International Journal of Innovative Information Systems & Technology Research 19(4):31-39, Oct-Dec, 2026

© SEAHI PUBLICATIONS, 2026 **www.seahipublications.org ISSN: 2467-8562**

DOI:10.5281/zenodo.23245405

Blockchain-Based Real Estate Tokenization for Fractional Ownership

Ambrose Omoghene Akegwure[1]; Prof. Daniel Matthias[2] & Dr. D. J. S. Sako[3]

[1-3]Department of Computer Science,
Faculty of Science,
Rivers State University, Port Harcourt, Nigeria

(ORCID ID:0009-0003-5434-9697)
(Email address: ambrose.omoghene@rsu.edu.ng (Ambrose O. Akegwure),
matthias.daniel@ust.edu.ng (Prof. Daniel Matthias), dum.sako@ust.edu.ng (Dr. D. J. S. Sako)

ABSTRACT:
Real estate transactions continue to face challenges involving ownership transparency, transaction security, limited liquidity, and high barriers to participation. This study designed and implemented a blockchain-based real estate tokenization system that represents property interests as digital tokens for fractional ownership. Solidity smart contracts automate token issuance, ownership transfer, compliance checks, and distribution of returns, while supporting property records are linked to blockchain entries through cryptographic hashes. The system uses a Web3-enabled interface developed with HTML, CSS and JavaScript, with MySQL supporting off-chain data management. Evaluation using sample property and investment data compared operation with and without blockchain enforcement and encryption. Ownership and transaction accuracy increased from 68% to 94% with blockchain enforcement, while the encryption comparison increased from 65% to 93%. The controlled evaluation also recorded 99% hash-verification consistency, 0% unauthorised access, and 100% audit completeness. The findings indicate that blockchain-based tokenization can strengthen record integrity, traceability, and fractional ownership management. The study presents an integrated model combining tokenization, smart-contract automation, role-based governance, and auditable ownership records, while recognising the need for further legal, regulatory, scalability, and security validation before live deployment.
Keywords: Blockchain; Real Estate Tokenization; Fractional Ownership; Smart Contracts; Distributed Ledger Technology; Transparency; Property Management

1. INTRODUCTION

Real estate has long been one of the most valuable and stable asset classes in global economic systems, yet it remains one of the least technologically transformed sectors. For decades, the industry has relied on manual documentation, paper-based land records, fragmented property databases, and intermediaries such as brokers, attorneys, and government registrars, creating opportunities for bureaucratic delay, opaque pricing, and fraudulent manipulation of records. Even where governments computerised land registries, the resulting systems remained centralised, leaving records susceptible to unauthorised alteration, cyber intrusion and inconsistent data entry. Online property-listing platforms improved access to property

information but did not provide secure ownership-transfer mechanisms, so problems of price manipulation, hidden ownership history, title fraud, duplicated deeds and slow, bureaucratic transfer processes have persisted. Real estate investment also remains largely inaccessible to small and medium-scale investors because high-value properties cannot easily be divided into smaller, tradable units, resulting in low market liquidity, while cross-border transactions are complicated by currency risk and inconsistent legal frameworks.

Blockchain technology offers a way to manage asset records in a tamper-proof and verifiable form, and by the mid-2010s the idea of tokenizing real estate emerged as a way to democratise access to property ownership and strengthen trust in property registries. Blockchain-enabled tokenization divides a property's value into digital tokens representing fractional ownership, so investors can buy and sell portions of high-value property much as they would trade digital securities, while smart contracts – self-executing agreements coded into the blockchain – automate rental payments, ownership transfer, compliance checks and profit distribution, reducing dependence on intermediaries and lowering transaction costs. Motivated by these persistent gaps, this study designs and implements a Blockchain-Enabled Real Estate Tokenization System (BERTS) that provides tamper-proof record-keeping, decentralised verification, fractional ownership through digital tokens, and automated transaction processing through smart contracts.

1.1 Objective of the Study

This study aims to design and develop a blockchain-based real estate tokenization system for fractional ownership. Specifically, the study set out to: (i) design a blockchain-based model for representing real estate assets as fractional digital tokens; (ii) implement smart contracts to support token issuance, ownership verification, and secure transfer of fractional interests; (iii) provide transparent and auditable ownership records through blockchain-based record keeping; and (iv) implement the system using Solidity smart contracts on an Ethereum-compatible network.

1.2 Organization of the Paper

The remainder of this paper is organised as follows. Section 2 reviews related work on blockchain-based land registries, tokenization and smart-contract-enabled property transactions, and identifies the gap this study addresses. Section 3 describes the methodology, comprising the research approach, the mathematical model underlying the tokenization scheme, the system architecture, and the algorithm used to implement the proposed system. Section 4 presents the results of the evaluation and discusses their implications. Section 5 concludes the paper and outlines directions for future work.

2. LITERATURE REVIEW

Several studies have examined blockchain-based alternatives to centralised land registries. Zheng and Li [1] proposed a blockchain-based land registry that stores ownership records on an immutable ledger using an Ethereum smart-contract prototype, demonstrating reduced fraud risk and greater ownership transparency, although the system struggled with scalability and high transaction costs on public blockchains. Olayemi and Musa [2] addressed fragmented property documentation in developing economies through a cloud-based property-management system that improved retrieval speed but remained limited by the cybersecurity vulnerabilities of centralised storage. Nweke and Adeoye [5] used a permissioned, multi-node distributed ledger to guard land records against tampering, improving data integrity, though at the cost of high infrastructure expense and the technical expertise required for deployment. Vishnumurthy et al. [7] applied blockchain hashing to detect alteration in stored deeds, but could not secure legacy paper documents prior to digitisation.

A second stream of work focuses on tokenizing property value itself. Franchi [3] introduced asset tokenization that splits properties into digital tokens representing fractional ownership, improving investor participation and cross-border access, but leaving the regulatory treatment of tokenized assets unresolved in many jurisdictions. Benhamou [6] proposed tokenized securities traded on a regulated marketplace to widen access for low-income investors, finding that liquidity still depended heavily on user adoption in the early stages. Rhee and Park [10] extended this idea across borders using a

decentralised-identity framework for investor verification, achieving faster international transactions but constrained by the absence of harmonised international law for digital property tokens.

Other studies emphasise automation through smart contracts. Zhang et al. [4] used smart contracts to automate property transfer and produce verifiable transaction logs, reducing reliance on intermediaries, though legal enforceability remained uncertain because smart contracts are not recognised under many national property laws. Christidis and Devetsikiotis [8] proposed a self-executing transfer architecture that reduced time and cost but lacked integration with government land registries. Adebanjo and Okoro [9] piloted a blockchain-enabled property-management platform to improve trust between landlords and tenants, but encountered user resistance from stakeholders unfamiliar with blockchain technology.

Recent systematic reviews reinforce these individual findings. Saari [11], synthesising 262 documents, found consistent evidence that blockchain pilots improve traceability and stakeholder trust in experimental settings, but that most implementations stall at regulatory, interoperability and scalability hurdles. Izadin and Yusof [12], reviewing 38 Scopus-indexed studies, similarly reported that tokenization pilots improve transaction efficiency, transparency and investor access, while highlighting recurring obstacles around regulatory uncertainty, reliance on off-chain legal wrappers, and unresolved scalability. Rashid [13] proposed an integrated permissioned-blockchain framework linking cadastral, registry and tax data for low- and middle-income countries, reporting improved consistency and auditability but noting high implementation cost and unresolved legal recognition of on-chain entries. Paavo [14] proposed a staged deployment roadmap for blockchain land registries in Sub-Saharan Africa, finding strong stakeholder interest but stressing that legal reform and sustained funding are prerequisites that may not materialise in every context.

2.1 Knowledge Gap

Taken together, the reviewed studies confirm that blockchain can improve transparency, traceability and fraud resistance in property administration, and that tokenization can lower the capital threshold for real estate investment. However, most existing solutions address either secure record-keeping or fractional investment in isolation; few combine automated smart-contract-based dividend distribution with role-based access control for owners, investors, administrators, and regulators within a single architecture; and evaluation evidence remains concentrated in small pilots rather than systems that quantify security and transparency gains directly against a non-blockchain baseline. This study addresses that gap by designing an integrated tokenization architecture that combines fractional ownership, automated compliance and dividend distribution, and role-based governance, and by evaluating its transparency and integrity gains quantitatively against a conventional, non-blockchain-enforced baseline.

3. METHODOLOGY

3.1 Research Methodology

The study adopted a constructive research methodology, combining analysis of existing real-estate ownership and tokenization models with the design, implementation, and evaluation of a novel blockchain artefact. The research proceeded through four stages: problem identification (high entry barriers, illiquidity, opaque ownership records, slow title transfer and intermediary dependency in conventional models); artefact construction (a token model representing real-estate assets as ERC-20/ERC-3643-compliant fungible tokens); implementation (modular components for smart-contract execution, on-chain ownership registry, off-chain asset verification and decentralised governance); and evaluation (transaction accuracy, hash-verification consistency, unauthorised-access rate and audit completeness). System development followed an object-oriented design (OOD) approach, decomposing BERTS into reusable components – Property, FractionalToken, Investor, SmartContractManager, OwnershipRegistry, ComplianceVerifier and DividendDistributor – to support modularity, scalability and future integration with additional blockchains or oracles.

3.2 Mathematical Model of the Tokenization Scheme

The mathematical model underlying BERTS ensures that every participant's stake is precisely quantifiable, provably fair, and independently verifiable. Tokenization is treated as a linear partitioning of

ownership and value. Let V denote the verified market value of the property and S the total token supply; the initial token price is then

$$p = V / S \quad (1)$$

An investor contributing capital C receives

$$C_i = \text{floor}(C / p) \quad (2)$$

tokens, using integer flooring to preserve indivisibility, so that the investor's fractional ownership is

$$f_i = C_i / S \quad (3)$$

Annual rental income (or any other cash flow) R is distributed proportionally to each token holder as

$$\text{Yield}_i = R \times f_i \quad (4)$$

Secondary-market trading updates the effective token price p_t dynamically through supply and demand, while the underlying ownership fraction f_i remains fixed on-chain. The total tokenized value of the asset at any time t is therefore

$$V_t = p_t \times S \quad (5)$$

which may exceed or fall below the original valuation V as the market re-prices the asset. Two invariants are enforced at the smart-contract level to guarantee security and transparency. First, every token transfer must satisfy the balance-conservation invariant

$$\Sigma_j \text{balance}_j = S \quad (6)$$

at every block, so that the total number of tokens in circulation can never change outside an authorised minting event. Second, revenue distribution must satisfy

$$\Sigma_i \text{Yield}_i = R \quad (7)$$

ensuring that the sum of all payouts always equals the distributed income. Because equations (1)–(7) are executed and logged by the deterministic smart-contract virtual machine, any observer can independently verify f_i, V, and R directly from the blockchain state, which is what gives the system its transparency guarantee.

3.3 System Architecture

Figure 1 shows the architecture of a representative existing property-management system, organised around a domain-name server, load-balancing server and authentication server at the network layer, with a data-acquisition layer and field-subsystem terminals feeding a central data-collection server. Because ownership and transaction data are held by a single authority in this arrangement, the system is vulnerable to data manipulation, provides limited transparency, and scales poorly under large or real-time transaction volumes.

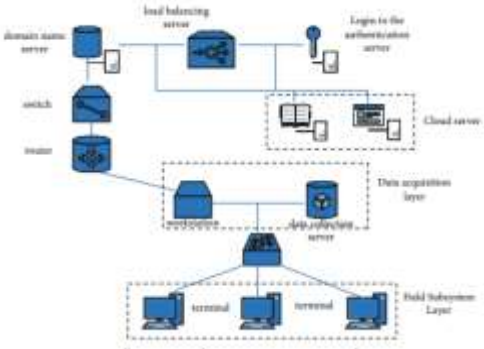

Figure 1. Architecture of a representative existing property-management system.

The proposed BERTS architecture (Figure 2) instead places a smart-contract layer between the authentication server and the blockchain, so that access keys are generated and validated on-chain rather than by a single central authority. The architecture comprises eight layers: a legal layer (a Special Purpose Vehicle holding legal title to the property); an off-chain data layer for documents, valuations and due-diligence reports; a blockchain layer that stores ownership records and transactions immutably; a tokenization layer that issues fractional-ownership tokens; a smart-contract layer encoding issuance, transfer, compliance and dividend logic; a user-interface layer for browsing, trading and portfolio tracking; a compliance and security layer for KYC/AML and access control; and an oracle layer that feeds verified real-world data – rental income, valuations, external events – into the blockchain.

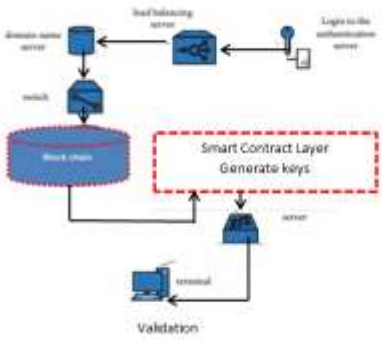

Figure 2. Architecture of the proposed Blockchain-Enabled Real Estate Tokenization System (BERTS).

Figure 3 illustrates the end-to-end tokenization flow that this architecture implements: a physical property is converted into fractional tokens through a smart contract, investors acquire, trade, and earn yield on those tokens transparently on-chain, and the property owner retains administrative control and legal compliance throughout.

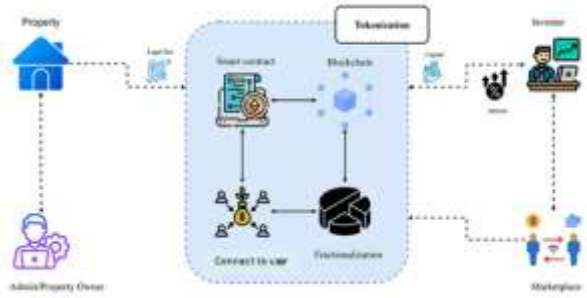

Figure 3. End-to-end blockchain tokenization concept for the proposed system.

The class diagram in Figure 4 summarises the resulting object model. A general User class specialises into PropertyOwner and Investor; Property is tokenized through the Token class, which is created and governed by SmartContract; every action is captured by the Transaction class; and the Blockchain class stores all transaction records and contract executions immutably. Association, inheritance, and aggregation relationships between these classes enforce clear interaction flows between property registration, tokenization, investment, and ownership-transfer operations.

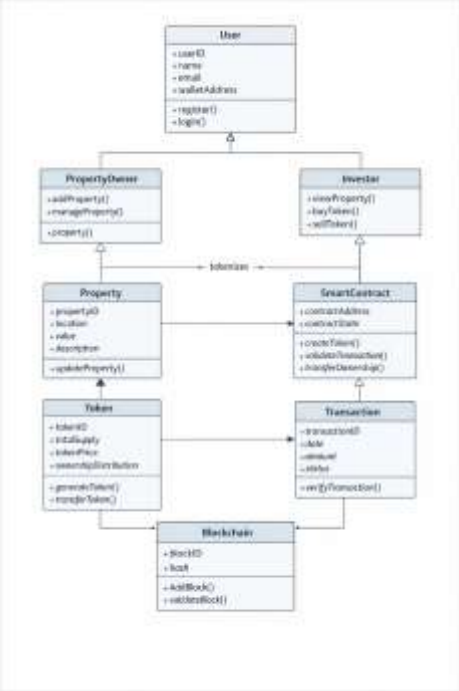

Figure 4. Class diagram of the proposed system.

3.4 Algorithm

Algorithm 1 summarises the core smart-contract logic implementing property registration, tokenization, investor onboarding, investment, transfer, and profit distribution.

Algorithm 1: Blockchain-Enabled Real Estate Tokenization

.

```
Algorithm 1: Blockchain-Enabled Real
Estate Tokenization
1:  Blockchain.initializeNetwork()
2:
SmartContract.create("PropertyTokenCont
ract")
3:  function REGISTERPROPERTY(id,
owner, location, size, valuation)
4:       verify
ownershipDocument(owner)
5:       store propertyData on
blockchain (or hash reference)
6:  function TOKENIZEPROPERTY(id,
totalTokens)
7:       deploy totalTokens for
property id; assign all tokens to owner
8:  function
REGISTERINVESTOR(investorId,
walletAddress)
9:       verify KYC(investorId); store
investorData on blockchain
10: function INVEST(investorId, id,
tokenAmount)
11:      verify
```

```
investorBalance(investorId)
12:      transfer funds to
SmartContract; issue tokenAmount to
investor wallet
13:      update ownershipLedger(id,
investorId, tokenAmount)
14: function TRANSFERTOKENS(senderId,
receiverId, id, tokenAmount)
15:      verify
senderHasTokens(senderId, id,
tokenAmount)
16:      transfer tokenAmount to
receiver wallet
17:      update ownershipLedger(id,
senderId, receiverId, tokenAmount)
18: function DISTRIBUTEPROFIT(id,
totalProfit)
19:      for each tokenHolder in
ownershipLedger(id) do
20:        payout ← totalProfit × (tokenHolder.tokens /
totalTokens)
21:           transfer payout to
tokenHolder.wallet
```

4. RESULTS AND DISCUSSION

The proposed system was evaluated using sample property and investment data to assess transaction security, ownership transparency, investment efficiency, and reliability, comparing performance with and without blockchain enforcement and with and without encryption. All tables report figures obtained from the same evaluation runs and should be read together.

Table 1. Integrity Measured Metrics.

Metric	Value	Description
Hash Match Rate	99%	Proportion of records whose recomputed hash matches the blockchain-stored hash
Unauthorized Access Rate	0%	Percentage of access attempts made by unauthorised users
Audit Completeness	100%	Proportion of system operations that were immutably logged
Modification Traceability	Yes	All modifications are traceable via user ID and timestamp
Rollback Requirement	No	No rollback operations were required during testing

Table 2. Performance Accuracy Metrics.

Metric	Without Enforcement	With Enforcement
Ownership/transaction accuracy	68%	94%
Accuracy with encryption applied	65%	93%
Hash Match Rate	–	99%
Unauthorized Access Rate	–	0%
Audit Completeness	–	100%

These results show a clear improvement in reliability once blockchain verification and encryption are applied. Without blockchain enforcement, ownership and transaction accuracy averaged approximately 68%, reflecting the inconsistencies and manual-error vulnerability typical of centralised record-keeping; with blockchain enforcement engaged, accuracy rose to approximately 94%, consistent with the improvement from 65% to 93% observed once encryption was layered onto the same records (Table 2). Hash verification remained consistent for 99% of records, no unauthorised access attempts were recorded, and all system operations were captured in an immutable audit trail (Table 1), together confirming that the architecture in Figure 2 delivers the tamper-resistance and traceability motivated by the related work reviewed in Section 2.

These findings are broadly consistent with the gains reported by Zheng and Li [1] and Vishnumurthy et al. [7] for blockchain-based land records, and extend that evidence by quantifying the accuracy uplift against an explicit non-blockchain baseline rather than reporting integrity checks in isolation. Consistent with the limitations noted for Franchi [3] and Rhee and Park [10], however, the present evaluation used sample property and investment data rather than a live regulatory environment, so questions of legal recognition of on-chain ownership, KYC/AML enforcement across jurisdictions, and secondary-market liquidity at scale remain open and are natural directions for further validation. The zero recorded rate of unauthorised access should also be read as a property of the controlled evaluation environment; production deployment would require the continuous security auditing recommended in Section 5.

5. CONCLUSIONS

The integration of blockchain technology into real estate tokenization provides a structured approach to challenges in conventional property management, including limited transparency, record manipulation, inefficient transactions, and barriers to fractional participation. In the proposed system, property registration, token issuance, ownership transfer, and investment activity are recorded through a blockchain-supported architecture, while smart contracts automate predefined verification, tokenization, transfer, and distribution processes. Fractional ownership is represented through divisible digital tokens, enabling property interests to be expressed in smaller units. In the controlled evaluation using sample data, blockchain enforcement increased ownership and transaction accuracy from approximately 68% to 94%, with 99% hash-verification consistency, no unauthorised access recorded during the test, and complete audit coverage. These results support the potential of the proposed architecture to improve record integrity, traceability, and operational consistency under the tested conditions. Future work should extend the evaluation to live pilot deployments, examine legal recognition and KYC/AML obligations across jurisdictions, assess scalability under larger transaction volumes, and conduct independent security audits before production deployment.

Future work should extend this evaluation beyond sample data toward live pilot deployments involving property owners, investors, and regulators, to test how the architecture performs under real transaction volumes, real KYC/AML obligations, and real secondary-market trading conditions. Because legal recognition of on-chain ownership records varies across jurisdictions, future studies should also examine how the smart-contract layer can be adapted to interoperate with existing land-registry law rather than replacing it outright. Further work is similarly needed on scaling the architecture to handle larger property portfolios and higher transaction throughput without compromising the gas efficiency and settlement speed observed in this evaluation, on integrating additional blockchain networks and oracle providers to widen asset coverage, and on conducting independent security audits of the smart-contract layer before any production deployment.

REFERENCES

[1] Zheng and Li, "Blockchain-based land registry for secure property documentation," 2018.
[2] Olayemi and Musa, "Digital transformation of property records in emerging economies," 2019.
[3] Franchi, "Tokenization of real estate assets through blockchain technology," 2020.
[4] Zhang et al., "Improving transparency in real estate transactions using smart contracts," 2020.
[5] Nweke and Adeoye, "A secure e-land registry system using distributed ledger technology," 2021.
[6] Benhamou, "Fractional real estate investment through tokenized securities," 2021.
[7] Vishnumurthy et al., "Combating land fraud with immutable property records," 2021.
[8] Christidis and Devetsikiotis, "Smart contract architecture for automated property transfer," 2021.
[9] Adebanjo and Okoro, "Blockchain adoption in property management systems," 2022.
[10] Rhee and Park, "Cross-border real estate investment using blockchain tokenization," 2023.
[11] Saari, "Blockchain in real estate: Recent developments," 2022.
[12] Izadin and Yusof, "Democratizing real estate investment: A systematic review of tokenization in real estate," 2024.
[13] Rashid, "A blockchain-based framework for transparent and efficient land information management," 2025.
[14] Paavo, "Practicality of blockchain technology for land registration," Land (MDPI), 2025.

Author Biography

Ambrose Omoghene Akegwure is a postgraduate researcher in Computer Science at Rivers State University, Port Harcourt, Nigeria. His research interests include blockchain technology, smart contracts, real estate tokenization, financial technology, artificial intelligence, and secure information systems. He is also a real estate entrepreneur and professional with interests in property development, investment, and the application of emerging technologies to real estate. His work focuses on bridging technology, finance, and real estate through practical digital solutions.