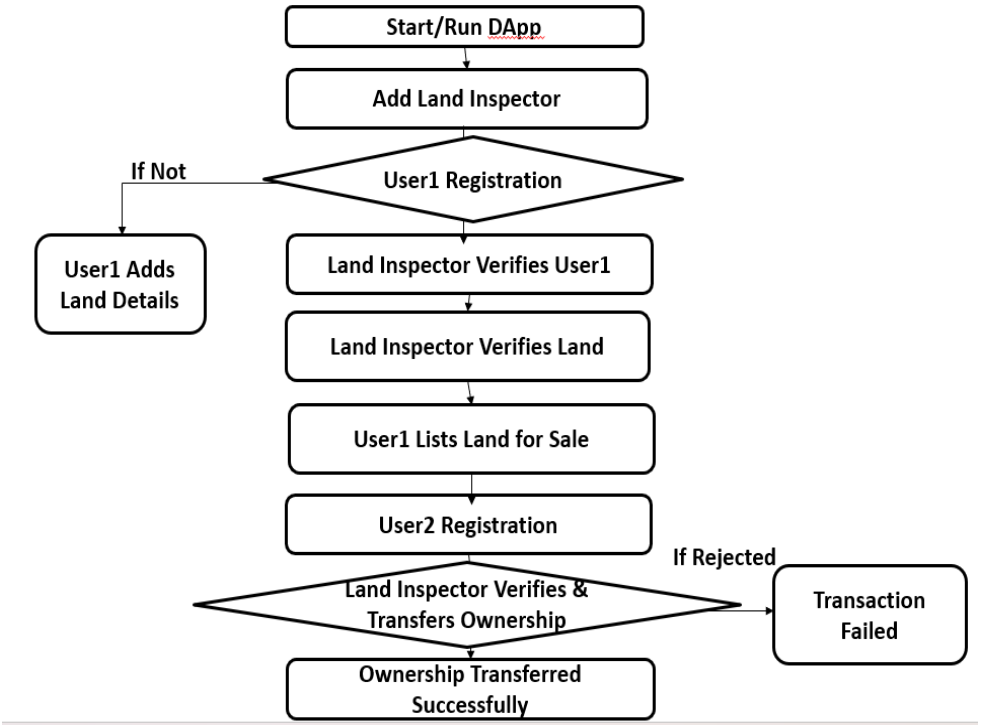

Figure 1.1: Work Flow of Blockchain Driven Land Ownership Verification System

Figure 1.1 depicts the proposed methodology for Blockchain based Land Ownership Verification System

3.1 User Login:

During log-in process users enter their unique ID and password for registration. If the user is logging in for the first time they must provide personal information such as name, address details along with identity documents for verification. The authentication and login requests which securely stores and manages credentials using a hashed password mechanism to ensure data privacy and security. Document storage and uploaded documents are securely stored on Blockchain ensuring distributed, immutable and tamper-proof storage.

3.2 Document Storage:

The users upload property or identity documents then the backend system processes and stores them securely to maintain transparency and tamper resistance. The document metadata (hash values) are recorded on the Ethereum blockchain. This ensures that even if someone tries to alter a file there may be the mismatch in the hash value immediately flag the change by guaranteeing immutability and data integrity. Each document entry making the records fully verifiable and traceable.

3.3. Inspector Assignment:

System Administrator assigns a land inspector through a dedicated admin portal. The inspector plays a key role in validating both user identities and land details. Each inspector has secure login credentials and specific authority levels within the system and ensuring that verifications are carried out transparently and within assigned jurisdictions. All inspector activities (such as approvals, rejections and remarks) are logged and linked to the blockchain to maintain an audit trail.

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3.4 User Verification:

Once inspectors log in they access a dashboard listed with pending user verification requests. For each user the inspector reviews the uploaded documents (such as ID proof, address proof and ownership certificates). Upon successful validation the inspector marks the user as "Verified" in the system. The verification result (approved/rejected) is recorded on the blockchain to ensure a tamper-proof record of the validation process. Verified users then gain permission to register land properties and participate in ownership transfer operations.

3.5 Land Registration and Transfer*:*

Users can add their property details which are then cross-checked by the land inspector. After verification the landowner (User 1) can list the property for sale. When another verified user (User 2) initiates a purchase request, the land inspector validates the transaction and the ownership transfer is executed through a smart contract.

3.6 Transaction Validation:

Before finalizing any transaction the system performs automatic validation checks which include

- Both buyer and seller are verified users.
- Land is properly registered and not under dispute.
- Land inspector approval is received.

If all conditions are fulfilled, the smart contract commits the transaction and permanently records the ownership transfer on the blockchain ledger. If any condition fails (for example, missing verification or mismatched details) the transaction is rejected automatically and the system marks it as "Transaction Failed". This ensures that no unauthorized or fraudulent land transfer can occur within the system.

IV. RESULTS AND DISCUSSION

Below is a result table for comparing traditional and blockchain land registry systems. Table 1.1 presents a detailed comparison of the conventional and blockchain based land registration systems by highlighting improvements in efficiency, trust and cost-effectiveness. Below is a sample graph visually comparing time, fraud rate and cost of traditional vs. Blockchain based systems. The graph is typically based on published evaluations and case studies where blockchain reduces transaction time, lowers fraud and decreases administrative costs.

Table 1.1 Traditional vs Blockchain Land Registry

Parameter	Traditional Registry	Blockchain Registry
Data Storage	Centralized	Distributed, Immutable
Average Registration Time	30 days	5 days
Fraud/Dispute Rate	~10%	<1%
Admin Cost per Transaction	$500	$120
Transparency	Low	High
Intermediary Requirement	Multiple parties	Minimal (Inspector Only)
Public Accessibility	Limited	24x7 via web portal

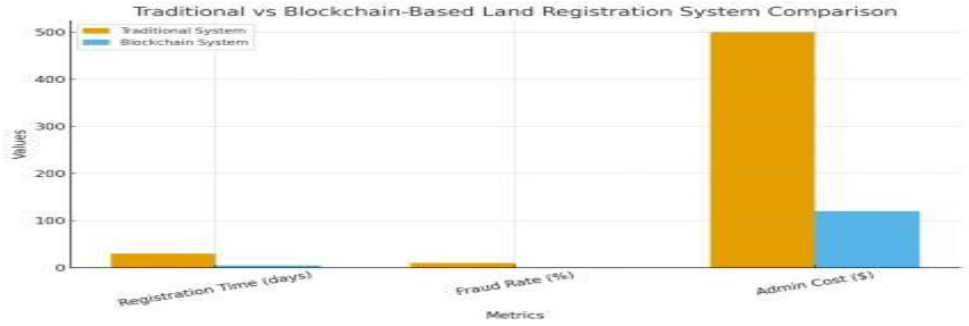

Figure 1.2: Comparison of Traditional and Blockchain-Based Land Registration Systems

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Figure 1.2 illustrates the effectiveness of a blockchain based land registration system over the traditional model, demonstrating an ~83% reduction in registration time, ~90% decrease in fraud/disputes and ~76% reduction in administrative costs.

V. CONCLUSION

The conventional property registration system contains several flaws such as record tampering, data manipulation, property misuse and unethical financial practices which make traditional land management unreliable and prone to corruption. The proposed Blockchain Driven Land Ownership Verification System overcomes these challenges by introducing a secure, decentralized and transparent framework for recording and verifying land transactions. By leveraging blockchain technology and smart contracts the system ensures data integrity, immutability and automation of verification processes without the need for intermediaries. Every record stored on the blockchain is permanent, traceable and accessible to authorized stakeholders thereby building trust and preventing fraudulent activities. This approach not only enhances transparency and efficiency in property registration but also reduces human error, processing time and the chances of disputes. The system establishes a trusted, tamper-proof and corruption-free model for land ownership verification by contributing towards a more reliable and digitally empowered land management framework.

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