LandVault: A Blockchain-Based Decentralized Land Registry and Rental Agreement System

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***Abstract*—"Blockchain has recently attracted wide attention because it offers a secure and transparent way of recording information. Since each participant keeps a copy of the data, tampering becomes extremely difficult. In this work, we present LandVault, a blockchain-based system aimed at simplifying land registration and rental agreements. Our design combines Hyperledger Fabric, IPFS for decentralized document storage, and smart contracts that handle ownership transfers and rental enforcement. Together, these components reduce the chances of fraud, improve record accuracy, and make property management more reliable. Based on our initial evaluation, LandVault shows promise as a practical option for both government land offices and private real estate players."**

The proposed LandVault framework focuses on addressing the weaknesses of conventional land registration and rental practices, which often suffer from inefficiency and fraud. By integrating permissioned blockchain, automated contracts, and decentralized storage, the system ensures transparency and accountability throughout ownership transfers and rental agreements. Initial evaluations demonstrate its ability to improve record management while maintaining scalability and compliance with legal standards. This paper also includes decentralized document storage using IPFS, identity verification through cryptographic hashing, and dynamic rental contract enforcement.

***Index Terms*—Blockchain, Land Registry, Smart Contracts, Hyperledger Fabric, IPFS, Real Estate, Rental Agreements, Cybersecurity**

I. INTRODUCTION

'Blockchain is mostly said to be a game changing technology because it makes it possible to build digital systems where trust and transparency are inbuilt rather than added later' [1].At its core, it works like a distributed ledger in which transactions are checked by the network as a whole. Once stored, these entries are very hard to alter unless most participants agree, which is why the technology is seen as trustworthy.

When it comes to land, the need for such trust is obvious. In many countries, land disputes and even fraudulent transactions are common, partly because records are still maintained on paper or scattered databases. People often face problems like duplicate sales or unclear ownership. In this context, blockchain offers a fresh substitute that makes verification easier, reduces dependence on middlemen, and even allows agreements to run automatically through smart contracts. With these motivations in mind, we propose LandVault, a blockchain-based project to modernize way for land records and rental contracts to be handled."

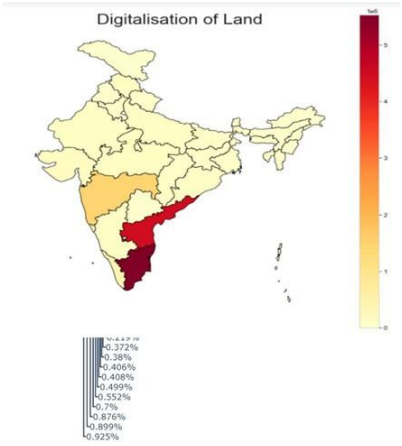

Fig. 1: Digitalisation of Land

Land is a fundamental asset for both individuals and nations. In many developing countries, land disputes, encroachments, and fraudulent land transactions are common due to a lack of transparency and tamper-proof mechanisms in registration systems. Government departments still heavily rely on paper-based systems or fragmented databases, which are vulnerable to loss, duplication, and human error. "Blockchain technology offers a promising solution to these issues due to its properties such as decentralization, immutability, transparency, and automation through smart contracts". [13] Blockchain enables peer-to-peer verification, eliminating the need for a

central authority and reducing the chances of data tampering. **LandVault** is a digital application built upon Hyperledger-Fabric, supporting digitized and decentralized land registry and intelligent rental contracts. The initiative addresses in efficiencies and corruption in the existing system while ensuring secure, transparent, and automatic property management.

II. Existing System and Limitations

Conventional land registration systems are still heavily paper-driven and rely on manual verification. Records are often stored at local offices without any shared mechanism to confirm authenticity, which creates inconsistencies when information is compared across regions. Ownership transfers are slow because they involve multiple documents and approvals, and errors are not uncommon.

'Another issue is the lack of transparency. In most cases, citizens cannot easily access land records, which limits trust and creates opportunities for manipulation. Fraudulent sales, where land is sold by individuals who do not actually own it, are frequent in such environments. To make things worse, different government departments may hold overlapping or even contradictory records, causing confusion. These weaknesses highlight the need for a system that is secure, reliable, and tamper-proof—features that blockchain can naturally provide'. [15] Blockchain can be utilized to create a decentralized, secure, and tamper-proof system of registration of assets. These are just some of the uses of blockchain for asset registration .The most notable benefits of using blockchain for asset registration are greater transparency, security, efficiency, and less risk of fraud. The conventional landregistry system has a number of disadvantages:

- **Centralization:** Land records are stored in isolated government offices, with no shared verification system across regions.
- **Manual Paperwork:** Ownership transfers and land-use changes still depend on paperwork and in-person approvals, leading to delays.
- **Limited Transparency:**Citizens will have no direct way to check land ownership details, which reduces public trust.
- **Risk of Fraud:** Cases of land being sold by unknowingly to individuals remain common under the current system.
- **Data Duplication:** Different departments sometimes maintain overlapping or inconsistent data, creating confusion.

These failings underscore the importance of a safe, decentralized, and tamper-proof system.

III. Need for a New Approach

To address the inefficiencies of the conventional land registry system, a platform based on blockchain offers a decentralized and tamper-evident solution. By sharing records across numerous validating nodes, it removes reliance on one point of failure and increases the resilience of the system. Since blockchain guarantees immutability, data once recorded cannot be amended or tampered with, keeping ownership information

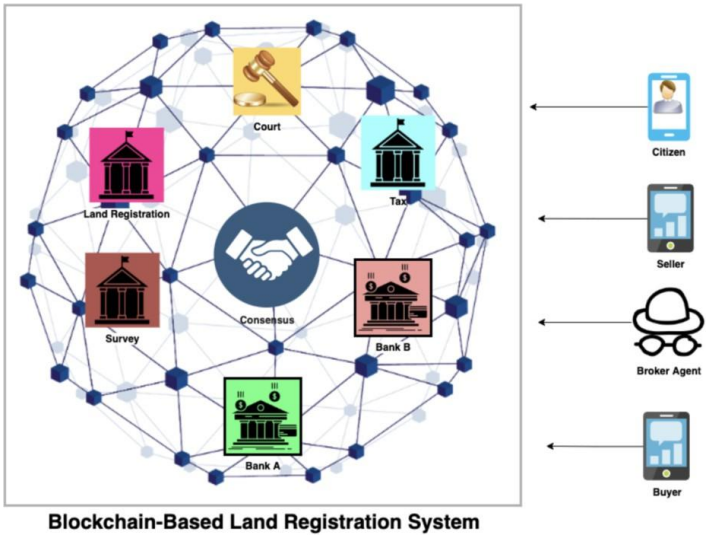

Fig. 2: Blockchain-Based Land Registration System

secure from fraud or backdated information. Smart contracts then reinforce the system further by automating contracts and enforcing compliance without the intervention of man, dramat- ically curbing delays and disputes. Concurrently, transparency is guaranteed through permissioned or public access models, rendering the system fair and auditable for everyone involved. Additionally, the use of digital identity verification—either by biometric authentication or cryptographic means—gives a secure method to authenticate ownership and keep unautho- rized transfers at bay. Collectively, these characteristics place blockchain as a viable solution for creating a trustworthy, efficient, and fraud-free land registry system.

- **Decentralization:** Multiple validating nodes remove the dependency on a single point of failure.
- **Immutability:** Once recorded, data cannot be changed, preventing manipulation or backdated entries.
- **Smart Contracts:** They ensure automatic and enforce- able agreements, reducing human intervention and po- tential disputes.
- **Transparency:** Public and permissioned access models make the system auditable and fair.
- **Integration with Digital ID:** Owner verification using biometric or cryptographic identity.

IV. Proposed System Overview

LandVault presents an end-to-end blockchain-enabled framework that integrates multiple features to provide secure and transparent land administration. A secure web portal is used by the citizens, government authorities, and landlords to interact with the system. Underlying LandVault is a per- missioned Hyperledger Fabric-based blockchain that manages roles of users and restricts access based on their rights. For safeguarding sensitive data, files are encrypted and kept on the InterPlanetary File System (IPFS), providing a decentralized and tamper-evident storage facility. The platform features

smart contract semantics to manage land registration, changes in ownership, rental contracts, automatic payments, and conflict resolution, minimizing the use of manual operations. Everything that happens is stored in permanent audit logs, allowing each activity to be traced throughout the network. One of the principal advantages of LandVault is that it can facilitate secure and automatic rental agreements. Rental duration is publicly stored on the blockchain, and payment is done automatically in accordance with the terms. At the end of the rental period, ownership rights automatically return to the original owner without needing manual approval. By combining automation, transparency, and security, LandVault makes land registration and rental management more reliable, efficient, and trustworthy for all participants.

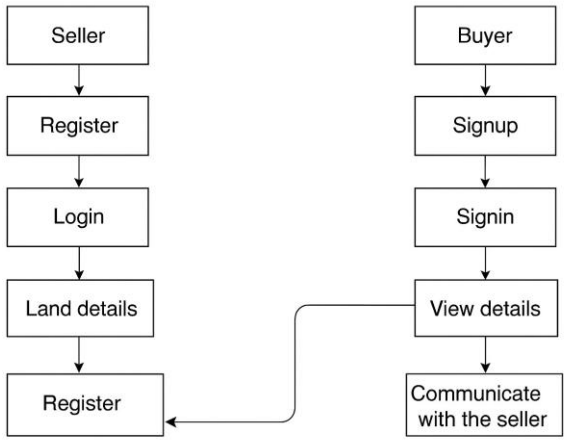

Fig. 3: System Flow

LandVault offers:

- **User Interfaces:** Citizens, officials, and landlords interact through a secure web portal.
- **Permissioned Blockchain:** Hyperledger Fabric enforces roles and restricts access.
- **Decentralized Storage:** IPFS stores encrypted documents securely.
- **Smart Contract Logic:** For registration, transfer, rent payments, and dispute handling.
- **Audit Logs:** Tamper-proof logs of actions across the network.

V. Related Work

In recent years, many research projects and pilot programs have explored applying blockchain in land registration and property management. According to previous studies, "Several national authorities have experimented with blockchain-based land systems. Sweden tested its use in property transactions to improve transparency and speed. Georgia implemented a pilot with blockchain technology to secure land titles, while Ghana has explored similar initiatives to reduce fraudulent sales and overlapping ownership claims. [14]

In academic studies, researchers emphasize the combination of smart contracts with digital identity verification to improve ownership transfer processes. Others propose decentralized storage solutions like IPFS to protect property records from tampering or loss.

Despite these efforts, most remain at the pilot stage due to legal and technical barriers.

Unlike these examples, LandVault combines Hyperledger Fabric, IPFS, and smart contracts in a single framework. In addition to handling land records, it also automates rental agreements, making it a more comprehensive approach to property management.

VI. Owner-ship Transfer

Ownership transfer is one of the most important processes in land registration systems, ensuring property rights are safely and transparently transferred from one individual to another. Traditional systems are characterized by manual paperwork, multiple verification by government officials, and long delays, which expose the process to human error, corruption, and fraudulent manipulation.

In LandVault, ownership transfer is fully managed through smart contracts stored on the Hyperledger Fabric blockchain. When a landowner requests a transfer, the system verifies the identities of both the current owner and the buyer using digital identity methods such as biometric checks or cryptographic hashes.

Once verified, a smart contract is initiated to record the agreement, property details, payment terms, and legal compliance. The transaction is validated by multiple blockchain nodes to achieve consensus before the ownership change is finalized. All ownership transfers are permanently stored on the blockchain, creating tamper-proof audit trails accessible to authorized parties.

This helps prevent duplicate sales or disputes over owner- ship claims. Additionally, decentralized storage (IPFS) ensures that supporting documents such as sale deeds and payment proofs are securely stored and easily retrievable when needed. By automating ownership transfer through blockchain, LandVault delivers an open, effective, and tamper-proof pro- cess that reduces administrative delays and builds trust among stakeholders.

VII. System Architecture

This section covers the technical specifications and tools used to develop a fully functional prototype of a blockchain- based land registration system.

Our LandVault system creates a simple and transparent journey for both sellers and buyers in a digital land transaction. Sellers start by registering on the platform, while buyers sign up to gain access. Once logged in, sellers can upload details about their land, making the information visible to potential buyers. Buyers, in turn, can browse through these listings and review the land details at their convenience.

A key feature of the system is the built-in two-way commu- nication channel, which allows buyers and sellers to directly

connect with each other. This makes it easy for buyers to ask questions and for sellers to provide clarification, helping both sides build trust and move forward confidently. In this way, LandVault combines simplicity, openness, and direct interaction to make the land transaction process more reliable and user-friendly.

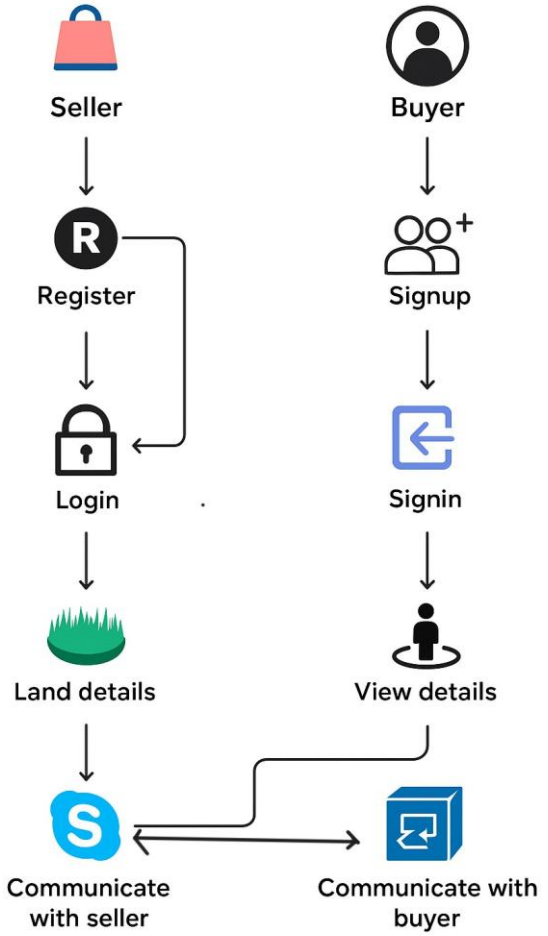

Fig. 4: Architecture Flow

VIII. Technical Specifications

This part addresses the technical requirements and software tools used in creating a working prototype of a blockchain-based land registry system.

A. Ethereum Blockchain

Ethereum is one of the most widely used blockchain platforms, and for good reason.Ethereum was built to support decentralized applications. Its main strength is the ability to run smart contracts—(small programs that execute automatically when certain conditions are met). Because Ethereum is open source and has a large developer community, it has quickly become the go-to choice for experimenting with blockchain applications. LAndVault use Ethereum TestNet as for the present project.

B. Solidity

To create smart contracts on Ethereum, developers generally use Solidity.Programs written in Solidity are compiled into code that runs on the Ethereum Virtual Machine (EVM). In our system, we used Solidity contracts to manage land transfers and rental agreements, ensuring that the process is automated and secure.

C. Smart Contracts

Two smart contracts were developed to manage the land transfer process and handle land migration. One contract handles asset registration and user data storage, while the other optimized contract manages ownership transfers between different parties.

IX. Modules

A. Buyer

- **Register:** Buyer will register to the page.
- **Login:** The Buyer will login after registration.
- **View Selling Land Details:** After login, the buyer can view the land details.
- **Communicate with the Seller:** Buyer can easily communicate with the seller after viewing the details.

B. Seller

- **Signup:** Seller needs to signup on the page.
- **SignIn:** After signup, the seller needs to sign in.
- **Add Land Details:** Seller can add details of land.
- **View Buyer Requests:** After adding land details, seller can view buyer requests.
- **Communicate with the Buyer:** Seller can communicate with the buyer.

X. Implementation

Frontend:for the user interface we have used javascript,html,css for the better visual for users.

Backend: As per Backend we used python, Django, Solidity for the better processing of the actions responsive to frontend.

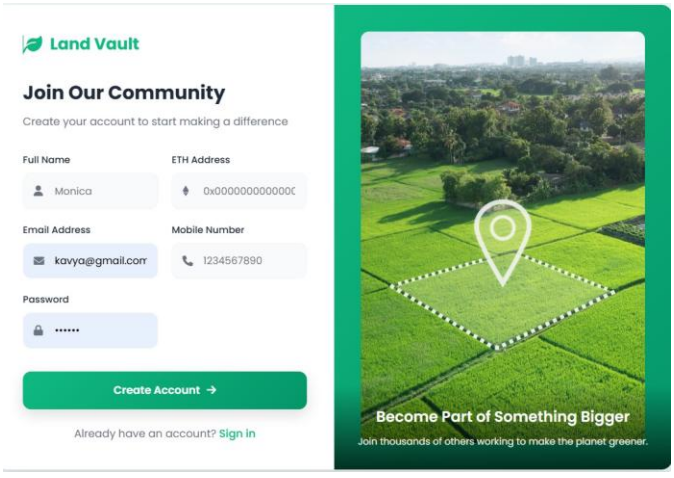

Fig. 5: SignUp Page

The Logic of the Code , Solidity-(a smart contract written Language) that helps us to write code that gets triggered when a certain event matches it conditions that are mentioned by the system.

Figure 5 illustrates the user registration interface of our LandVault system, where new users can join the platform by creating an account. The form collects essential details such as full name, Ethereum (ETH) address, email, mobile number, and a secure password. This ensures that every participant has a unique blockchain-linked identity, which is crucial for maintaining trust, security, and accountability in the system.

As for Logic of Authorising , Buy, Sell, view all lands that are for sale , based on the smartcontract defined for the conditions the flow of the event occurs , If i'm a user and has added a land in the system for sale,before going into chain,it has to be verified by the admin or when fully developed the miners are the verifiers for the process. when the land gets verified its sent to the block and visible to every user in the network.

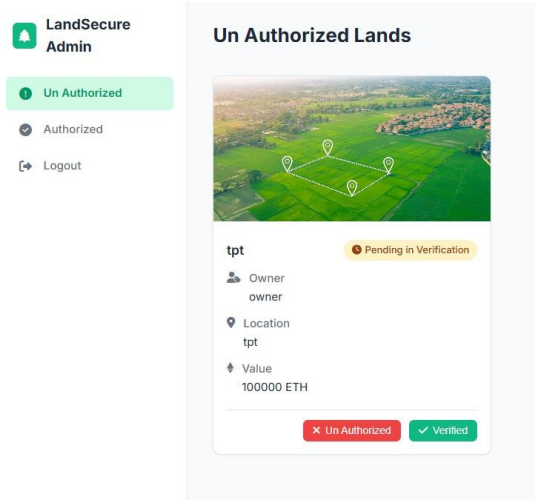

Fig. 6: Verification Required

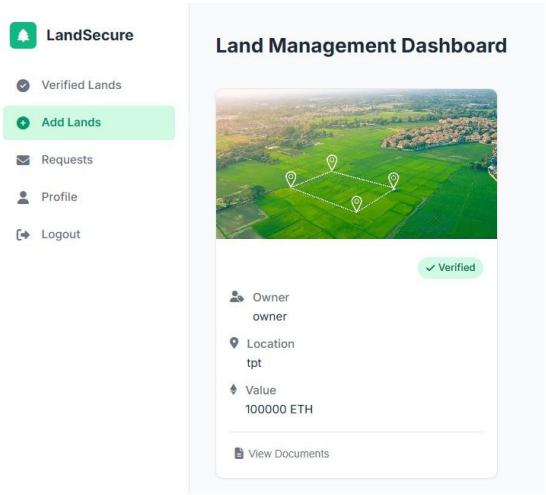

Fig. 7: Verified Land

Figure 7 The LandVault platform was developed to bring transparency, security, and trust to the process of land registration using blockchain technology. The system features two main dashboards — one for administrators and one for regular users.The admin dashboard allows authorized personnel to view all pending land registration requests under the "Un Authorized Lands" section. Each land record displays key information such as the owner's name, location, property value (in ETH), and current verification status. LandVault Exclusively shows the landa that need to be verified and once verified they are forwarded to the market panel.where buyers can choose the land to take. Admins can either verify the land or reject the request, ensuring only legitimate entries are added to the blockchain.

Figure 8 The proposed system is structured into three main layers: the Web Server, the Admin Server, and the Ganache Server, each playing a unique role in the overall functionality. The Web Server is the entry point for users and provides an intuitive interface through which they can interact with the system. From this interface, users are able to register themselves using the Registration Module, list properties through the Property Listing Module, and carry out financial operations such as deposits or payments using the Payment Processing Module.

The Admin Server acts as the supervisory layer. It consists of an Admin Panel and an Admin Management System, which give administrators oversight and control over the platform. Through this, administrators can verify property details, approve or reject submitted listings, and monitor ongoing transactions. This separation of roles not only ensures accountability but also strengthens trust between users and the system, as decisions are made transparently and systematically.

At the backend, the Ganache Server integrates blockchain technology to handle data storage and transaction records. It contains three databases: the User Database, which stores user profiles and registration details; the Property Listings Database, which securely holds property-related information; and the Transaction Database, which records all financial exchanges made within the platform.

Unlike traditional databases, this blockchain-backed server guarantees immutability and transparency, meaning that once data is stored, it cannot be altered without leaving a trace. This feature plays a crucial role in preventing fraud and ensuring the credibility of property records.

By combining these three layers, the system creates a balanced environment where users can perform essential operations easily, administrators can supervise and validate activities, and the blockchain ensures that every action is securely recorded. This modular design not only makes the platform scalable and maintainable but also directly addresses the common challenges in property management, such as lack of transparency, disputes over ownership, and risks of tampering with records.

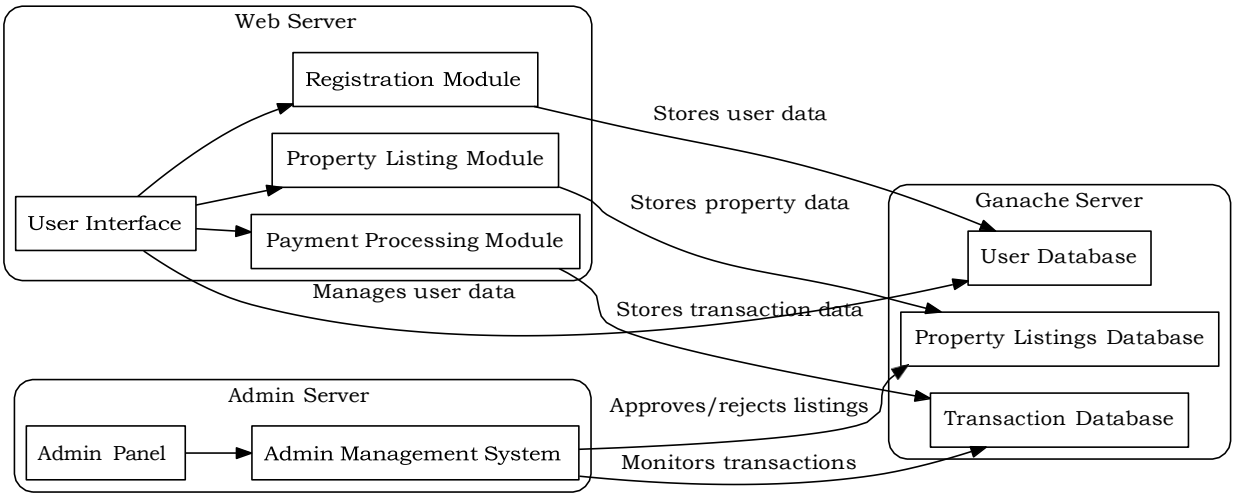

Fig. 8: Implementation Flow

XI. Conclusion and Future Scope

LandVault shows how blockchain can bring real change to the way land and rental records are managed. Today, people often face problems like fraud, tampered records, and long bureaucratic processes. By shifting to a decentralized and secure system, LandVault makes transactions more transparent and trustworthy. Citizens, landlords, and tenants can interact with confidence, knowing that the records cannot be altered without proper approval. Smart contracts further simplify the process by automating agreements and payments, reducing disputes and delays.

By combining these innovations, LandVault can grow into a national platform that serves both citizens and government alike. It not only reduces fraud and paperwork but also builds public trust in digital governance. With the right support, this approach could even inspire similar solutions for other public services in the future.

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