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Development of A Secure Land Registration and Verification System

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ABSTRACT :

Land registration is a critical process for establishing legal ownership and preventing property disputes. Traditional systems rely on paper-based records and centralized databases, which are vulnerable to document tampering, fraud, data loss and unauthorized modification. These weaknesses lead to ownership conflicts, delayed verification and a lack of transparency in property transactions. This project, "Development of A Secure Land Registration and Verification System", proposes a transparent and reliable digital platform for managing land ownership records using Blockchain technology and map-based geospatial verification. Land ownership details and transaction history are stored in a distributed ledger through Solidity smart contracts, so that records are immutable, traceable and cryptographically verifiable. Smart contracts enforce predefined rules for registration and ownership transfer. In addition, the system validates the location and boundaries of each land parcel using geographic coordinates and digital mapping services (Google Maps API), which helps to prevent duplicate registrations, boundary disputes and fraudulent claims. A web-based interface built with HTML, CSS and JavaScript, supported by a Node.js/Express backend and a MySQL or MongoDB database for off-chain data, allows landowners, buyers and government officials to register land, verify ownership, view transaction history and visualize land locations on a map

Introduction:

Recent research has focused on using technologies such as Blockchain, Geographic Information Systems (GIS) and digital governance frameworks to improve the transparency, security and efficiency of land administration systems. This chapter reviews published work on blockchain-based land registries, QR-code based verification, decentralized registration models, GIS-based parcel mapping and digital land administration, and identifies the gap that the present project addresses.

Review of Existing Systems:

Ref.	Author(s), Year	Approach	Key contribution	Remarks
[1]	Zein and Twinomurinzi, 2024	Blockchain framework using Hyperledger Fabric	Transparent, immutable and secure management of land ownership records; trusted information sharing among government authorities	Permissioned ledger suited to multi-agency use; geospatial verification is not its central focus
[2]	Singh et al., 2024	Blockchain combined with QR-code verification	Quick access to ownership details; simplified authentication and reduced fraud	Fast verification of records; boundary validation is not the main focus
[3]	Nair et al., 2024	Decentralized blockchain-based registration model	Transparency and prevention of unauthorized modification; reduced dependence on centralized databases	Strengthens trust; map-based parcel checking is not emphasized
[4]	Shahariar et al., 2023	Blockchain-based land record management using cryptographic techniques	Secure storage of ownership data; protection from manipulation and unauthorized access	Focus on record security; spatial validation is limited
[5]	Wang et al., 2025; Longley et al., 2025	GIS and geo-tagging for parcel mapping; integration of blockchain with GIS	Accurate identification of land locations and verification of boundaries through spatial data analysis	Addresses boundaries and location; the ledger side must be combined with it
[6]	Mezquita et al., 2022	Review of digital land registry systems	Blockchain solutions improve transparency, reduce corruption and enhance efficiency; digital	Survey study; no implementation

Table 2.1: Summary of reviewed literature

Beyond these studies, the references listed at the end of this report also provide supporting background: the use of blockchains and smart contracts for trusted record keeping [7], the relationship between land registration, governance and development [8], the suitability of blockchain for trustworthy records [9], blockchain-enabled e-government for land records [10], and the use of blockchain to protect personal data [11].

Research Gap

The reviewed work shows that blockchain improves the immutability, transparency and traceability of land records, and that GIS improves the accuracy of parcel location and boundary identification. In most of the studies, however, these two aspects are treated largely separately: blockchain-based systems concentrate on secure record keeping and verification of ownership, while GIS-based work concentrates on mapping and boundaries. Many practical systems in use also still depend on manual documentation, paper records and centralized databases, which lack spatial validation of land boundaries. The present project fills this gap by combining both approaches in a single web-based platform. Ownership records and transactions are stored on a blockchain through smart contracts, and every registration is validated against geographic coordinates and digital maps before it is accepted, so that duplicate registrations and boundary conflicts can be detected early.

Methodology:

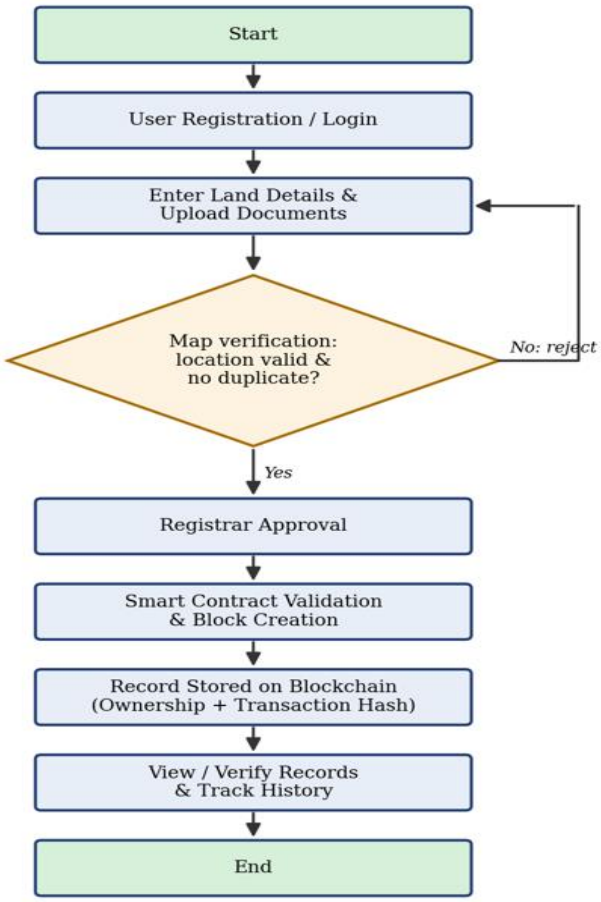


Figure 3.2 shows the step-by-step flow of land registration in the system.

The methodology consists of the following stages:

- **User registration:** users create accounts and provide identification details for secure access.
- **Land data entry:** landowners enter details such as survey number and ownership information and upload the relevant documents.
- **Map verification:** the system verifies the geographical location and boundaries of the land using digital maps and geographic coordinates. If the location is invalid or duplicates an existing parcel, the request is rejected and the user must correct the entry.
- **Blockchain recording:** after approval, ownership details and transactions are stored on the blockchain as immutable records.
- **Smart contract verification:** smart contracts validate ownership transfer and ensure that transactions follow predefined rules.
- **Transaction monitoring:** the web interface lets users and authorities view land records, verify ownership history and track transactions securely.

Results

The expected outcomes of the system are listed below. Screenshots from the final build are to be inserted in the places indicated.

- The login and registration pages allow a user to create an account and sign in with role-based access.
- The land registration page accepts land details and coordinates and displays the parcel on the map before submission.

- A duplicate or invalid parcel is rejected with a clear message.
- An approved registration is stored on the blockchain, and a transaction hash is displayed.
- The record page shows the current owner and the complete transaction history.

Performance Analysis

Table 5.2 compares the proposed system with the existing manual and centralized approaches on the basis of the features discussed in this report.

Feature	Manual / paper-based	Centralized database	Proposed system
Tamper resistance	Low	Medium (single point of failure)	High (immutable ledger)
Transparency	Low	Limited	High (traceable transactions)
Verification speed	Slow	Moderate	Fast (real-time lookup)
Spatial / boundary validation	Not available	Often absent	Map-based verification
Duplicate registration check	Manual	Limited	Automated by smart contract and map check
Processing time per transaction	Long	Short	Additional blockchain confirmation time

Table 5.2: Qualitative comparison with existing approaches

The proposed system trades a small increase in transaction processing time, caused by blockchain confirmation, for higher security, transparency and automated duplicate detection. Quantitative metrics such as average transaction confirmation time and API response time are to be measured on the final build and added here.

Conclusion

The proposed system, "Blockchain-Based Land Registration System with Map Verification", offers a secure and transparent approach for managing land ownership records. By using blockchain technology, it ensures tamper-resistant storage of land transactions through cryptographic security and decentralized data management, improving the reliability of ownership information. The integration of map-based verification using geographic coordinates enables accurate validation of land locations and boundaries, which helps reduce duplicate registrations and minimizes land ownership disputes.

Against the objectives stated in Chapter 1, the system provides a digital registration platform, an immutable ledger of ownership and transactions, a transparent verification mechanism, map-based location validation and a user-friendly interface for landowners, buyers and authorities. Overall, the system enhances security, transparency and efficiency in land record management while supporting reliable verification of property records for both government authorities and citizens.

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