Land Record System Management Using Blockchain

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***Abstract*—Blockchain technology has emerged as a transformative force across various industries, Similarly, the Land Record sector stands to benefit significantly from this innovation. Despite being a lucrative long-term investment, the Land Record System is plagued by administrative challenges such as lack of transparency, fraud, involvement of multiple intermediaries, title disputes, excessive paperwork, arbitration, and limited liquidity. This report proposes a comprehensive framework that harnesses the potential of blockchain technology to address these challenges within the Land Record Management investment ecosystem. By leveraging blockchain's inherent features, including smart contracts, immutable record management, tokenization, record tracking, and time-stamped storage, the framework aims to streamline processes and enhance transparency and security.**

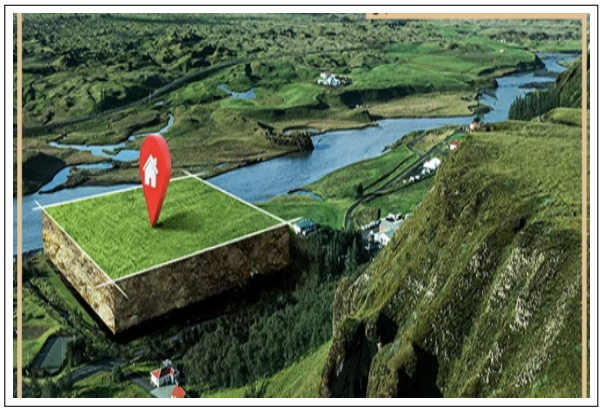


Fig. 1.

I. Introduction

LAND Record System Management is a blockchain-based platform designed to address inefficiencies and vulnerabilities in land record management. Leveraging blockchain's inherent features—decentralization, immutability, and transparency—LandChain aims to eliminate fraud, reduce transaction costs, and streamline land ownership transfers. The platform integrates smart contracts, decentralized data storage, and digital identity verification to revolutionize how land records are maintained, accessed, and transferred.

Opportunities for Innovation in Land Management:

Fraud Prevention: Blockchain can prevent title fraud, unauthorized land transfers, and identity theft through immutability and transparency.

Streamlined Ownership Transfers: Smart contracts can automate complex processes like land registration, reducing time and costs.

Accessibility and Transparency: A decentralized ledger allows stakeholders to verify ownership, transaction history, and legal status without relying on intermediaries.

Tokenization: Land assets can be fractionalized and tokenized, enabling smaller investments and enhancing liquidity in the real estate market.

Record System Management is a complex and unique asset class. The commercial Land Record Management sector, with its vast asset base and significant transactional activity, plays a crucial role in the global economy. Despite its size, the sector is predominantly controlled by a few corporate entities capable of making substantial, illiquid investments. This industry involves the buying, selling, and development of properties, including land, residential, and commercial buildings, all of which are essential to the economy.

However, Land Record transactions are vulnerable to various types of fraud, including title fraud, identity theft, and the double-selling of properties. These fraudulent activities result in financial losses and undermine trust in the Land Record market. Traditional fraud prevention methods often fail due to their reliance on centralized authorities and paper-based documentation, which can be easily manipulated or falsified.

Blockchain is a decentralized ledger that records all transactions transparently and immutably. Its architecture is well-suited for preventing unauthorized access and offers benefits

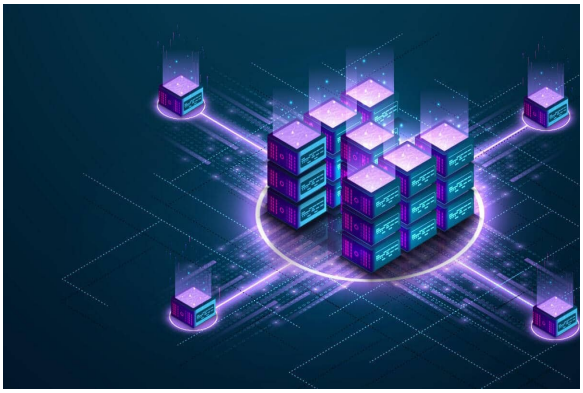


Fig. 2. Blockchain in Land Record Management

such as immutability, enhanced availability, and decentralization. This technology has the potential to revolutionize asset management by enabling simple and automated transactions.

Given that the Land Record sector is typically illiquid and traditional methods lack transparency, involve high processing fees, numerous intermediaries, and do not support fractional ownership, blockchain-based tokenization is an ideal solution. This approach enhances the ecosystem's liquidity, security, and efficiency.

This report examines how blockchain can transform the Land Record sector by making transactions faster, more secure, and transparent. It also aims to improve investment safety and reduce transaction costs by utilizing blockchain for Land Record asset tokenization. Additionally, it proposes an automated solution for token transfers and earnings distribution to investors.

II. Area of Focus

Land Record Management and Property Registration Systems.

The report emphasizes the application of blockchain technology in modernizing and addressing the inefficiencies of traditional land record management systems. It identifies key issues such as lack of transparency, susceptibility to fraud, inefficiencies in property registration, and the challenges posed by centralized, paper-based systems.

Key Aspects of the Focus Area:

Transparency and Security: Blockchain's decentralized nature ensures tamper-proof record-keeping, providing stakeholders (buyers, sellers, inspectors) with immutable and verifiable transaction histories.

Fraud Prevention: Mitigates title fraud, identity theft, and unauthorized modifications by securely managing records with digital signatures and smart contracts.

Efficiency in Processes: Streamlines ownership transfers, document verification, and land inspections through automated workflows using smart contracts.Reduces dependency on intermediaries and processing time.

Integration with Modern Technology: Uses tools like Ethereum blockchain, smart contracts, IPFS, and Web3.js to create a seamless, digital-first land management system.

III. Idea Description

The idea is to create a blockchain-based platform called LandChain, which digitizes and secures land records. The platform aims to improve transparency, efficiency, and security in land record management by addressing issues such as title fraud, unauthorized land transfers, and inefficient ownership transfer processes. LandChain will use smart contracts, decentralized storage, and identity verification to streamline land transactions, automate ownership transfers, and provide immutable records of property ownership.

IV. Domain Understanding

Current Value Chain and Pain Points:

The existing land record management system involves multiple stakeholders, including property owners, buyers, land inspectors, government registrars, and financial institutions.

Key steps in the current process include:

Ownership Verification: Often done manually, resulting in delays and errors.

Document Verification: Paper-based, leading to fraud and tampering risks.

Registration Process: Involves multiple intermediaries, lengthy timelines, and high transaction costs.

Accessing Land Records: Centralized and outdated databases are prone to errors and inaccessibility.

Pain Points: Lack of transparency and susceptibility to fraud. Manual processes result in inefficiency and high costs. Centralized systems are vulnerable to data breaches and corruption. Poor synchronization between stakeholders leads to disputes.

Where LandChain Fits in the Value Chain:

LandChain will disrupt and enhance the value chain by addressing the following steps:

Ownership Verification: Blockchain-based immutable records ensure accurate and transparent ownership history.

Document Verification: Smart contracts and decentralized storage automate and secure the process.

Registration Process: A blockchain ledger reduces reliance on intermediaries, minimizing time and costs.

Record Access: Decentralized and digitized records provide real-time, secure access for all stakeholders.

By embedding blockchain into these critical steps, LandChain will eliminate inefficiencies, enhance trust, and provide a streamlined experience for all participants.

V. Literature Review

The current land record system in India is outdated, stemming from the colonial era, and the existing records are worn out and village maps are outdated. State governments have failed to update these records, leading to land grabbing and alienation of disadvantaged communities by powerful individuals with vested interests. As Saxena (2005) notes, land possession and ownership often transfer without proper mutation in records, resulting in land records that do not accurately reflect actual ownership. This issue is exacerbated by instances where land remains recorded in the names of

deceased individuals, and transfers occur without updates to the records. Consequently, the reality on the ground is rarely mirrored in the official documents. Decrepit village maps further compound land disputes, leading to the dispossession and displacement of marginalized groups such as tribals, forest communities, small and marginal farmers, and landless laborers. Additionally, the Indian land market is plagued by high transaction costs. According to a World Bank study, India ranks 94th in efficiency for property registration (Faizi and Behera, 2014).

Property records in India contain essential details about land, such as its size, location, and current ownership. However, they do not necessarily verify the legal ownership of the land. Ownership is typically determined by possession, established through a chain of prior transactions. Land can be transferred through various means, including sale, purchase, gifting, inheritance, mortgage, and tenancy. According to the Transfer of Property Act, any document transferring rights, title, or interest in immovable property must be registered. The Registration Act mandates that all sales agreements for land transfers be registered. However, this registration pertains to recording the transaction, not establishing the land title.

Despite genuine transfers, ownership may still be disputed due to the possibility of prior contested transfers. The aim of registration is to make transactions public, enabling buyers to verify the sequence of prior transactions on the property. Transfers requiring registration under the Registration Act are not admissible as evidence of ownership in court if not registered. Additionally, not all transactions necessitate registration, such as government acquisitions, judicial orders, land grants, partitions, and short-term leases. The absence of mandatory registration for these transactions has led to numerous legal disputes.

The Registration Act of 1908 requires verification of the identities of the buyer and seller during registration. While verifying identities is straightforward, the registering officer may not always be able to confirm the exact location and characteristics of the land in question. Identity verification does not guarantee the seller's legal title to the property. It is the buyer's responsibility to ensure that the seller is the legitimate owner with a transferable title, which involves investigating past transactions and ownership records. This task is challenging when ground transactions are not adequately recorded, and discrepancies exist between government records and the actual state of land ownership. Older records are especially prone to gaps, making it easier to contest ownership.

Land Registry in Honduras

Honduras, a Central American country with approximately 8.8 million people, faces significant economic challenges, including unequal income distribution and high underemployment. Land ownership is concentrated in large estates or small plots with many plots, lacking proper titles. According to USAID, most privately owned land is either untitled or improperly titled, with only 14 percent of Hondurans legally occupying their properties. This lack of clear ownership leads to disputes, conflicts, displacement of indigenous groups, and fraudulent land appropriation (USAID, 2018).

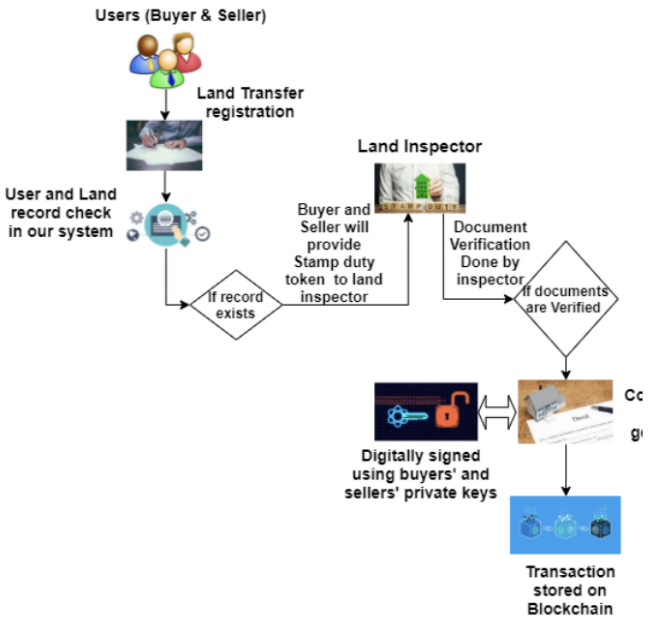


Fig. 3. Land Registry system

The Honduran government recognized that legal land titles issued through a centralized land registration system would provide security that informal documents could not (Nelson, 2003). Despite efforts to digitize records, the system suffers from inefficiencies, incomplete information, and cadastral deficiencies, leading to issues such as duplicate titles and unauthorized changes (Lemieux, 2016). To address these challenges, Honduras considered modernizing its land registry with a tamper-proof blockchain database, becoming one of the first countries to explore this innovation (Colindres et al., 2016).

In 2015, Factom, a Texas-based technology company, proposed a blockchain-based solution for Honduras's land registry. The blockchain would create a permanent, timestamped record of land transactions, ensuring data integrity and preventing corruption. Factom's system involves a process of creating entry blocks and directory blocks, validated client-side, and stored on the blockchain. This method aims to improve transparency and security in land ownership records (Lemieux, 2016).

Land Registry in Georgia

Georgia, located between Turkey and Russia in southwestern Asia, has a population of nearly 5 million, primarily around its capital, Tbilisi. After regaining independence from the Soviet Union in 1991, Georgia faced a lengthy and corruption-prone process for land transactions. Buyers and sellers had to visit public registries and pay fees, making the process slow

and susceptible to bribery.

In recent years, Georgia has taken significant steps to modernize its systems and reduce corruption. By 2013, the government updated the public registry, resulting in Georgia ranking third globally for ease of property registration according to The World Bank Doing Business report (Heider and Connelly, 2016). In 2014, BitFury, a Bitcoin blockchain infrastructure provider, established a data center in Gori, supported by the Georgian Investment Fund, attracted by low electricity costs, preferential taxes, and a sustainable investment environment.

In late 2015, BitFury announced a $100 million investment to build a data center in Tbilisi and partnered with the Georgian government to develop a private blockchain for the National Agency of Public Registry (NAPR). This blockchain, anchored to the Bitcoin Blockchain through digital time-stamping, aimed to enhance transparency in land titling (Shin, 2016). Government officials praised the project's role in increasing transparency and modernizing land titling (Shin, 2017).

This cumbersome process not only consumes a considerable amount of time but also involves numerous intermediaries and third parties who often charge illegal fees, exploiting those unfamiliar with the procedures. The entire process, which should be swift in today's digital age, takes over 10-15 days. Although the government has been moving towards digitalization and centralized digital databases, these centralized systems also have critical vulnerabilities. Issues like data security breaches, fraudulent data modifications, and the risk of data loss during disasters are significant concerns. Additionally, maintaining centralized systems is costly and involves unnecessary intermediaries, even though technological advancements could automate the entire process.

Gaikwad et al. (2022) propose using blockchain technology to improve transparency, efficiency, and security in land record management. Their system leverages smart contracts on the Ethereum Virtual Machine (EVM) to manage transactions and interactions, ensuring all transactions are securely recorded on a distributed ledger, making them resistant to hacking and fraud.

Decentralized Data Storage and Smart Contracts

Decentralized data storage combined with smart contracts can revolutionize land record management. Gaikwad et al. (2022) describe a system where all transactions are stored on a blockchain, creating a secure, transparent, and immutable record of ownership and transaction history. This approach enhances security and simplifies the contracting process, making it more user-friendly and efficient.

Graglia and Mellon (2018) discuss the requirements for adopting blockchain in real estate and land registries, presenting a framework for integrating blockchain solutions. The Republic of Georgia started using blockchain for land titling in 2016 to reduce corruption. Similarly, Andhra Pradesh in India piloted blockchain-based land registries, securing 100,000 land records (Haridas, 2018). The UAE and Dubai launched the "UAE Blockchain Strategy 2021" to lead globally in blockchain adoption across multiple sectors, including land and real estate (UAE government, 2021).

History of Blockchain

Blockchain, introduced a decade ago, has the potential to become a foundational technology for global record-keeping systems. It was created by the enigmatic figure(s) behind the cryptocurrency Bitcoin, under the pseudonym Satoshi Nakamoto. The concept of a cryptographically secured chain of blocks dates back to 1991, described by Stuart Haber and W. Scott Stornetta. In 1998, Nick Szabo worked on 'bit gold,' a decentralized digital currency, followed by Stefan Konst's theories on cryptographic chains in 2000. Nakamoto's 2008 white paper laid the groundwork for blockchain, leading to the first blockchain implementation as Bitcoin's public ledger in 2009. By 2014, blockchain technology expanded beyond cryptocurrency to include various financial and interorganizational transactions, ushering in Blockchain 2.0. The Ethereum blockchain system further advanced the technology by introducing smart contracts, which are computer programs representing financial instruments like bonds.

Bitcoin, launched by Nakamoto in 2009 following their 2008 white paper, aimed to create a peer-to-peer cash system without the need for a central authority, akin to physical cash. Bitcoin's proposal addressed several key issues in online currency, establishing it as the most successful version to date. The underlying engine, the blockchain, remains the largest and most active, continuing to facilitate Bitcoin transactions today.

VI. Geography and Regulation

Geography

The Blockchain Tech Startup, LandChain, will initially operate in India, targeting the Indian land record management sector. India faces significant challenges in land registration due to outdated processes, lack of transparency, and widespread fraud, making it a prime geography for implementing a blockchain-based solution.

Regulatory Bodies

In India, the following regulatory bodies oversee areas relevant to blockchain and land record management:

Ministry of Electronics and Information Technology (MeitY): Responsible for promoting blockchain technology and overseeing data protection policies.

Department of Land Resources (DoLR): Oversees land reforms and administration in India, including digitization of land records under the Digital India Land Records Modernization Programme (DILRMP).

Reserve Bank of India (RBI): Regulates digital currencies and blockchain-based financial transactions that may arise as part of tokenized land investments.

Ministry of Law and Justice: Governs property and contract laws, including the Registration Act of 1908 and the Transfer of Property Act, 1882.

Regulations Supporting or Restricting LandChain

Supporting Regulations: Digital India Land Records Modernization Programme (DILRMP): Encourages digitization of land records and supports the adoption of technology for land management. Blockchain aligns with this initiative to ensure transparency and tamper-proof records.

Link to DILRMP Guidelines Information Technology (IT) Act, 2000: Provides legal recognition for electronic records and digital signatures, supporting the use of blockchain for ownership transfers and document verification.

Link to IT Act Blockchain Initiatives by NITI Aayog: NITI Aayog, a government think tank, has piloted blockchain-based land records in certain states, promoting its adoption across India. Blockchain for Land Records Report by NITI Aayog

Restricting Regulations: Lack of Legal Framework for Blockchain

VII. Technology

A. List of tools used throughtout the Process

Smart Contracts - Different smart contracts are made for buyer, seller, land inspector and events are generated in smart contracts for web application, different functionalities and data structures are used while writing smart contracts, those are structures, arrays, contracts, modifiers, functions, constructor.

Solidity - solidity programming language is used while writing smart contracts, solidity compiler is used for generating bin and abi files. Bin file is used while communicating with blockchain and abi file is used for accessing the smart contract functions.

Web3js - web3js is a javascript library which is used for connecting the web application to blockchain via rpc port, web3 object is generated and different functions of web3 are used while communicating with ganache, truffle console.

Ganache - ganache is a testing environment which is used for testing the functionality of smart contracts, ganache provides 10 pre funded accounts for testing the transactions, and smart contracts.

Ethereum: A decentralized blockchain platform used to deploy smart contracts and decentralized applications.

Truffle - truffle is a framework used for deploying the contracts, truffle automatically provides the structure for storing the contracts and migrations folders for connecting it with mainnet and testnet

Hardhat provided a local Ethereum network for development and testing, along with tools for deploying smart contracts and running scripts.

IPFS-IPFS is InterPlanetary File System. It is a protocol and network designed to create a content-addressable, peer-to-peer method of storing and sharing hypermedia in a distributed file system. IPFS is often seen as a potential replacement for the traditional Hypertext Transfer Protocol (HTTP) and aims to create a more efficient and decentralized internet infrastructure.

B. Architecture of the Project

User Login - Users will register on the system by providing their contact details,email address, name,aadhar number and the details would be verified from digilocker which inturn would be integrated in the system, If the user details are verified successfully, then through the system private and public keys would be generated for users, keys are generated using aws key management store.

Seller/Buyer - Once the registration is done, option would be given to sellers for the transfer of land ownership, prior to conveyance deed, buyers and sellers has to submit some amount of token to land inspector for document verification, once the documents are verified by land inspector, seller would provide the contact details, aadhar number, email address of a buyer and a buyer would receive a notification on an email regarding land transfer process to accept or reject the request. Once the request is accepted, the buyer will enter their details and the details would be matched with the details given by the seller, if the details are matched, notification would be sent to both buyer and seller regarding signing the conveyance deed.

Conveyance deed - once the notification accepted by both buyer and seller,corresponding private keys would be fetched from aws key management store and a digital signature would be generated which would be stored on blockchain and the digital file would be sent to the buyer via email. Once the land transfer process is completed, events would be triggered and the land ownership function would be called from a smart contract for updating the land owner and a transaction would be generated on blockchain.

Verification Module - In the verification process, different third parties will verify the owner and land details by uploading the digital file on the system, digital file would be matched with the records stored on the blockchain, once the digital file is matched with the record, the details of the owner and land details will be sent to the third party via email. Third party can be a financial institution wherein owner can apply for a loan, institution would ask for a proof of land property, owner can provide them a digital file generated through the system and institute would make a request for details and send notification via email to the system, provided digital file would be matched with the system blockchain records, if digital file found out, then the owner and land details would be send to the bank via email.

Throughout the process, blockchain plays a very important role in maintaining transparency, digitally signing and verifying the land records without involving any intermediaries, and securely storing the land record ownership transfer history on blockchain..

This structured architecture highlights seamless integration,

robust security, and transparency offered by blockchain technology for land management.

C. Setup and Deployment, Testing, and Evaluation

Implementation Phase

Blockchain Network Setup: Configure a permissioned blockchain network to manage access and ensure security. Deploy smart contracts on the blockchain network. Integrate smart contracts with front-end applications.

Data Migration: Use dummy data to simulate the land record management process. Ensure data integrity and consistency during migration.

System Testing and Evaluation: Conduct functional testing to verify that all system functionalities work as intended. Perform performance testing to evaluate the system under various loads and conditions. Carry out security testing to assess resistance to unauthorized access and data breaches. Implement a pilot version in a controlled environment to gather real-world data and user feedback. Analyze feedback to evaluate the system's effectiveness and address challenges.

D. Addressing Limitation

Recognizing the constraints of this study, including the reliance on precise and comprehensive data from current land record systems, as well as the possible hurdles in stakeholders embracing the new system.

VIII. Results And Discussion

An organized and systematic strategy was taken in carrying out the project. To guarantee methodical development and execution, the project's flow was split into many phases:

A thorough analysis of the limitations of the current property registration systems was carried out. A decentralized blockchain-based property registration system was conceptualized as a result of this investigation. Smart contracts, the DApp, and interaction with IPFS and MetaMask were all carefully considered in the system architecture, which ensured a complete and effective solution.

Backend Development: To handle ownership transfers, property registration, and verification procedures, smart contracts were created on the Ethereum blockchain using Solidity.

Frontend Development: Using Flutter, the decentralized application (DApp) was created, offering customized user interfaces for a range of stakeholders, including contract owners, buyers, sellers, and land inspectors.

Integration: To provide smooth connection between the DApp and the blockchain, Web3.js was used to link the smart contracts with the UI.

Data Storage: To ensure high data integrity and security, IPFS was used for the decentralized storage of user documents and information that were deemed sensitive.

The Truffle suite allowed the contracts to be deployed, compiled, and tested on the Ropsten Testnet, allowing for thorough testing of smart contracts. Simultaneously, the DApp was put through a rigorous testing process that included a wide range of testing scenarios in order to ensure that it is functional, user-friendly, and secure.

A. Development and Testing

Multiple iterations were made during the development and testing phase to improve and optimize the system. Important actions comprised:

Solidity was employed to implement smart contracts that define guidelines for real estate transactions, ensuring secure ownership transfer, conditional transactions, and document verification. By leveraging the Truffle suite, a stable development environment was established, allowing these contracts to be deployed and tested on the Ropsten Testnet. This approach ensured the reliability and security of the real estate transaction process.

Frontend: Flutter was used in the development of the DApp in order to take advantage of its cross-platform features and guarantee compatibility with web, iOS, and Android platforms. For a variety of stakeholders, user interfaces with features including adding properties, confirming documents, making and receiving property requests, and transferring ownership were created. This guaranteed a fluid and easy-to-use user interface on many devices.

Backend: Designed to complement the frontend's features, the backend integrates with the blockchain to safely handle data and transactions. In order to establish the rules for real estate transactions, smart contracts were used. These rules cover secure ownership transfer, conditional transactions, and document verification. In order to guarantee strong speed and security, the backend also managed user authentication, data storage, and communication with the decentralized ledger.

Web3.js was used to integrate the smart contracts with the DApp in a seamless manner, enabling easy communication between the Ethereum blockchain and the frontend. IPFS was used to decentralize user documents for data storage, guaranteeing low latency, high throughput, and data integrity. User documents and transaction data were securely managed and readily accessible thanks to this integration, which made the system dependable and effective.

Truffle and Ganache were used to effectively simulate blockchain environments during the smart contract's unit and integration testing. To guarantee a seamless user experience, extensive functional and usability testing of the DApp was

carried out. Furthermore, a variety of attack vectors and failure scenarios were used to thoroughly test the system's security and resilience, guaranteeing a dependable and secure platform for all users.

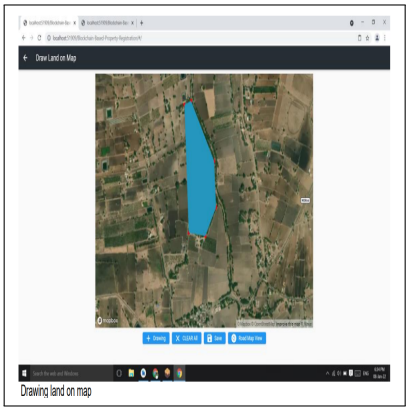


Fig. 4. Drawing land on map

B. *Results*

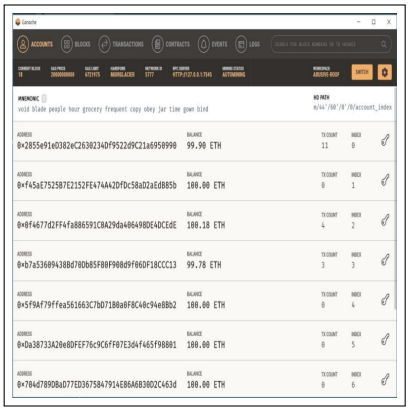
The project's noteworthy outcomes demonstrate how blockchain technology has the ability to completely transform property registration processes. Important results consist of:

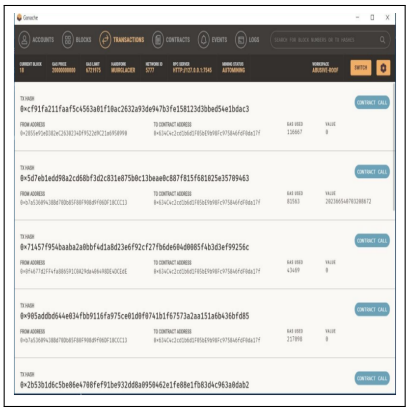
With nearly instantaneous changes to the land record and speedier implementation of ownership transfers, the blockchain-based system greatly shortened the time needed for property transactions.

The project improved process transparency by using automated alerts to notify stakeholders of ownership transfers and other significant modifications. Furthermore, the decentralized ledger ensured data integrity and promoted participant confidence by offering a tamper-proof record of every transaction.

Increased Flexibility and protection: The project made use of IPFS and blockchain technology to provide strong protection for user data, preventing manipulation and unwanted access. Together, these elements offered a strong foundation for preserving data integrity throughout real estate transactions. Additionally, the system provided flexibility by allowing digital archives for files and contracts, which made document management and access easier. This dual strategy improved the effectiveness and user-friendliness of the overall property registration procedure in addition to fortifying security safeguards.

Robustness and User-Friendly Interface: The Flutter-based DApp ensured ease of use and navigation for all stakeholders by providing an intuitive and user-friendly interface. The user experience was improved by this interface's smooth interaction with the property registration system. Furthermore, the system demonstrated scalability to accommodate future development by effectively handling numerous users and transactions, indicating resilience.





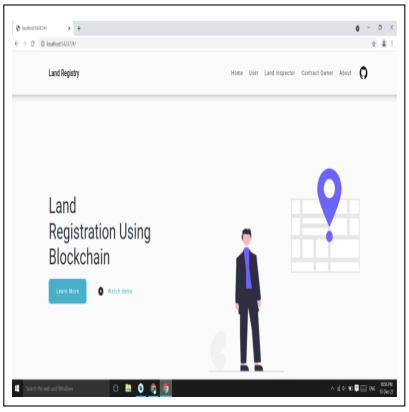
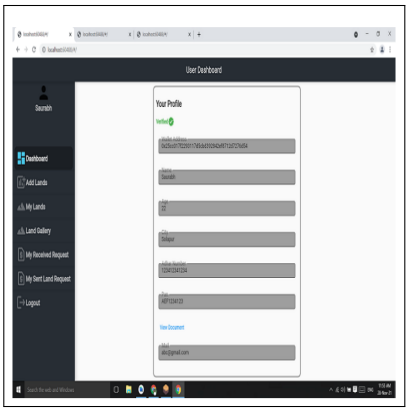
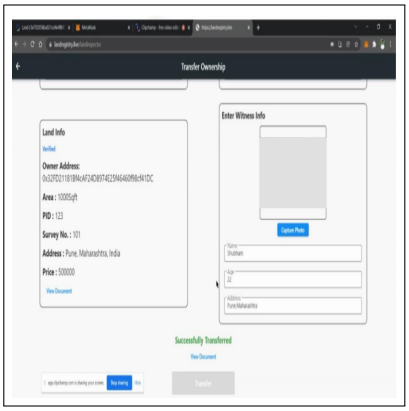
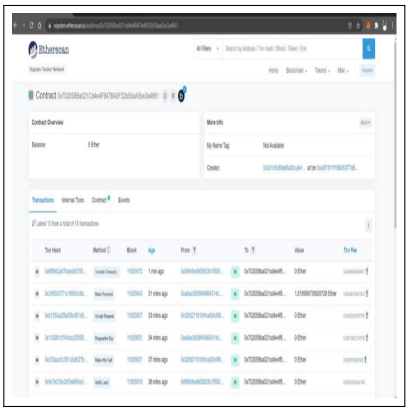


Fig. 5. Login Page







C. Snippets of Website

IX. Customer and User Behavior

Identifying Target Users: The primary target users of the blockchain-based land record management system include: - Property buyers and sellers seeking a secure and efficient transaction process. - Land inspectors and government officials requiring transparent verification systems. - Financial institutions such as banks that depend on accurate land records for loan approvals. - Real estate investors interested in fractional ownership and tokenized assets.

Value Proposition for Users: The platform's key offerings that users find valuable include: - Transparency: Blockchain's immutable ledger eliminates disputes and builds trust. - Efficiency: Automated smart contracts reduce transaction times significantly. - Accessibility: Real-time data availability simplifies property management for stakeholders. - Security: Robust cryptographic mechanisms ensure data integrity and prevent fraud. - Cost Savings: Eliminating intermediaries and paper-based systems lowers expenses for users.

Quantification of Value: - Users report a 50 percent reduction in transaction processing times compared to traditional systems. - Financial institutions experience up to a 30 percent decrease in verification costs due to automated processes.

Payers for the Service: - Primary Payers: Property buyers and sellers who directly use the platform for transactions. - Secondary Payers: Financial institutions paying for verification services and enhanced access to secure records. -Government Bodies: May invest in the system to modernize land records and improve public service efficiency.

Pricing Structure: - Per Transaction Fee: A small percentage of the transaction value charged to buyers and sellers. - Subscription Model: For financial institutions requiring regular access to land records and verification services. - Government Licensing: Annual licensing fees for access to the system's features for public administration purposes.

Addressing the User and Payer Gap: The platform bridges the gap between users (e.g., buyers, sellers) and payers (e.g., financial institutions, government bodies) by offering dual value streams: - Direct benefits to users through enhanced transaction efficiency. - Indirect benefits to payers via improved operational processes and lower costs.

X. Conclusion

- In conclusion, blockchain technology has demonstrated its potential across various industries, including

cryptocurrency, asset transfer, and document verification, due to its key characteristics of decentralization, anonymity, persistence, and auditability. The traditional land registration system, with its cumbersome process involving multiple intermediaries and verifications, stands to benefit significantly from blockchain technology's immutability and security features.

Our proposed solution leverages blockchain to streamline the land registry procedure by minimizing intermediaries, reducing time consumption, and simplifying complexity. The use of smart contracts automates procedures, speeds up transactions, and securely stores land ownership hierarchy, thereby reducing disputes and fraudulent activities.

This work effectively addresses the limitations of the traditional land registration system, ensuring data safety and transparency. Blockchain's properties, including hash cryptography, consensus protocol, and public-private key pair, enhance security, monitor transactions, and minimize human error. It significantly impacts the current system by eliminating fraud, reducing middleman costs, and improving efficiency in terms of security, time, and cost.

Future research endeavors should concentrate on expanding the proposed framework to enable its widespread implementation across diverse geographical regions. This expansion should include seamless integration with existing land management systems. Moreover, there is a need to explore the integration of other emerging technologies like artificial intelligence and Internet of Things (IoT) to augment the functionality and resilience of blockchain-based land registries. An essential aspect of future research would be to delve into the legal and regulatory ramifications of adopting blockchain for land management. Addressing these aspects will be crucial in fostering broad acceptance and implementation. Additionally, disseminating knowledge about this technology to a wider audience will pose a significant challenge.

Looking ahead, blockchain has the potential to create a virtual financial identity for consumers, impacting shopping, payments, and lending practices. Starting with commercial real estate, blockchain's practical applications are poised to go mainstream, influencing e-commerce, finance, and real estate practices.

XI. References

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