Secure Real Estate Transaction using Smart Contract on Blockchain Technology

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***Abstract*— The real estate industry faces numerous challenges, including non-transparency, inefficiencies, fraud, corruption, high costs, and trust issues. The contract has been initially tested using Mocha and chai to ensure that it functions properly. The contracts were deployed first on a local blockchain using the Hardhat framework, and then transferred to Sepolia testnet and were successfully confirmed on Sepolia testnet. Our approach allows only verified members to add properties, where only the seller can approve and list the property. This improves security by preventing inappropriate property listings and offers decentralized approach to real estate transactions, utilizing blockchain, smart contracts, escrow mechanisms, and as a secure React-based front end. The implementation on the Sepolia testnet confirms its dependability and practical utility. This method lays the groundwork for more efficient, fraud-resistant, and transparent in real estate ecosystem.**

Keywords—Blockchain technology, Smart Contracts, Transparency, Security, Decentralized

I. INTRODUCTION

The real estate [2] industry faces numerous challenges, including high transaction costs, lack of transparency, inefficiencies, and vulnerability to fraud and corruption. These problems stem from the reliance on intermediaries, disorganized record-keeping systems, and cumbersome, paper-based processes. This initiative aims to revolutionize [1] the sector by utilizing blockchain technology and smart contracts [3] to establish a more secure, efficient, and transparent system for real estate transactions. The key aspect of this solution involves digitizing real estate properties as non-fungible tokens (NFTs), which serve as proof of ownership and can be traded on a blockchain. To facilitate seamless transactions, smart contracts—developed using Solidity on the Ethereum blockchain—automate agreements between buyers and sellers. These self-executing contracts ensure that all transaction terms remain unaltered and are carried out securely, eliminating the need for intermediaries.

This approach guarantees the authenticity and integrity of all agreements, serving as legally binding proof of identity and consent for both parties. By minimizing the risk of fraud, it fosters greater trust in real estate transactions [7]. To ensure a smooth user experience, the initiative features a front-end interface built with React. Designed for ease of use and responsiveness, the interface allows users to efficiently navigate the platform and manage their transactions with minimal effort.

By integrating blockchain technology [24], smart contracts [6], and a user-friendly design, this initiative effectively addresses key challenges in the real estate sector. It provides a secure, cost-efficient, and transparent alternative to conventional methods, paving the way for a more reliable and streamlined real estate market

II. BLOCKCHAIN-POWERED REAL ESTATE: SECURE AND DECENTRALIZED TRANSACTIONS

Blockchain technology [13] [14], with its core principles of decentralization, transparency, and immutability, provides an innovative solution to overcome these challenges. By implementing smart contracts—self-executing agreements embedded within the blockchain—real estate transactions [11] [15] can be streamlined and securely completed without requiring third-party involvement. Additionally, representing property [22] ownership through Non-Fungible Tokens (NFTs) enables a secure and verifiable digital asset registry. The integration of digital signatures within these smart contracts further reinforces the authenticity and integrity of agreements, ensuring a trustworthy and fraud-resistant transaction process.

This initiative focuses on utilizing the Ethereum blockchain and Solidity to develop smart contracts [3] [6] for decentralized real estate transactions [16] [17] [20]. By taking advantage of Ethereum's reliable infrastructure and incorporating a user-friendly front-end interface, the system ensures a smooth and accessible experience while maintaining strong security and transparency. Transactions carried out through this platform are tamper-proof, resistant to fraud, and cost-effective, effectively addressing major challenges associated with traditional real estate processes.

III. PROBLEM DEFINATION

The conventional real estate [2] transaction process is plagued by inefficiencies, high costs, and a lack of transparency. These challenges primarily arise from reliance on intermediaries and disorganized record-keeping systems, leading to delays, inflated transaction expenses, and an increased risk of fraud. As a result, trust between buyers and sellers is often compromised. This research identifies the

need to overcome these inefficiencies and risks by introducing a more secure and transparent alternative. The proposed solution leverages blockchain technology to establish a decentralized platform [8] [10] for real estate transactions. By transforming property assets into Non-Fungible Tokens (NFTs) and implementing smart contracts[3] for automated agreements, the system aims to streamline transactions, ensure secure and immutable[5][25] ownership records, and remove the dependency on intermediaries. This approach enhances trust, reduces costs, and improves the overall efficiency of property dealings, offering a modern and reliable alternative to traditional real estate processes.

IV.SIMILAR SYSTEM INFORMATION

A. Blockchain-Based Real Estate Transactions [9] in Dubai

Dubai has emerged as a leader in blockchain adoption, with the Dubai Land Department (DLD) integrating blockchain [23] into its real estate operations. This system digitizes property transactions, including ownership transfers, contract management, and payment processing, ensuring secure, transparent, and immutable[5] records.

Key features include Ethereum-based smart contracts[3] to automate agreements, real-time updates for accurate property records, and tamper-proof storage for trust and security. The platform eliminates paperwork by digitizing processes and facilitates secure cross-border transactions, reducing costs and delays.

Dubai's model demonstrates blockchain's potential to revolutionize[1] real estate by enhancing efficiency and transparency. Our initiative draws inspiration from this, adding cross-border compatibility, decentralized identity verification, and advanced smart contract [12] [19] features for a more streamlined system.

B. Development and Implementation of Blockchain-Based Transactions in the Real Estate Industry

This initiative leverages blockchain technology to revolutionize [1] real estate by addressing inefficiencies, high costs, and delays. A dedicated platform ensures secure, transparent, and decentralized management of property transactions and ownership records. Smart contracts automate key tasks, such as property transfers and payment releases, eliminating intermediaries, reducing costs, and saving time. Real-time updates provide instant access to verified data for all stakeholders, enhancing transparency and accuracy. The platform explores tokenization [3], enabling fractional ownership and improving market liquidity. This allows smaller investments, making real estate more accessible to a wider range of investors. Immutable [5] records eliminate fraud risks, ensuring secure transactions. Overall, the initiative showcases blockchain's potential to create a more efficient, secure, and inclusive real estate ecosystem.

C. Blockchain in Real Estate Sector: Benefits and Challenges

Blockchain technology [4] offers significant benefits in the real estate sector by enhancing transparency and security through immutable [5] and tamper-proof transaction records. It reduces costs and delays by eliminating intermediaries like brokers and notaries with the use of smart contracts, which automate processes. Real-time updates of property records ensure stakeholders have instant access to accurate data. Tokenization [3] further improves accessibility by enabling fractional ownership, increasing liquidity in the real estate market. Additionally, fraud risks are minimized as blockchain verifies ownership and transaction details. However, challenges such as regulatory uncertainties and lack of standardization hinder widespread adoption. The high initial implementation costs and technical complexities create barriers, particularly for smaller firms. Furthermore, limited awareness and understanding of blockchain among stakeholders contribute to resistance in adopting this transformative technology in the real estate industry.

D. Development and Implementation of Blockchain-Based Transactions in the Real Estate Industry

This initiative focuses on addressing inefficiencies, high costs, and delays in the real estate industry through blockchain technology. By leveraging a decentralized platform, it ensures secure and transparent management of property transactions and ownership records. Smart contracts automate key processes, such as property transfers and payment releases, reducing reliance on intermediaries and cutting costs. Real-time updates provide instant access to verified property data, enhancing accuracy and transparency for all stakeholders. The platform also incorporates tokenization [3], allowing fractional ownership and improving market liquidity, making real estate investments accessible to a broader audience. Overall, the initiative demonstrates blockchain's potential to transform real estate into a more secure, efficient, and inclusive system.

V. ESCROW BASED NFT TRANSACTION

The proposed solution utilizes blockchain technology to enhance transparency, security, and efficiency in real estate transactions. At its core, an Escrow Smart Contract manages interactions between buyers, sellers, inspectors, and lenders. The process begins when the buyer initiates a purchase. The property undergoes an inspection, and loan processing is conducted through the escrow contract. Once all conditions are satisfied, the seller finalizes the transaction, and ownership is transferred as a Non-Fungible Token (NFT), providing a secure and immutable proof of ownership. This system removes the need for intermediaries, minimizes delays, and builds trust by automating processes through smart contracts. Additionally, by preventing fraud and inefficiencies, it modernizes real estate transactions[9] while also enabling opportunities for tokenized fractional ownership, making property investments more accessible.

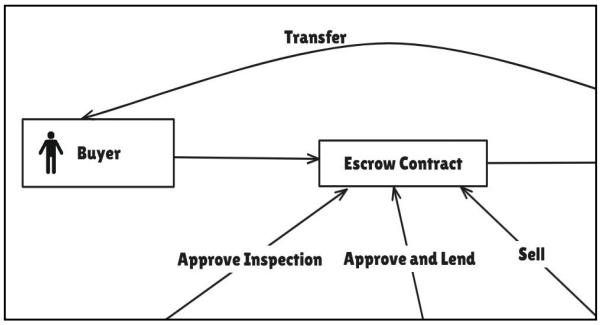

Fig.1.Escrow based NFT transaction diagram

VI.METHODOLOGY

The integration of blockchain technology into real estate transactions aims to address challenges such as high costs, inefficiencies, fraud, and lack of transparency. The first step involves identifying these issues and analyzing how blockchain can streamline the process. Once the challenges are clear, the next step is requirement analysis, where the technical and functional specifications for blockchain and smart contract implementation are defined.

Ethereum is chosen as the preferred blockchain due to its robust support for smart contracts and widespread adoption. Smart contracts, developed using Solidity, automate transactions, eliminate intermediaries, and ensure secure agreements between parties. Additionally, real estate properties are tokenized as non-fungible tokens (NFTs) on the blockchain, allowing for transparent and verifiable ownership transfers. To facilitate user interaction, a front-end interface is developed using HTML and CSS, ensuring a seamless experience for buyers and sellers illustrated in figure 1.

Rigorous testing is conducted to validate the functionality of smart contracts, blockchain integration, and the user interface. Once verified, the system is deployed on the Ethereum network, enabling secure and transparent real estate transactions. Finally, continuous monitoring and optimization are performed to track performance, gather user feedback, and implement improvements to enhance scalability and efficiency. This approach revolutionizes real estate transactions, making them faster, safer, and more efficient.

VII. ARCHITECTURE DIAGRAM

The user seamlessly interacts with a highly dynamic and intuitive web application, which is intricately integrated with MetaMask, allowing for secure and decentralized authentication. This cutting-edge platform leverages the power of blockchain technology to redefine the way Real Estate transactions [9] are conducted. By utilizing Ethers.js, the application bridges the gap between the blockchain network [21] and a structured JSON database, ensuring smooth and efficient data retrieval and storage. At the heart of this revolutionary system lies the Escrow smart contract, a robust and tamper-proof mechanism designed to facilitate trustless transactions. It guarantees that funds are securely held until all contractual conditions are met, eliminating the need for intermediaries.

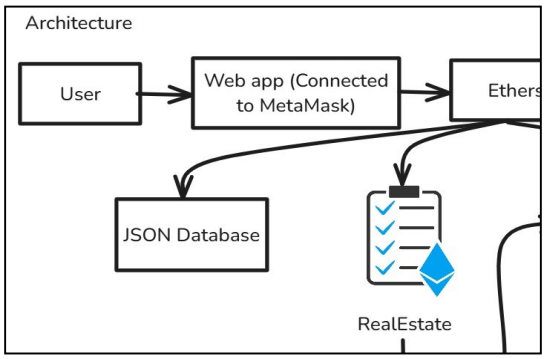

Fig.2.Architecture Diagram

The Mint function, a pivotal component of this architecture, allows for the seamless generation and registration of property ownership on the blockchain. This ensures that each real estate asset is uniquely tokenized, granting users indisputable proof of ownership. By fusing advanced Web3 technologies with decentralized finance principles, the platform is transforming the real estate industry, making property transactions more efficient, secure, and globally accessible mentioned in figure 2.

VIII.FUELING TRANSPARENCY AND SECURITY WITH CUTTING-EDGE TECHNOLOGY

A. Robust Architecture for Enhanced Interaction

The system is designed with a modern architecture that prioritizes usability and security. React.js powers a user-friendly interface, while Web3.js ensures smooth integration with the blockchain. MetaMask serves as a secure wallet for user authentication and transaction management. Solidity and Hardhat form the backbone for developing smart contracts, enabling a scalable and transparent solution for real estate transactions.

B. Smart Contracts: Automating Processes with Security

Smart contracts are the cornerstone of the system, written in Solidity and deployed on the blockchain to automate trust. These self-executing contracts handle critical operations such as property transactions, escrow management, and ownership transfer. By eliminating the need for intermediaries, the system minimizes risks, ensures transparency, and accelerates transaction processing.

C. Transforming Ownership with NFTs

Non-Fungible Tokens (NFTs) introduce a groundbreaking way to represent property ownership. The NFT Contract facilitates the minting and secure transfer of digital tokens, ensuring immutable proof of ownership. This innovation unlocks new possibilities such as fractional ownership, enabling wider access to real estate investments and reducing barriers for small-scale investors.

D. Ensuring Transparency and Security

The system utilizes blockchain's decentralized ledger to maintain a secure and tamper-proof record of all transactions, ensuring complete visibility for all stakeholders. Advanced cryptographic methods, including digital signatures, are employed to verify user identities, ensuring that agreements are both secure and legally binding. By promoting trust, increasing transparency, and minimize.

ng the risk of data manipulation, this solution effectively addresses major challenges in the real estate industry. It establishes a new standard for security, reliability, and efficiency in property transactions.

IX.DEMOCRATIZING OWNERSHIP THROUGH THE POWER OF NFTs

A Unlocking the Potential of Tokenized Real Estate

The adoption of blockchain technology in real estate is revolutionizing [1] the industry by transforming physical properties into unique NFTs. This tokenization [3] process paves the way for fractional ownership, enabling individuals with limited capital to invest in real estate—an asset class traditionally accessible only to high-net-worth individuals.

By digitizing real estate assets, this approach fosters a more inclusive and diversified investment landscape, breaking down financial barriers and making property ownership more accessible to a broader audience.

B. Liquidity and Shared Wealth

NFTs revolutionize [1] the process of ownership transfers, replacing slow and cumbersome traditional methods with secure, efficient, and instantaneous transactions. This boosts liquidity, enabling users to buy, sell, and trade fractionalized real estate assets effortlessly. Through this mechanism, individuals can diversify their portfolios, investing in global real estate opportunities represented by secure, blockchain-based NFTs. In this new paradigm, real estate becomes more accessible and liquid, offering a broader range of investment possibilities to individuals across the globe.

C.Collective Governance and Community Empowerment

The integration of NFTs in real estate not only enables fractional ownership but also introduces a decentralized governance model. In this system, verified NFT holders actively participate in property-related decisions, including management and improvements. By allowing stakeholders to have a direct say in these matters, this approach fosters a strong sense of community and shared responsibility.

This democratic decision-making process enhances transparency and ensures that every co-owner plays an essential role in shaping the future of their jointly owned property, thereby creating a more inclusive and participatory real estate ecosystem.

D. Regulatory Considerations and Risk Management

With blockchain and NFTs transforming real estate transactions, establishing a well-defined regulatory framework is essential to manage the complexities of digital asset ownership. While this study highlights the potential of these technologies, it also underscores the importance of clear legal guidelines and compliance measures. Collaboration between regulatory bodies, legal experts, and policymakers will be crucial in formulating structured policies for blockchain-based real estate transactions. Additionally, implementing a comprehensive risk management strategy is vital to address challenges such as technological vulnerabilities, market fluctuations, and regulatory uncertainties. Educating investors and stakeholders on the implications of blockchain in real estate will further promote responsible adoption and informed decision-making, ensuring a sustainable and well-regulated transition into this evolving digital landscape.

X.CONCLUSION

In conclusion, immutable smart contracts are changing the way transactions work by making them more secure, transparent, and efficient. They remove the need for middlemen, making processes faster and more reliable, especially in fields like real estate, finance, and supply chain management. However, challenges such as high costs, legal concerns, and the inability to fix errors still need to be solved.

Future improvements, like better auditing systems, improved security measures, and clearer regulations, can help make smart contracts more practical for everyday use. As technology advances, overcoming these challenges will determine how smart contracts shape the future of digital transactions.

REFERENCES

[1] Blockchain for Transaction Transparency and Fraud Prevention: My Real Estate: Revolutionizing Real Estate Transactions and Ownership Management with Blockchain and NFTs- 6th International Conference on Computing and Informatics

[2] Real Estate Management System using Blockchain Proceedings of the 3rd International Conference on Applied Artificial Intelligence and Computing (ICAAIC- 2024): IEEE Xplore Part Number: CFP24BC3-ART; ISBN: 979-8-3503-7519-0

[3] Smart Contracts and Tokenization: Revolutionizing Real Estate Transactions with Blockchain Technology Proceedings of the 7th International Conference on Inventive Computation Technologies (ICICT 2024)Xplore Part Number: CFP24F70- ART: ISBN: 979-8-3503-5929-9

[4] BlockPerf: A Hybrid Blockchain Emulator/Simulator Framework: Received July 12, 2021, accepted July 26, 2021, date of publication July 28, 2021, date of current version August 9, 2021.

[5] Immutable Smart Contracts on Blockchain Technology: Its Benefits and Barriers: 2021 9th International Conference on Reliability, Infocom Technologies and Optimization (Trends and Future Directions) (ICRITO) Amity University, Noida, India. Sep 3-4, 2021

[6] Security Vulnerabilities and Counter measures of Smart Contracts A Survey 2022 IEEE International Conference on Blockchain

[7] Land Registration System using Blockchain - 2023 5th International Conference on Advances in Computing, Communication Control and Networking (ICAC3N)

[8] Decentralized one stop solution for real estate - 2023 International Conference on Advanced Computing Technologies and Applications

[9] Streamlining Real Estate Transactions Using Blockchain and Smart Contracts International Journal of Research Publication and Reviews, Vol 5, no 5, pp 9598-9601 May 2024

[10] Blockchain Technology and Smart Contracts in Decentralized Governance Systems: International Journal of Research Publication and Reviews, Vol 5, no 5, pp 9598- 9601 Aug 2024M. Young, The Technical Writer's Handbook. Mill Valley, CA: University Science, 1989.

[11] 1. S. Humdullah, S. H. Othman, M. N. Razali, and H. K. Mammi, "Secured data storage framework for land registration using blockchain technology," in 2021 3rd International Cyber Resilience Conference (CRC), pp. 1–6, IEEE, 2021.

[12] M. Stefanovic, Pr ` zulj, S. Risti ` c, and D. Nikoli ` c, -Smart contract application for ` managing land administration system transactions,‖ IEEE Access, vol. 9,pp. 41 558-41 565, 2021.

[13] F. Sharma, Y. Galphat, E. Kithani, J. Tanwani, B. Mangnani and N. Achhra Digital land registry system using blockchain, SSRN 3866088,2021.

[14] UAE government launches blockchain strategy 2021 – coin telegraph.

[15] A. F. Mendi, K. K. Sakakh, and A. C, abuk, -A blockchain based land registration system proposal for turkey,‖ in 2020 4th International Symposium on Multidisciplinary Studies and Innovative Technologies in Engineering (ICACITE), 2021, pp. 769-772.

[16] N. Jiang, W. Wang, J. Wu, and J. Wang, -Traceable method for personal information registration based on blockchain, ‖ IEEE Access, vol. 8, pp. 52 700-52 712, 2020.

[17] M. S. Islam, F. S. Iqbal, and M. Islam, -A novel framework for implementation of land registration and ownership management via blockchain in Bangladesh, IEEE Region 10 Symposium (TENSYMP), 2020, PP. 859-862.

[18] M. Abdullah, W.A.L.T.E.R De Vries, and Z.Ali, "Assessing the performance of land administration system in Punjab after land records computerization," in Conference: 2020 World Bank Conference on Land and Poverty At: The World BankWashington DC, pp. 1-24, Washington, 2020.

[19] A. Sahai and R. Pandey, - Smart contract definition for land registry in blockchain, || in 2020 IEEE 9th International Conference on Communication Systems and Network Technologies (CSNT), 2020, pp. 230-235.

[20] S. A. Gollapalli, G. Krishnamoorthy, N. S. Jagtap, and R. Shaikh, - Land registration system using block-chain, || in 2020 International Conference on Smart Innovations in Design, Environment, Management, Planning and Computing (ICSIDEMPC), 2020, pp. 242-247.

[21] International Conference on Communication Systems and Network Technologies (CSNT). IEEE, 2020.

[22] Graglia JM, Mellon C.Blockchain and Property in 2018: At the End of the Beginning. Innovations:Technology, Governance, Globalization. 2018 Jul:12(1-2):90-116.

[23] Benbunan-Fich R, Castellanos A. Digitalization of Land Records: From Paper to Blockchain.

[24] Barbieri M, Gassen D. Blockchain-can this new technology really revolutionize the land registry system. In Land and Poverty Conference 2017: Responsible Land Governance 2017: Responsible Land Governance 2017.

[25] M. Raja, P. Devisivasankari, M. Vilasini, D. Loganathan, 2023, The Enhanced Optimization of Information Mining Systems for Big Data Protection using Blockchain,, European Chemical Bulletin, Volume - 12, Special Issue-3 pp 173 – 183