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Real Estate Trading Using Blockchain

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***Abstract*— The conventional real estate industry is plagued by inefficiencies, lack of transparency, and centralized control. This paper investigates the transformative potential of Web 3.0 technologies, particularly blockchain and smart contracts, in revolutionizing the sector through the creation of a decentralized real estate platform. We explore the development of a user-friendly application, facilitating direct property transactions using cryptocurrency and smart contracts. We delve into the technical intricacies of the project, delineating the development environment, smart contract functionalities, front-end design, and deployment procedures. Furthermore, we tackle the challenges inherent in blockchain-based applications, including security and scalability. This research aims to contribute to the evolving discourse on Web 3.0's transformative potential, particularly its capacity to disrupt established industries like real estate. Through an analysis of the feasibility and features of a decentralized real estate platform, we endeavor to offer valuable insights for researchers and developers navigating the future landscape of blockchain technology in reshaping traditional systems.**

Keywords*— *Blockchain Technology, Real Estate, Smart Contracts, Non-Fungible Tokens (NFTs), Ethereum, Decentralization, Interplanetary File System (IPFS), Escrow Contract

I. INTRODUCTION

The real estate industry is confronting a multitude of challenges, ranging from cumbersome processes to opacity in transactions and centralized control. These hurdles underscore the pressing need for innovative solutions to address systemic inefficiencies. To tackle these issues head-on, we are directing our efforts towards leveraging the transformative capabilities of web 3.0 [1] technologies, particularly blockchain and smart contracts. These technologies hold great promise in offering solutions to the longstanding problems plaguing the industry..

Our initiative aims to develop a decentralized real estate platform akin to user-friendly platforms like Zillow. Traditional property transactions are encumbered by numerous intermediaries, extensive paperwork, and bureaucratic hurdles. Our primary objective is to streamline this process, facilitating direct property transactions that are not only simpler but also more secure, transparent, and efficient. Drawing inspiration from resources such as Dapp University, we are laying the groundwork for creating decentralized applications (dApps) utilizing Ethereum and Solidity.

Blockchain and smart contracts wield significant potential to revolutionize the real estate sector. By decentralizing control, eliminating intermediaries, and ensuring immutable records of property and transactions, blockchain technology offers a paradigm shift in the way real estate transactions are conducted. Smart contracts further enhance this potential by automating various transactional processes, reducing manual intervention, and mitigating the risk of fraudulent activities. Our research delves into the intricate technicalities of constructing a distributed real estate platform, addressing challenges specific to blockchain applications while advancing the discourse on the transformative power of Web 3.0. Through our endeavours, we aim to furnish valuable insights to researchers and developers exploring the future landscape of blockchain technology, ultimately paving the way for a more open, efficient, and decentralized real estate ecosystem.

II. MOTIVATION AND CONTRIBUTION

The traditional real estate sector is burdened by inefficiencies and centralized control, necessitating a shift in paradigm. Our project endeavors to leverage the transformative potential of blockchain and smart contracts to confront these challenges head-on. Through the development of a decentralized real estate platform, our aim is to streamline real estate transactions, enhance transparency, and mitigate security risks. This research serves as a valuable exploration into the feasibility and efficacy of blockchain technology in reshaping entrenched systems like real estate. Ultimately, our objective is to pave the way for a more open, efficient, and decentralized real estate ecosystem..

Real estate transactions are marred by inefficiencies, exorbitant costs, and opacity, fostering complexity and susceptibility to fraud. Urgent innovation is required in the field to bolster security, accessibility, and efficiency. Real Estate Tokenization seeks to digitize real estate assets as

blockchain-based tokens, enabling fractional ownership and enhanced liquidity. Secure Transactions focus on leveraging cryptographic techniques to safeguard the confidentiality, integrity, and authenticity of real estate assets on the blockchain. Decentralized ownership registries aim to maintain immutable ownership records on a decentralized ledger, reducing reliance on centralized authorities. Automated Escrow seeks to streamline the escrow process using smart contracts, facilitating secure and transparent handling of funds during real estate transactions..

The real estate industry is ripe for disruption due to its entrenched inefficiencies and opaque practices. Our project aims to revolutionize the sector by harnessing the power of blockchain technology and smart contracts. Through the creation of a decentralized real estate platform, we seek to streamline transactions, enhance transparency, and mitigate security risks. This research serves as a critical examination of how blockchain can transform traditional systems like real estate. Ultimately, our goal is to foster a more accessible, efficient, and decentralized real estate ecosystem, paving the way for innovation and progress in the industry.

III. Related Work

Blockchain technology has received considerable attention in recent years due to its potential to revolutionize various industries, including real estate. Several researches and practical implementations have explored the application of blockchain in various areas of the real estate industry. A Real Estate Tokenization One prominent area of research is real estate tokenization, which involves representing real estate ownership as digital tokens on the blockchain. A study by Mougayar (2018)[1] describes how tokenization can facilitate fractional ownership, allowing greater liquidity and accessibility for investors. Projects such as Propy and RealT have demonstrated the feasibility of real estate tokenization, allowing investors to purchase portions of real estate with cryptocurrencies. Smart contracts for real estate transactions Smart contracts have emerged as an effective tool to automate various aspects of real estate transactions. Bohme et al. (2019)[2] explores the potential of smart contracts to streamline asset transfer processes, automate foreclosure actions and enforce contractual agreements without the use of intermediaries.

Platforms such as Ubiquity and Shelter Zoom have developed smart contract solutions for real estate that promise greater efficiency and transparency. Decentralized Property Registries Traditional property registries are often centralized and prone to errors or falsification. Blockchain-based solutions offer the possibility of creating decentralized real estate, where ownership information is stored immutably in a decentralized ledger. A study by De Filippi and Wright (2018)[3] discusses the concept of decentralized land registries and their potential to increase transparency and reduce fraud. Projects such as Bitland[4] and Chroma Way have initiated efforts to digitize real estate and create decentralized real estate registries in various regions. Challenges and Limitations Despite the promising applications of blockchain in the real estate sector, there are still some challenges and limitations. Scalability, interoperability, regulatory compliance and privacy concerns are major barriers to widespread adoption. The research of Swan (2015)[5] highlights the need for further research and collaboration to address these challenges and unleash the full potential of blockchain technology in the real estate industry.

IV. Proposed System

The architecture of the blockchain-based real estate website comprises several interconnected components designed to facilitate property listing, sale, and ownership transfer securely and transparently. The system primarily consists of three main layers: the frontend user interface developed with React.js, the backend smart contracts written in Solidity and deployed on the Ethereum blockchain, and the interaction layer facilitated by the Ethers.js library.

A. Frontend User Interface (React.js)

The front-end layer acts as a user-specific interface, providing users with a seamless experience with the platform. A popular JavaScript library for creating user interfaces developed using the React.js[7] interface. It allows usersto browse listed properties, initiate purchase transactions and monitor the progress of ongoing transactions.

Key Features of the frontend Interface Include:

1) Property Listing : Users can view detailedinformation about available properties, including images,descriptions and prices.

2) Starting a transaction: Buyers can start apurchase transaction by selecting the item of interest and submitting thenecessary transaction information.

3) Transaction Tracking: Users can track the status ofongoing transactions, includingseller, inspector and lender approval processes.

B. Smart Contracts (Solidity)

The core logic of the system is implemented by smart contracts written in the Solidity[8] programming language specifically designed for the development of Ethereum smart contracts.

NFT Contract: This contract is responsible for creating and managing Fts[10] that represent individual properties listed on the platform. Each property is uniquely identified with its corresponding NFT, which stores metadata including asset information, images and documents. to Interplanetary File System (IPFS)[11]. The contract follows theERC721 standard, ensuring compatibility with and wallets.

Escrow Agreement: An Escrow Agreement[12] acts as a intermediary to facilitate secure transactions between buyers and sellers. When a property is listed for sale, ownership of the corresponding NFT initially belongs to the seller. At the start of a purchase transaction, ownership of the NFT is transferred to an escrow agreement, which holds it until the transaction is completed. An escrow agreement coordinates the transfer of funds from the buyer and lender to the seller, provided all parties have agreed and verification procedures have been completed.

Interaction Layer (Ethers.js):

The Interaction Layer acts as a bridge betweenfront-end and back-end smart contracts, enabling seamless communication and interaction with theEthereum blockchain. Ethers.js, a JavaScript library forinteracting with Ethereum nodes and smart contracts,is used to facilitate transaction signing, contractimplementation, and transaction tracking.

Key functionalities of the interaction layer include:

Transaction signing : Ethers.js enables users to securely sign and broadcast transactions, such as purchasing a property or approving a transaction proposal.

1) *Contract communication:* The library provides APIs to communicate with implemented smart contracts,

allowing users to call contract methods, retrieve data, and listen to contract events.

2) *Blockchain Interaction:* Ethers.js facilitates integration with the Ethereum blockchain, enabling real-time updates and notifications on transaction status and contract events.

The system architecture leverages a combination of frontend, backend, and interaction components to create a decentralized real estate platform powered by blockchain technology. By utilizing NFTs and smart contracts, the platform enables transparent, secure, and efficient transactions while providing a user-friendly interface for seamless interaction. Notably, tools like Eraser.io were instrumental in visualizing and designing this architecture.

Architecture Diagram:

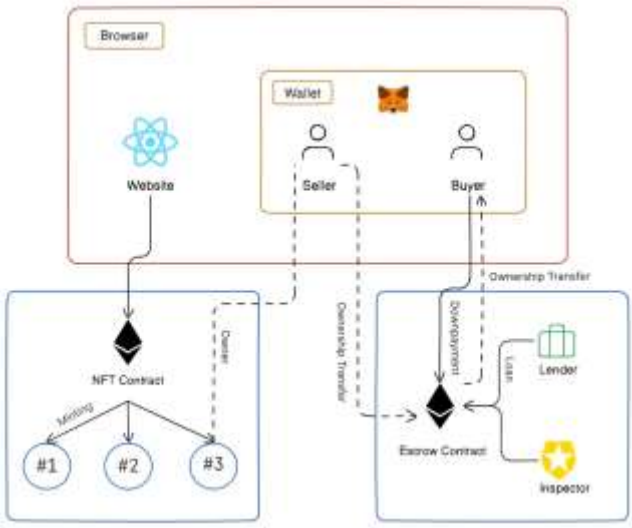

Fig. 1 Architecture

V. Algorithm Design

1. *Setting up the project:*

- Install Node.js and its package manager npm.
- Install the required dependencies using npm install

2. *Creating the smart contract:*

- Use the Solidity programming language to write the smart contract for the real estate NFT.
- The smart contract will include properties like the property address, purchase price, number of bedrooms and bathrooms, and a link to the image hosted on IPFS.
- Use the Open Zeppelin library to simplify the NFT creation process.
-

3. *Building the front-end website:*

- Use React.js to build the user interface of the website.
- The website will allow users to browse properties, view details, and initiate the purchase process.
- Connect the website to the smart contract using the ethers.js library.

4. *Implementing the purchase process:*

- *When a user clicks the "buy" button, the website will trigger a transaction on the blockchain to purchase the NFT.*
- *The transaction will involve multiple steps, including:*
- *Depositing earnest money into an escrow contract.*
- *Getting approval from other parties involved in the transaction (e.g., lender, inspector).*
- *Finalizing the sale and transferring the ownership of the NFT to the buyer.*

VI. Implementation And Results

Implementing a blockchain-based real estate website involves several technical components and processes, including creation of NFTs, development of smart contracts, integration of back-end functions, and implementation of user interfaces. This section provides a detailed overview of the main implementation aspects of the project..

Creating NFTs with Solidity and IPFS

The process of creating NFTs for representing individual properties on the platform begins with the development of a Solidity smart contract following the ERC721 standard. This contract defines the structure and functionality of the NFTs, including methods for minting new tokens, transferring ownership, and accessing token metadata.

To store metadata associated with each NFT, such as property details, images, and documents, the platform leverages the Interplanetary File System (IPFS). When a new property is listed on the platform, its metadata is uploaded to IPFS, and the resulting IPFS hash is stored within the NFT contract. This decentralized approach ensures the immutability and availability of property information while minimizing storage costs on the blockchain.

Development of Smart Contracts using Solidity and OpenZeppelin

The core logic of the platform is implemented with smart contracts written in the Solidity programming language specifically designed for Ethereum smart contracts. To accelerate development and ensure security best practices, the project uses the OpenZeppel[13] library, which provides-verified, reusable smart contract components..

The main smart contracts developed for the platform include :

NFT Contract:

This contract extends the ERC721 standard and implements additional functionalities such as metadata storage and IPFS integration. OpenZeppelin's ERC721 implementation serves as a foundation, with custom modifications to support IPFS metadata retrieval and ownership transfer mechanisms.

Escrow Contract:

This contract extends the ERC721 standard and implements additional functionalities such as metadata storage and IPFS integration. OpenZeppelin's ERC721 implementation serves as a foundation, with custom modifications to support IPFS metadata retrieval and ownership transfer mechanisms.

Backend Integration with Ethers.js

The backend functionalities of the platform are integrated with the Ethereum blockchain using Ethers.js, a JavaScript library for interacting with Ethereum nodes and smart

Key backend functionalities implemented with Ethers.js include:

Transaction Management:

Ethers.js facilitates transaction signing and broadcasting, enabling users to initiate property purchases, approve transaction proposals, and interact with smart contracts securely.

Contract Interaction:

The library provides APIs to interact with the implemented smart contract, allowing backend services to call contract methods, retrieve permission metadata, and monitor contract events in real time.

Frontend User Interface with React.js

React.js User Interface The user interface of the platform is developed usingReact.js, a popular JavaScript library for building dynamic web applications. The user interface

contracts. Ethers.js provides a convenient API for sending transactions, deploying contracts, and querying blockchain data, enabling seamless integration with the frontend user interface.

provides an intuitive and responsive experience that allows users to browse listed features, fire. events, and monitor status of event.

Key frontend functionalities implemented with React.js include:

Property Listing:

Users can browse available properties, view detailed information, and filter listings based on various criteria such as location, price, and property type.

Transaction Initiation:

Buyers can initiate property purchase transactions by selecting a property, providing necessary transaction details, and submitting the transaction for approval.

Transaction Monitoring:

Users can track the progress of ongoing transactions, including approval status, payment settlements, and ownership transfers, with real-time updates and notification

Fig. 2 Landing Page

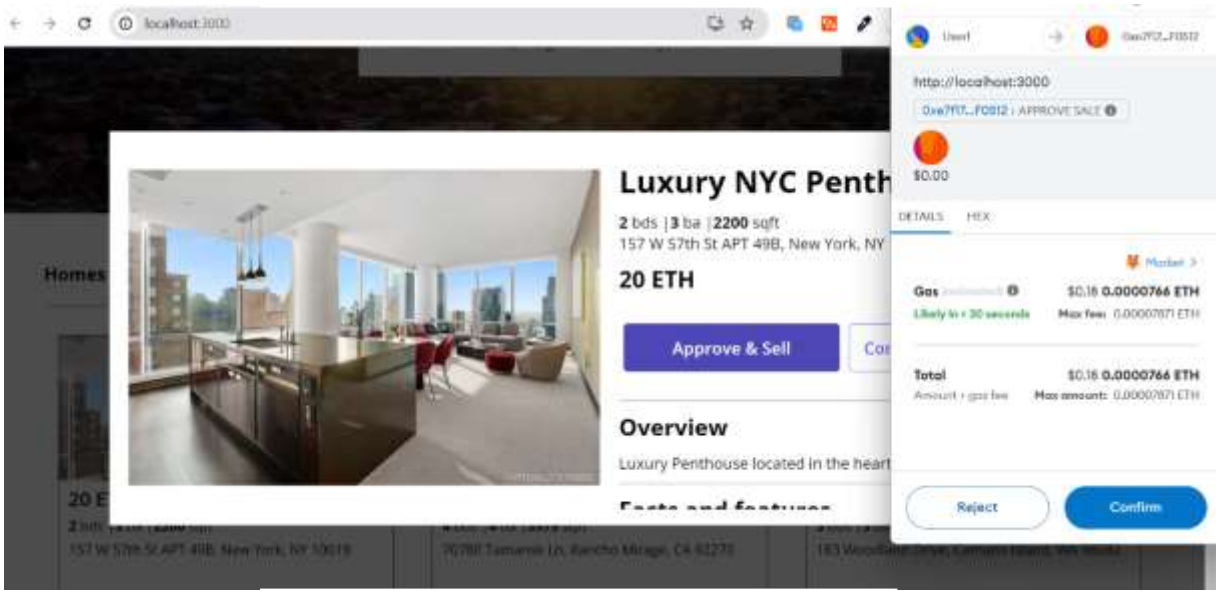

Fig. 3 Buy Request

TABLE NO. 1: GAS FEE

FUNCTION NAME	GAS FEE
Buy	0.00004544 ETH
Approve & Lend	0.00006967 ETH
Approve Inspection	0.00008069 ETH
Sell	0.00004507ETH

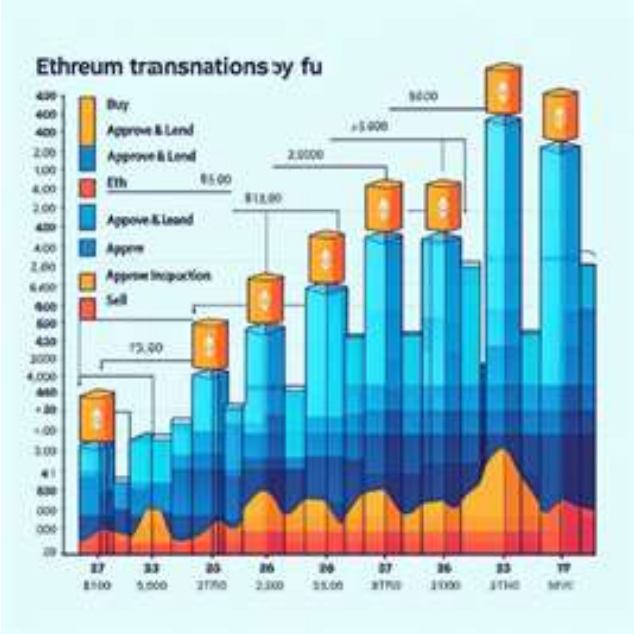

Fig. 4 Plot

As Figure 4 illustrates, this graph depicts the distribution of Ethereum transaction volume over a specified time period. The data for this visualization was derived from Table 1, which details gas fees for various functionalities on the Ethereum network. To enhance readability and visual appeal, the graph was created using Co-pilot, a tool that facilitates data visualization.

MetaMask[14] stands out as one of the foremost decentralized cryptocurrency wallets recognized for its accessibility and functionality across both desktop and mobile platforms. Users can seamlessly engage in purchasing, sending, and receiving cryptocurrencies through the MetaMask wallet. Furthermore, it facilitates the storage, transfer, and management of NFTs alongside cryptocurrencies. Transactions conducted via MetaMask are not subjected to fixed prices; instead, they incur processing fees termed "Gas Fees." MetaMask assists users in accurately determining and deducting the requisite gas fee for their transactions.

As Figure 2 shows, the landing page of our proposed blockchain trading website, PropTrade, utilizes a clear and concise user interface. The tagline "Search it. Explore it. Buy it." prominently positions the platform's core functionalities: facilitating property discovery, exploration, and acquisition.

Fig 3. Purchase Confirmation Screen describes the figure and clarifies that it depicts a specific stage within the PropTrade website. Briefly describe the key elements of the user interface, such as the property details, confirmation button, and gas fee information.

Any user activities such as selling, buying, lending, or inspecting on the platform necessitate payment of gas fees, which are then deducted from the MetaMask wallet balance. The application's functionality was evaluated through testing, with response times documented in Table 2.

TABLE NO. 2: RESPONSE TIME OF TRANSACTIONS

Functions	Block mining started at (unix epoch time)	Block mined (unix epoch time)	Latency
Lend	1707148057	1707148080	<30 second
Approve Inspection	1707148103	1707148125	<30 seconds

TABLE NO. 3: Approve Sale

Gas Limit (Units)	Gas Used (Units)	Base fee (GWEI)	Priority fee (GWEI)	Total
44012	44012	0.082892243	1.5	0.00006967ETH

TABLE NO. 4 Finalize Sale

Gas Limit (Units)	Gas Used (Units)	Base fee (GWEI)	Priority fee (GWEI)	Total
99549	94040	0.042596998	1.5	0.00004507ETH

Table 3 and 4 illustrates the components involved, including gas used, gas limit, base fee, priority fee, total gas cost[15].

Gas Limit (Units): The maximum gas allotted for a specific blockchain network transaction or operation. It is intended to stop resource-intensive processes from depleting resources or creating endless loops. When starting a transaction, the gas limit is usually stated and expressed in units of gas.

Gas Used (Units): The precise quantity of gas used on the blockchain network to carry out a transaction. It stands for the amount of computing labor needed to successfully finish the transaction. The amount of gas utilized is expressed in units of gas and can change based on the transaction's complexity and resource needs.

Base Fee (GWEI): The starting price for using the Ethereum blockchain network to conduct a transaction. It is expressed in ether (ETH) denominations called Gwei.It indicates the price for each unit of gas consumed in the exchange. The base charge, which is influenced by network factors like congestion and demand, adds to the total cost of the transaction.

Priority Fee (GWEI): Users can choose to add an optional extra charge to their transaction in order to provide it priority processing by Ethereum blockchain network miners. The priority fee, which is also stated in Gwei, gives miners an additional reason to include the transaction to the next block. A user's priority fee can be changed to speed up transaction confirmation when network traffic is heavy.

VII. Conclusion

This blockchain-based property trading platform, facilitated by cryptocurrency, revolutionizes real estate transactions. The integration of smart contracts ensures trust and transparency, reducing the need for intermediaries. Transactions are executed swiftly and cost-effectively, transcending geographical limitations. However, scalability and regulatory compliance remain critical concerns. As the technology evolves, opportunities for fractional ownership and property tokenization emerge, promising further innovation. This project lays a robust foundation for a more accessible and secure global real estate market, heralding a transformative era in property trade. With continued refinement and collaboration, the potential for positive industry-wide impact is significant

VIII. Acknowledgement

I am deeply grateful for the invaluable guidance, motivation, and support I received throughout this journey. This work wouldn't have been possible without the unwavering backing of Shah & Anchor Kutchhi Engineering College.

IX. References

[1] Fernando L. F. Almeida; Justino M. R. Lourenço, "Creation of value with Web 3.0 technologies", 6th Iberian Conference on Information Systems and Technologies (CISTI 2011),15-18 June

[2] Roberto Infante, Building Ethereum Dapps: Decentralized applications on the Ethereum blockchain , Manning, 2019.

[3] Sakshi Sanjay Pande; Shrushti Mandolikar; Sanjay Shitole, "Bitland-A Decentralized Commercial Real Estate Platform", 2022 IEEE Bombay Section Signature Conference (IBSSC) DOI:10.1109/IBSSC56953.2022.10037494

[4] K Madhura; R Mahalakshmi, "Usage of block chain in real estate business for transparency and improved security", 2022 International Conference on Advances in Computing, Communication and Applied Informatics (ACCAI),DOI: 10.1109/ACCAI53970.2022.9752593

[5] Ankit Mittal; Bhavyansh Sharma; Pinku Ranjan, "Real Estate Management System based on Blockchain", 2020 IEEE 7th Uttar Pradesh Section International Conference on Electrical, Electronics and Computer Engineering (UPCON), DOI: 10.1109/UPCON50219.2020.9376540

[6] VO Khoa Tan; Thu Nguyen, "The Real Estate Transaction Trace System Model Based on Ethereum Blockchain Platform", 2022 14th International Conference on Computer and Automation Engineering (ICCAE), DOI: 10.1109/ICCAE55086.2022.9762429

[7] C. M. Novac, O. C. Novac, R. M. Sferle, M. I. Gordan, G. BUJDOSó and C. M. Dindelegan, "Comparative study of some applications made in the Vue.js and React.js frameworks," 2021 16th International Conference on Engineering of Modern Electric Systems (EMES), Oradea, Romania, 2021, pp. 1-4, doi: 10.1109/EMES52337.2021.9484149.

[8] Ritesh Modi, Solidity Programming Essentials: A guide to building smart contracts and tokens using the widely used Solidity language , Packt Publishing, 2022.

[9] A. Konagari, H. P. Kusuma, S. Chetharasi, R. Kuchipudi, P. R. Babu and T. S. Murthy, "NFT Marketplace for Blockchain based Digital Assets using ERC-721 Token Standard," 2023 International Conference on Sustainable Computing and Smart Systems (ICSCSS), Coimbatore, India, 2023, pp. 1394-1398, doi: 10.1109/ICSCSS57650.2023.10169350.

[10] I. Abaci and E. E. Ulku, "NFT-based Asset Management System," 2022 International Symposium on Multidisciplinary Studies and Innovative Technologies (ISMSIT), Ankara, Turkey, 2022, pp. 697-701, doi: 10.1109/ISMSIT56059.2022.9932702.

[11] R. Kumar and R. Tripathi, "Implementation of Distributed File Storage and Access Framework using IPFS and Blockchain," 2019 Fifth International Conference on Image Information Processing (ICIIP), Shimla, India, 2019, pp. 246-251, doi: 10.1109/ICIIP47207.2019.8985677.

[12] H. Takahashi and U. Lakhani, "High Secure Mobile Wallet for Token Transfer using Escrow Account on PoA Voting Blockchain," 2023 IEEE 12th Global Conference on Consumer Electronics (GCCE), Nara, Japan, 2023, pp. 478-480, doi: 10.1109/GCCE59613.2023.10315485.

[13] M. Saim, M. Mamoon, I. Shah and A. Samad, "E-Voting via Upgradable Smart Contracts on Blockchain," 2022 International Conference on Futuristic Technologies (INCOFT), Belgaum, India, 2022, pp. 1-6, doi: 10.1109/INCOFT55651.2022.10094482.

[14] D. Pramulia and B. Anggorojati, "Implementation and evaluation of blockchain based e-voting system with Ethereum and Metamask," 2020 International Conference on Informatics, Multimedia, Cyber and Information System (ICIMCIS), Jakarta, Indonesia, 2020, pp. 18-23, doi: 10.1109/ICIMCIS51567.2020.9354310.

[15] T. Q. Do and M. T. Ta, "Performance analysis of Ethereum smart contracts: A Study on Gas cost and block size impact," 2023 IEEE Statistical Signal Processing Workshop (SSP), Hanoi, Vietnam, 2023, pp. 591-595, doi: 10.1109/SSP53291.2023.10207974.