

Blockchain-Based Digital Assets Management (Case of Decentralized Autonomous Organizations)

Agyo Raphael Baku^{1,*}, Anderson Yohanna², Adda Danjuma Ato³

Abstract

The advent of Web 3.0 and the rise of decentralized applications (DApps) are reshaping the very fabric of the Internet. Gone are the days of centralized control, as Web 3.0 empowers users with greater privacy, security, and ownership over their data. Web 3.0 represents a paradigm shift from Web 2.0, which primarily relied on centralized platforms and intermediaries. Blockchain technology is important for Web 3.0. It makes things more transparent and trustworthy. Blockchain has these things called contracts. These are self-executing agreements that operate automatically and are securely recorded on the blockchain. This means that when people make transactions, we can see what is happening, and nobody can change it afterwards. This means we don't require any human assistance to carry out the transactions. This saves us money. Makes it harder for people to cheat. Applications known as DApps (decentralized applications) are developed on blockchain platforms such as Ethereum. DApps are making new things happen in different areas. Blockchain technology and DApps are really changing the way we do things. This study proposes a blockchain-based digital assets management system that mitigates the problems faced in Decentralized Autonomous Organizations (DAOs). An open-source Remix-Ethereum Integrated Development Environment that supports blockchain models, programmable-leverage containers to host smart contracts, and IPFS support for digital assets management on Web 3.0 development services was used for smart contracts and user front-end development. The result of the study shows a compiled smart contract run and deployed on the Interplanetary File System (IPFS) and connected to a Web 3.0 database through an Application Programming Interface, where the digital assets hash tag is saved to the blockchain. This provides improved security and protection to the data stored on the blockchain digital assets management system for decentralized Autonomous Organizations. It is recommended that this study proposal be implemented and deployed in real-world decentralized organizations and digital assets management institutions for transparency and trust.

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INTRODUCTION

Decentralized Autonomous Organizations (DAOs) are digitally governed systems that use blockchain technology, digital assets, and related tools to manage resources, organize activities, and make collective decisions. They aim to reduce centralized control by ensuring transparency in both operations and finances while giving token holders the authority to suggest, vote on, and implement changes within the organization. The critical first step in establishing a DAO is galvanizing a community that is united for a common purpose [1].

DAOs are launched by peers coordinating on communications platforms such as Discord, Telegram, and Twitter. The founders collaborate to define the purpose of the DAO, establish its governance rules, and plan its implementation strategy. In some cases, a DAO can evolve from an existing community or a blockchain-based platform. Once the group has attained agreement, the community can then encode its mandate and rules into smart contracts, which will ultimately bind the group to its decisions [2].

Blockchain-based smart contracts and decentralized applications can increase trust in computationally networked organizations by harnessing data visualization tools, spatial data mining, and machine learning techniques [3].

The emergence of Web 3.0 and the growing adoption of decentralized applications (DApps) are transforming the core functions of the Internet. Gone are the days of centralized control, as Web 3.0 empowers users with greater privacy, security, and ownership of their data. Web 3.0 represents a paradigm shift from Web 2.0, which primarily relies on centralized platforms and intermediaries. Web 3.0 uses blockchain and decentralized systems to build a more user-focused Internet experience. By removing intermediaries, blockchain allows people to interact directly with one another, giving them greater ownership and control over their digital activities and data [4].

Data ownership is one of the core tenets of Web 3.0. Traditionally, tech giants have amassed vast amounts of user data, leading to concerns about privacy and security. Web 3.0 addresses these issues by providing users with encrypted and decentralized storage solutions. Through blockchain-based identity systems, individuals can retain ownership of their personal information and choose how and when it is shared [5]. Blockchain technology, which is a key component of Web 3.0, provides greater transparency and reliability to digital systems. Smart contracts, which are automated agreements stored on the blockchain, execute transactions securely while ensuring transparency and tamper-proofing. By removing the need for middlemen, this approach lowers costs and significantly reduces fraud risk. DApps built on blockchain platforms, such as Ethereum, are driving innovation across various sectors [6].

Decentralized applications (DApps) are at the forefront of the Web 3.0 revolution. These applications leverage blockchain technology to provide decentralized, transparent, and secure user experiences. DApps often incorporate cryptocurrencies or tokens, enabling new economic models and incentivizing user participation [7].

Supporters of DAOs argue that this emerging organizational model can overcome the drawbacks of centralized systems by enabling more democratic decision-making and aligning efforts toward diverse objectives, including socially beneficial initiatives. By leveraging open-source software, blockchain infrastructure, incentive-based mechanisms, and programmable smart contracts, DAOs can provide enhanced transparency, build trust, and offer greater flexibility and efficiency compared with traditional structures such as corporations [8].

Many DAOs operate pseudonymously; users can develop trust within communities and exercise their token-based voting rights without revealing their identities. However, the widespread use of pseudonymous identities in DAO communities may create information asymmetries that can disadvantage participants in these ecosystems. Pseudonymity can also contribute to a lack of accountability and hinder efforts to combat financial crime [9].

Voter engagement is another problem in many of today's most significant DAOs. Research has shown that most participants in online communities and open-source environments are "lurkers," as is prevalent in decentralized communities. This study proposes a blockchain-based digital asset management system that mitigates the problems faced by DAOs. The specific objectives are as follows:

1. Design a blockchain-based DigiAssets Management System for DAOs.
2. Demonstrate the Design prototype using Remix IDE, Solidity & Node.js.
3. Analyze the performance of the experimental results.

RELATED WORK

Many studies presented an in-depth review exploring the integration of blockchain technology with the metaverse and its role in managing digital assets [10]. This study discusses how blockchain can enable the metaverse from different perspectives, ranging from user applications to virtual services and blockchain-enabled economic systems. The potential of blockchain for the security and privacy aspects of the metaverse infrastructure is determined, and a full flow of blockchain-based digital asset management for the metaverse is investigated.

A blockchain-based management system was developed to handle digital COVID-19 certificates [11]. It integrates a proxy re-encryption (PRE) mechanism with a blockchain protocol, introducing a governing authority responsible for supervising and regulating the centers that issue digital certificates.

Proposes a blockchain-based secure storage scheme for medical information [3]. A Hyperledger Fabric and an attribute-based access control framework were used. This scheme utilizes attribute-based access control information in the blockchain. The experimental results show a high throughput when accessing medical information.

A blockchain-based system was designed and developed for private data management [12]. The study presented blockchain architecture and discussed proof-of-concept prototypes using Hyperledger Fabric and showed the evaluation results of the proposed system using Hyperledger Caliper.

This study explored blockchain technology and the rise of Decentralized Autonomous Organizations (DAOs) through a comprehensive literature review, identifying three key characteristics: decentralization, automation, and organizational autonomy [13]. An integration model of DAO for research and theory-building is proposed.

A systematic literature review was conducted to examine the role of blockchain technology and smart contracts in decentralized governance systems [14]. This study analyzed how blockchain technology and its applications can reconfigure organizational governance mechanisms. This finding clarifies that smart contracts are pivotal in transactions on blockchain platforms.

METHODOLOGY

Analysis and Design of the Proposed System Architecture

The proposed system architecture is designed to provide a secure, scalable, and efficient framework for detecting cyber threats and supporting timely responses. It integrates data acquisition, preprocessing, AI-based analysis, risk assessment, and alert generation into a unified architecture to enhance the overall system resilience and operational performance, as shown in Figures 1 and 2.

ALGORITHM OF THE PROPOSED ARCHITECTURE

1. *DApps Node*: initialization
2. *Digital Assets Uploads*: Register, login, upload
3. *IPFS*: If Successful: Goto 4
4. *Generate Hash ID*: Get hashtag
5. *Connect*: API, Ethernet
6. *Smart Contract*: Generated and sealed
7. *Consensus mechanism*: Get 6, update
8. *Chain code*: Block created: hashtag saved to DB
9. *DAOs*: Get updates, confirm and manage Block
10. *End*: return OK

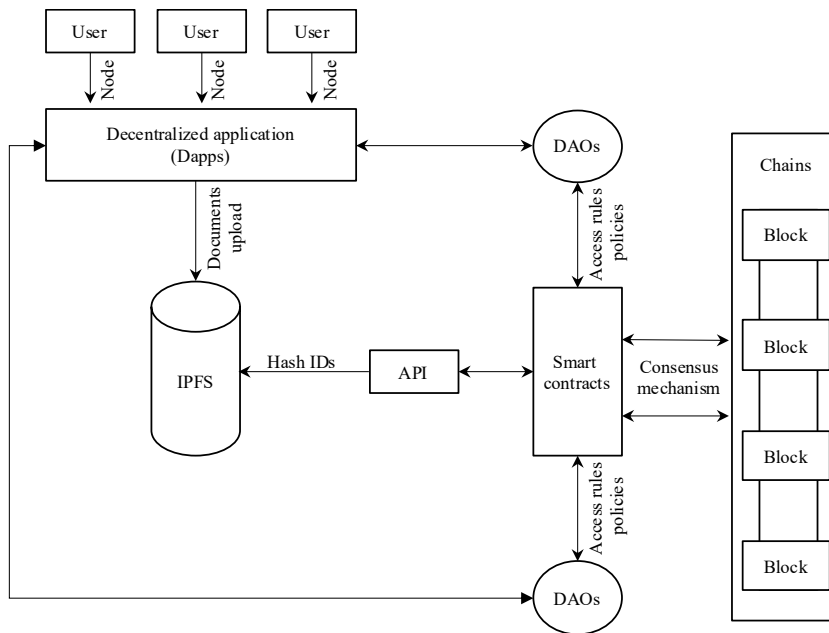


Figure 1. Proposed blockchain-based DigiAsset management system architecture.

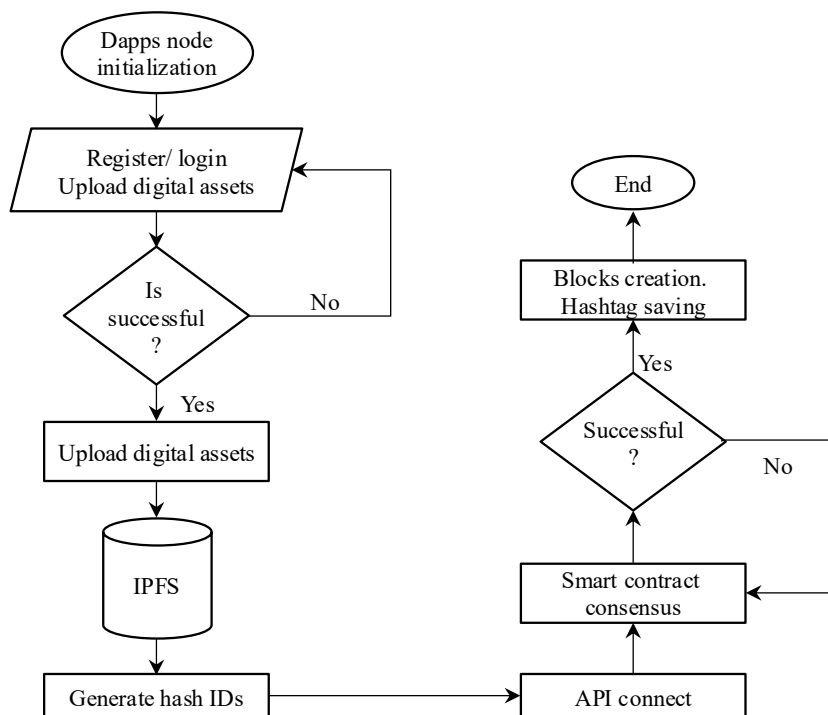


Figure 2. Workflow of the proposed architecture.

Design Tools

Microsoft Visio was used for the design of the proposed system architecture.

Developmental Framework

An open-source Remix-Ethereum IDE that supports blockchain models, programmable-leverage containers to host smart contracts with IPFS-loaded support for digital assets management on Web 3.0 development services was used for smart contracts and user front-end development.

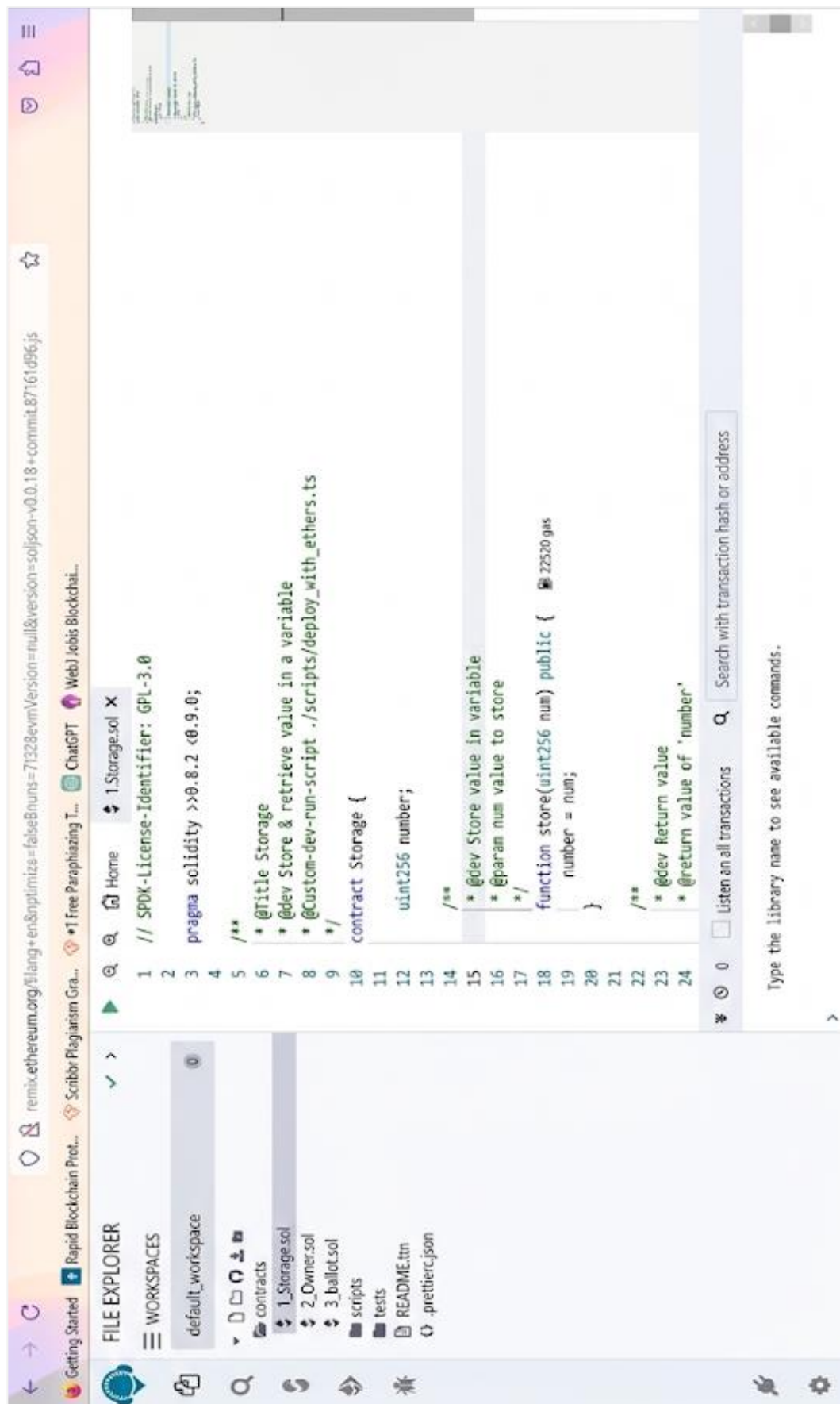


Figure 3. A smart contracts template showing the DAOs rules to enforce.

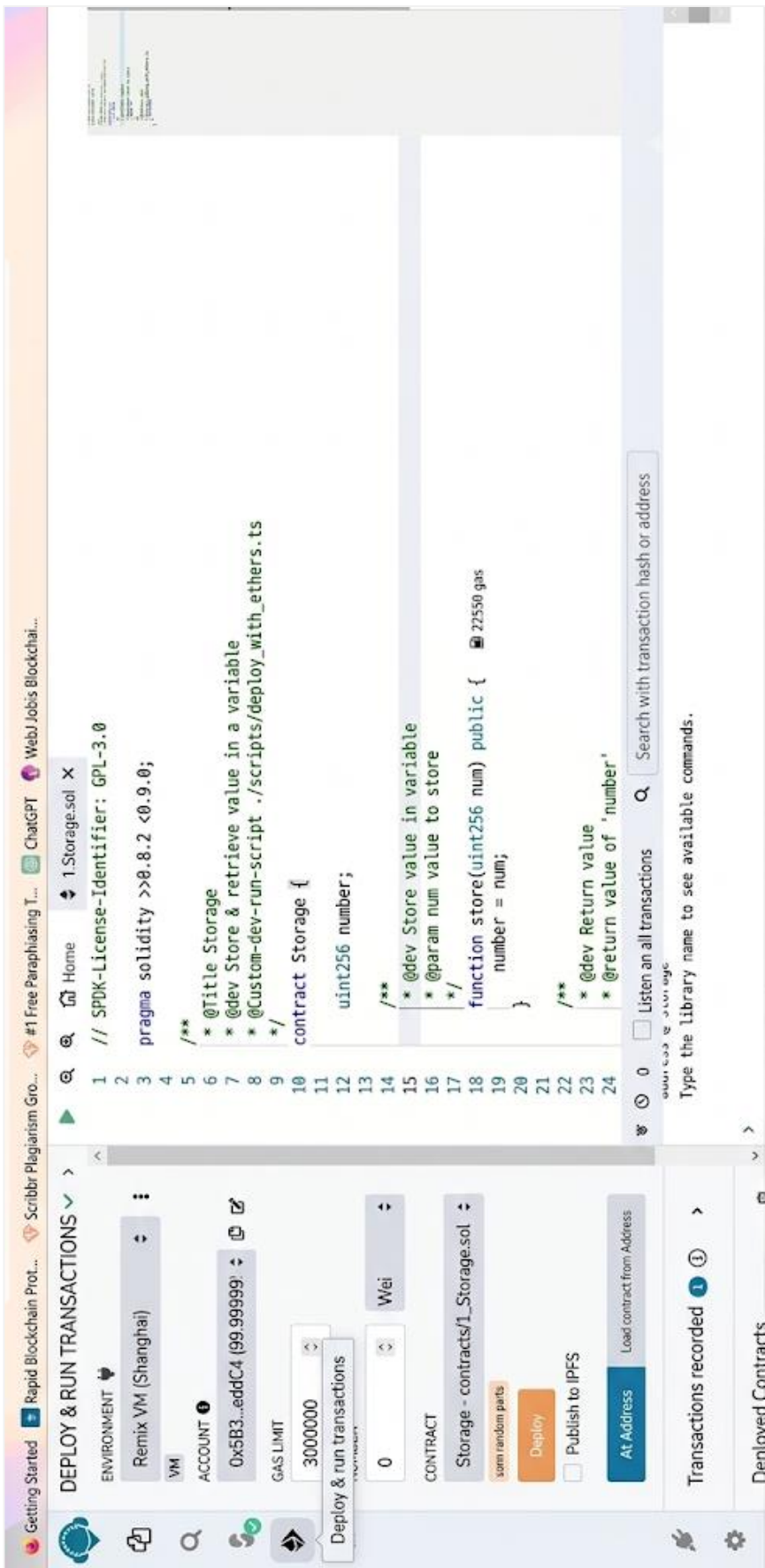


Figure 4. Compiled smart contracts run and deployed on interplanetary file system (IPFS).

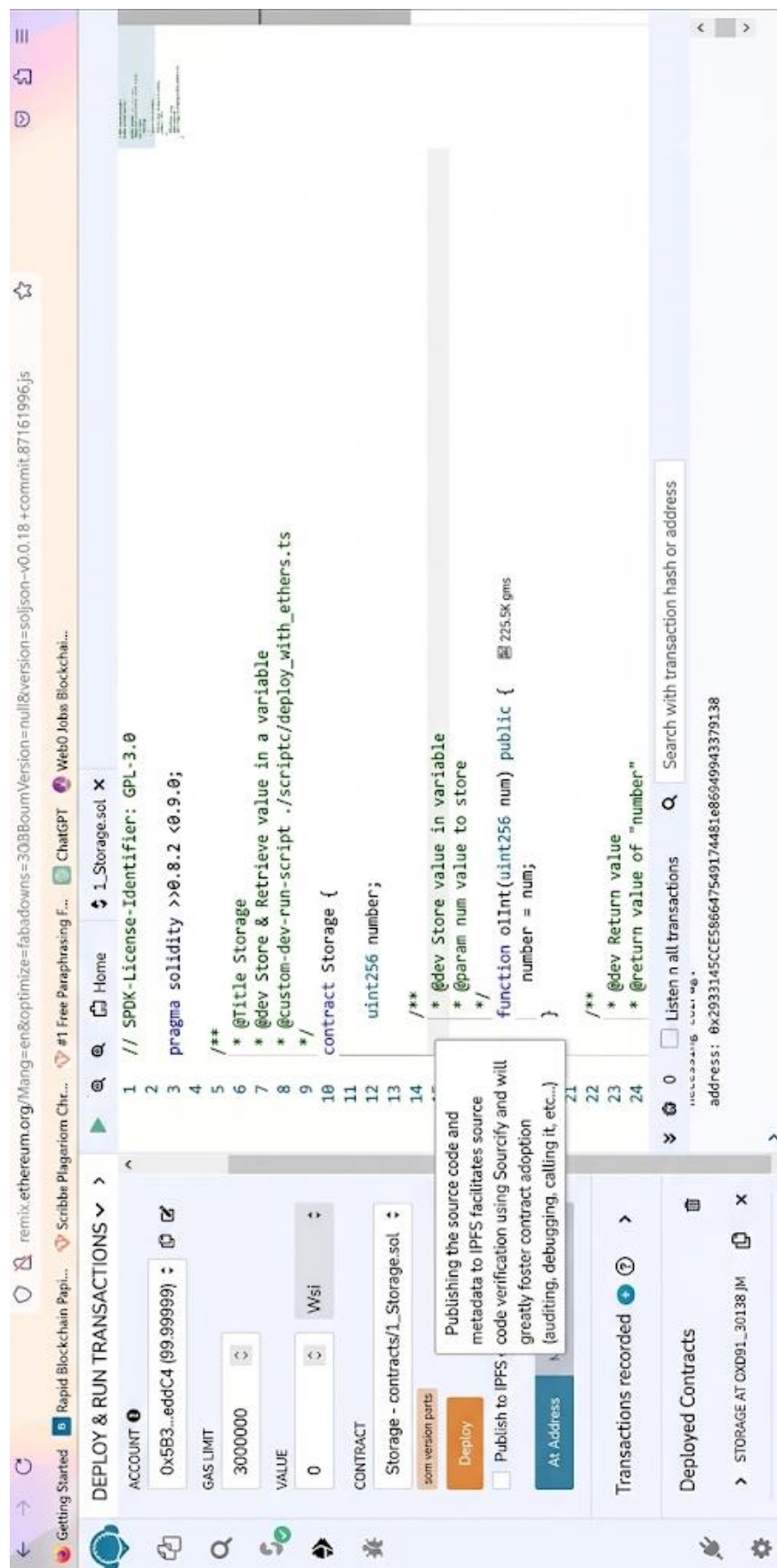


Figure 5. Smart contracts Settings on interplanetary file system (IPFS).

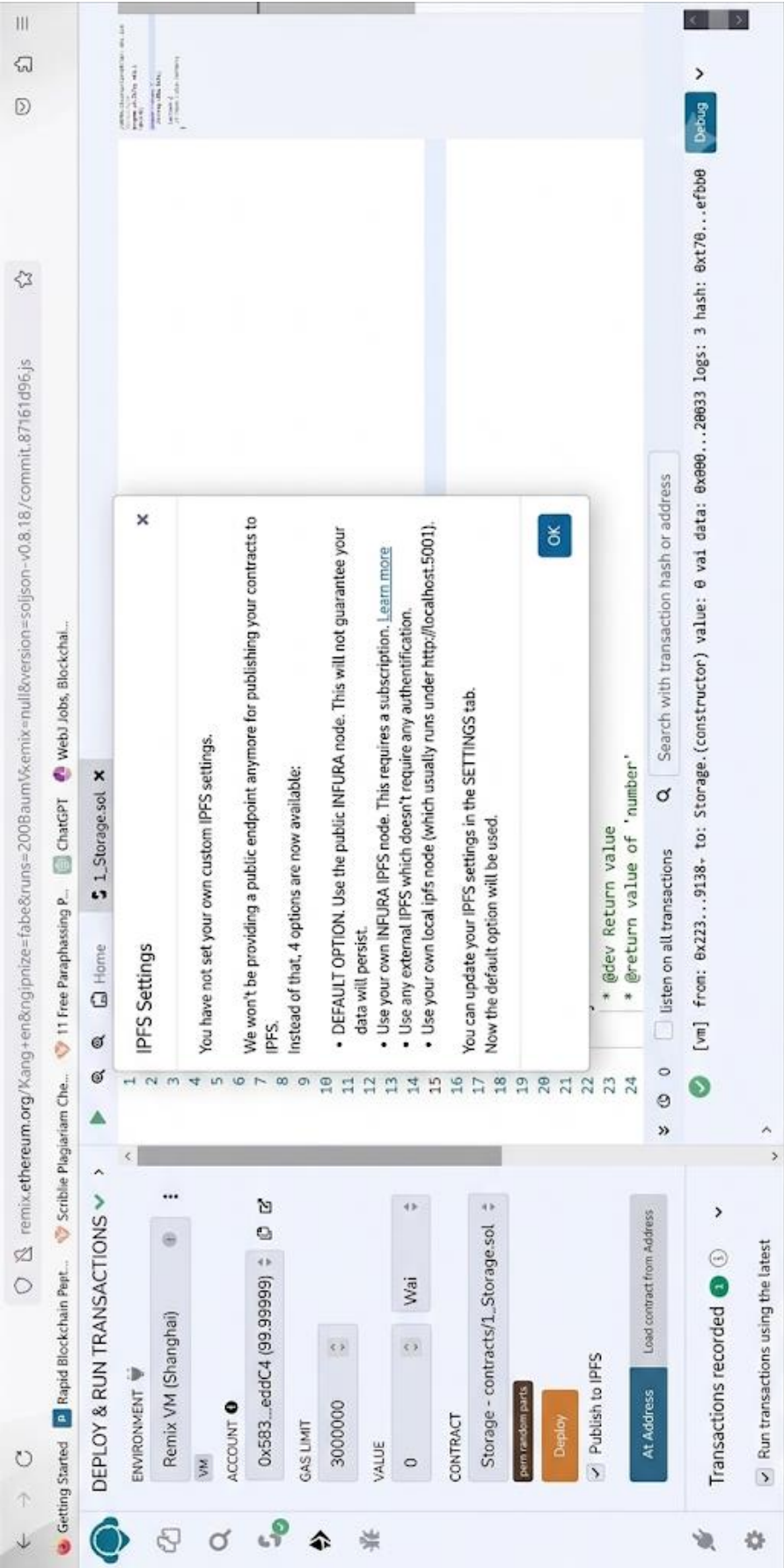


Figure 6. Show settings on interplanetary file system (IPFS).

Implementation Tools

The Remix development kit, Solidity, Node.js, and Ethereum integration platform were used on a PC with Windows 10 operating system (64-bit), 4GB of RAM, Intel(R) Core i5 CPU 2.20 GHz, and 500 GB of HDD.

RESULTS AND DISCUSSION

This study presents a demonstration of the proposed Decentralized Autonomous Organization Architecture for Digital Asset Management, as shown in Figure 1. A smart contract is created to enforce the DAOs rules and automate governance.

Figures 3–6 show a compiled smart contract to be run and deployed on the Interplanetary File System (IPFS) and connected to the Web 3.0 database through an application programming interface, where the digital asset hash tag is saved to the blockchain. This improves the security and protection of the data stored on the blockchain digital asset management system for decentralized Autonomous Organizations and helps meet regulatory requirements.

CONCLUSION, RECOMMENDATIONS, AND FUTURE WORK

The advent of Web 3.0 and the rise of decentralized applications (DApps) are reshaping the fabric of the Internet. Gone are the days of centralized control, as Web 3.0 empowers users with greater privacy, security, and ownership over their data. Web 3.0 represents a paradigm shift from Web 2.0, which primarily relies on centralized platforms and intermediaries. Blockchain technology, which forms the foundation of Web 3.0, enhances the transparency and reliability of digital systems. Smart contracts are self-executing digital agreements stored on a blockchain that automatically carry out transactions and remain tamper-proof once recorded. By eliminating intermediaries, they help cut costs and minimize the chances of fraudulent activity. Decentralized applications (DApps), especially those developed on platforms such as Ethereum, play a key role in transforming and innovating multiple industries. This study proposes a blockchain-based digital asset management system that mitigates the problems faced by DAOs. An open-source Remix-Ethereum IDE that supports blockchain models and programmable-leverage containers to host smart contracts with IPFS-loaded support for digital asset management on Web 3.0 development services was used for smart contracts and user front-end development. The results of the study show a compiled smart contract to be run and deployed on the Interplanetary File System (IPFS) and connected to a Web 3.0 database through an Application Programming Interface, where the digital asset hash tag is saved to the blockchain. This provides improved security and protection of the data stored on the blockchain digital assets management system for decentralized Autonomous Organizations, and it helps meet regulatory requirements. It is recommended that this study proposal be implemented and deployed in real-world decentralized organizations and digital asset management institutions for transparency and trust. Future research can be conducted to integrate machine learning algorithms with blockchain technology to manage DAOs' digital asset systems and enterprise documents. Further studies should focus on the integration of Blockchain Technology for data mining and data structuring to cope with the challenge of data theft over public networks. The integration of blockchain technology in 5G networks for the complete automation of processes could be another area of research interest.

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