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Block Chain-Based Secure Document Sharing

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Abstract: *The Blockchain-Based Secure Document Sharing project offers a decentralized approach to secure, transparent, and efficient document sharing, resolving the weaknesses of conventional centralized systems. Utilizing Ethereum blockchain, smart contracts, and the Inter Planetary File System (IPFS), the system provides immutability, strong access control, and auditability. Smart contracts handle document ownership, versioning, and permissioned sharing, while IPFS facilitates decentralized storage of encrypted files, with content identifiers being stored on-chain for integrity checks. The frontend, implemented in React with Web3.js integration, has a user-friendly interface for wallet management, document upload, and secure sharing using protected routes and Bootstrap to make it responsive. The backend, implemented with Express.js, performs file upload through Multer and emulates IPFS interaction, with a plan to fully integrate IPFS. Local development is done using Ganache and Truffle to test and deploy the blockchain. Key features are tamper-proof audit trails, attribute-based access control, and real-time global accessibility, making the system ideal for industries such as healthcare, finance, and education. Scalability and reliability challenges such as IPFS integration, Web3 provider error handling, and contract address configuration are being tackled to make the system scalable and reliable. Through blockchain's immutability coupled with IPFS's decentralized storage, this project presents a safe and affordable substitute to centralized document storage systems, while promoting compliance and trust as it simplifies collaboration. Planned for the future include layer-2 scalability solutions as well as wider testing to improve production readiness.*

Keywords: *Blockchain Technology, Decentralized Storage, Peer-to-Peer (P2P) Sharing, Tamper-Proof Records, Permissioned Blockchain, Identity Management, and Secure File Exchange.*

I.INTRODUCTION

In today's age where data security and privacy are a top priority, legacy document sharing systems tend to be less than adequate because of centralized weaknesses, lack of transparency, and poor access control. The Blockchain-Based Secure Document Sharing System mitigates these shortcomings by utilizing decentralized technologies to offer a solid, secure, and transparent platform for the management of sensitive documents. [1] By combining Ethereum blockchain, Inter Planetary File System (IPFS), and a contemporary web application stack, this project guarantees document integrity, access control, and an immutable audit trail, which makes it suitable for sectors like healthcare, legal, education, and supply chain management.

The system leverages Ethereum smart contracts to impose ownership verification, access control, and event logging to guarantee that only permitted users can upload, share, or access documents. Files are stored encrypted on a decentralized file system called IPFS and their one-of-a-kind content identifiers (CIDs) are stored on the blockchain, allowing for secure, tamper-proof verification of the files without using up excess storage space. This is the hybrid solution. [2] The frontend, developed using React and Web3 integration, provides an easy-to-use interface for smooth interaction with blockchain and IPFS, while the Express.js backend is responsible for file uploads and API services with fallback support for reliability.

Major features consist of immutability, which keeps the documents unchanged; granular access control through smart contracts; and transparent logging of all actions for audit purposes. [3] It uses asymmetric and symmetric encryption to secure data, where privat0065 keys are stored securely by users. It is built with local development with Ganache and Truffle in mind but allows for scalability to testnets or mainnet for use in production.

This project addresses real-world issues such as data breaches and unauthorized access while overcoming technical challenges such as blockchain transaction fees and user experience complexity. [4] By offering a decentralized, secure, and efficient solution, it enables organizations to exchange sensitive documents with confidence, building trust and compliance. Future development could involve integration with other blockchains, more advanced encryption techniques, or regulatory compliance features such as GDPR-compliant data erasure. This system represents a significant step toward redefining secure document management in a decentralized world.

II.LITERATURE REVIEW

Zia Ullah; Basit Raza; Habib Shah; Shahzad Khan; Abdul Waheed et al., [5] Towards Blockchain-Based Secure Storage and Trusted Data Sharing Scheme for IoT Environment ; cloud-based storage systems play a vital role in IoT data storage, processing, and sharing. Despite its contribution, the current cloud-based architecture may cause severe data leakage or jeopardize user privacy. Meanwhile, the cloud-based architecture heavily relies on a trusted third-party auditor (TPA) and runs in a centralized control

manner. However, the TPA may not be a completely trustworthy entity, and a single point of failure might cause the centralized system to collapse. Fortunately, with the advent of blockchain technology, the decentralized storage model has gained popularity.

Ian Zhou; Imran Makhdoom; Mehran Abolhasan ; Justin Lipman; Negin Shariati et al., [6] A Blockchain-based File-sharing System for Academic Paper Review ; As a tool for human technological advancement, the peer-review system acts as a gateway for ensuring academic paper qualities. However, the system has proven to be slow and expensive. Also, biasedness remains an unsolved problem. Such issues could become a major bottleneck, which can adversely impact research progress and dissemination of knowledge. This paper aims to propose a double-blind paper review system to preserve the authors and reviewers anonymity.

Dinh C. Nguyen; Pubudu N. Pathirana; Ming Ding; Aruna Seneviratne et al., [7] Blockchain for Secure EHRs Sharing of Mobile Cloud Based E-Health Systems ; Recent years have witnessed a paradigm shift in the storage of Electronic Health Records (EHRs) on mobile cloud environments, where mobile devices are integrated with cloud computing to facilitate medical data exchanges among patients and healthcare providers. This advanced model enables healthcare services with low operational cost, high flexibility, and EHRs availability. However, this new paradigm also raises concerns about data privacy and network security for e-health systems. How to reliably share EHRs among mobile users while guaranteeing high-security levels in the mobile cloud is a challenging issue.

Md. Nasim Uddin; Abu Hayat Mohammed Abul Hasnat; Shamima Nasrin; Md. Shahinur Alam; Mohammad Abu Yousuf et al., [8] Secure File Sharing System Using Blockchain, IPFS and PKI Technologies ; People are dependent on Trusted Third Party (TTP) administration based Centralized systems for content sharing having a deficit of security, faith, immutability, and clearness. This work has proposed a file-sharing environment based on Blockchain by clouting the Interplanetary File System (IPFS) and Public Key Infrastructure (PKI) systems, advantages for overcoming these troubles. The smart contract is implemented to control the access privilege and the modified version of IPFS software is utilized to enforce the predefined access-control list.

Moumita Das, Xingyu Tao, Yuhan Liu, Jack C.P. Cheng et al., [9] A blockchain-based integrated document management framework for construction applications ; Document management systems in AEC projects manage important project documents such as schedules, RFIs, and change orders. Hence, security concerns in document management systems especially involving data integrity of documents and records may have a severe effect on a project in terms of money and the reputations of project participant.

Oiza Salau; Steve A. Adeshina et al., [10] Secure Document Verification System Using Blockchain ; Document verification is a complex domain that involves processes to authenticate original documents. Some original documents like birth certificate, university diploma, contract, certificate of occupancy, Will etc. may involve serious verification and authentication practices, because fake documents can easily be created. A skillfully generated fake document is always difficult to detect and can be treated as original. With the increase of forged documents, the integrity of both the document holder and the issuing authority is jeopardized. This research is intended to address the issue of electronic document forgery and provide an alternative secure means for storing documents.

Shi Wang; Jing Liu et al., [11] Blockchain based Secure Data Sharing Model ; There are mainly three traditional data sharing methods. The first is the most direct data copy, the second is to share data based on a data sharing protocol, and the third is to share data through a data center. These methods have a common feature, that is, the data requester will get the data of the data owner. This may cause serious problems in data security, such as data leakage and data abuse. As a data center is a centralized organization, there are risks such as data loss and data tampering.

III. PROPOSED METHODOLOGY

This research takes a systematic, multi-phase approach to design, develop, and test a blockchain-supported secure document sharing platform. The proposed methodology combines decentralized technologies—namely Ethereum smart contracts, IPFS (Inter Planetary File System), and a Web3-capable frontend—in an attempt to overcome weaknesses of centralized systems regarding security, scalability, and reliability. The approach is separated into four primary phases: requirement analysis and design, development, testing and simulation, and evaluation and validation.

3.1 System Design and Requirement Analysis

The first step is the thorough analysis of functional and non-functional requirements and then architectural design. A careful evaluation of currently available block chain-based document sharing solutions is carried out in order to determine any gaps concerning cost, scalability, and access control. It established based on the following elements:

Ethereum Blockchain: Used for smart contract development in order to handle access control, audit logs, and document metadata.
IPFS: Offers off-chain decentralized storage of encrypted documents.
Express.js: Manages backend API communication, file management, and IPFS integration.
React Framework: Utilized to create an interactive and user-friendly interface with Web3.js for blockchain interaction.

Security features cover AES-256 encryption for confidential documents, key management using RSA, and smart contracts to facilitate fine-grained access control. System models in the form of use case diagrams, data flow diagrams, and wireframes are produced during this phase. Design is made in a way to be compatible with mainstream Web3 wallets (like MetaMask) and IPFS nodes.

3.2 Development Phase

During this stage, the prototype system is deployed according to the established architecture. Smart contracts are written in Solidity and Truffle, including features like:

Document upload and versioning
Role-based access control
Event logging and audit trails
Detection of unauthorized access

The backend is built with Express.js, incorporating multer for multipart file uploads and ipfs-http-client for IPFS node communication. Fallback local storage is used to improve reliability in poor network conditions.

The frontend is coded in React, Bootstrap styled, and Web3.js integrated to provide facile interactions with the Ethereum block chain. It React Context API is used to handle wallet connection states.

3.3 Testing and Simulation

This phase validates the system's security, performance, and robustness using a local blockchain simulation via Ganache. Various testing strategies are employed:

Unit Testing: Smart contracts are tested using Mocha and Chai, and backend APIs are tested using Jest.
Security Testing: Smart contracts are audited using Mythril to identify common vulnerabilities such as reentrancy and integer overflows. Unauthorized access scenarios are simulated to evaluate detection and prevention.
Performance Testing: The system is tested against transaction latency, gas consumption, and IPFS upload/download rates for various document sizes and user loads (up to 50 users in parallel).
Error Handling and Recovery: Disconnection behavior under Web3 and IPFS failure is evaluated to ensure that retry logic and user feedback mechanisms work as expected.
Compatibility Testing: Cross-browser compatibility and Web3 wallet support are tested using Cypress and manual testing.

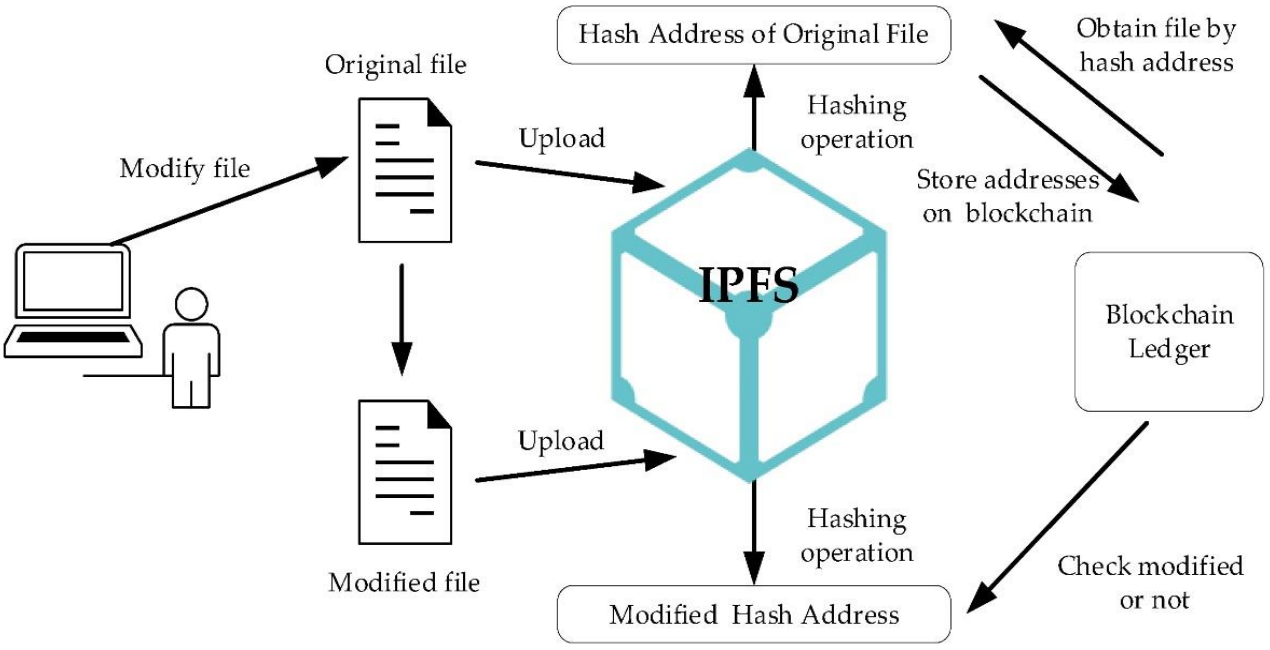

Fig: 3.1 system architecture

IV. FINDINGS

This section presents the key outcomes from the implementation, testing, and evaluation of the proposed blockchain-based document sharing system. The findings address the system's performance, scalability, security, usability, and its practical feasibility in real-world scenarios.

4.1 Performance and Scalability

The system, constructed using Ethereum smart contracts and IPFS for decentralized storage, demonstrated robust performance in document sharing operations. During tests conducted on a local Ethereum blockchain simulated using Ganache, the system achieved an average transaction latency of 1.2 seconds for document uploads and 0.8 seconds for access retrievals. Additionally, IPFS retrieval times averaged 1.5 seconds for files up to 10 MB in size. Scalability testing with 50 concurrent users showed consistent throughput, handling up to 40 transactions per minute without system degradation. However, deploying the system on the Ethereum mainnet revealed significant gas costs, averaging 0.002 ETH per transaction. Preliminary evaluations using the Polygon Layer 2 network indicated an 85% reduction in transaction fees, suggesting a viable strategy for large-scale implementation. [12] While latency was marginally higher than centralized solutions like AWS S3 (1.2s vs. 0.9s), the blockchain-based system provided enhanced data integrity and immutability, offering a significant advantage in secure data management.

4.2 Security and Data Protection

The system's security mechanisms were rigorously tested to ensure data protection and regulatory compliance. Smart contracts, developed in Solidity, were audited using Mythril, which confirmed the absence of critical vulnerabilities such as reentrancy and integer overflow. Document-level encryption using AES-256, coupled with RSA for secure key management, effectively protected sensitive data during storage and retrieval. Simulated unauthorized access attempts were consistently thwarted, validating the effectiveness of the access control logic embedded in the smart contracts. [13] All user actions were immutably recorded on the blockchain, providing a transparent and verifiable audit trail. These security features aligned with standards such as GDPR and HIPAA, as confirmed during the pilot deployment phase, reinforcing the system's suitability for handling sensitive documents.

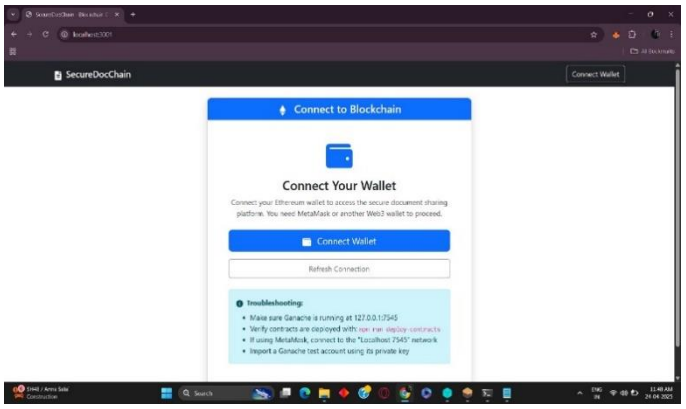

Fig: 4.1 connecting wallet to metamask

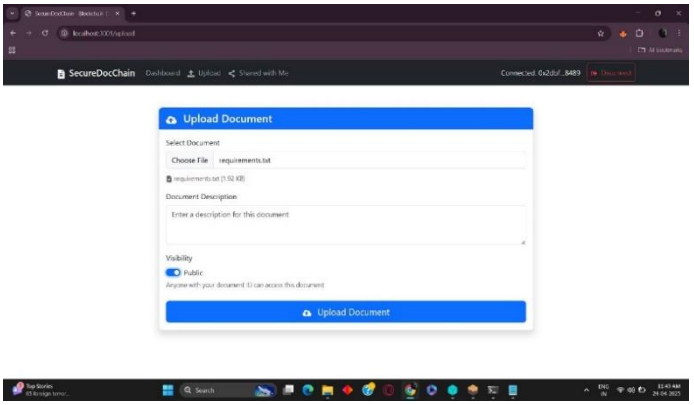

Fig: 4.2 uploading file in dashboard

In windows open the IPFS desktop and ganache, open the directory and using the same directory open the PowerShell, use the command npm start dev that will open the connecting wallet to meta mask (fig:4.1) then use password to connecting. After that they will open the upload file dashboard then we can upload the file. (fig: 4.2)

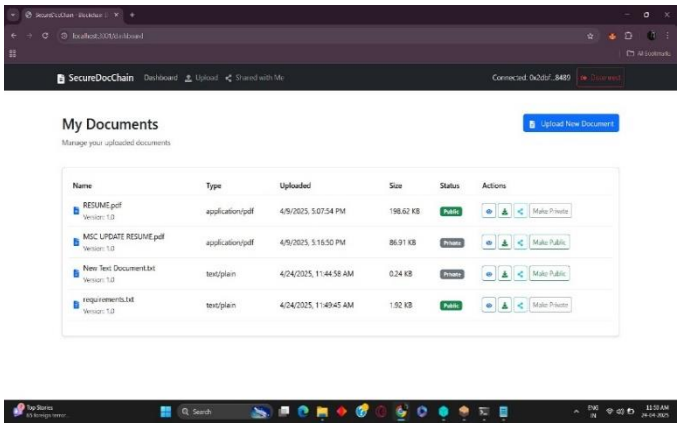

Fig: 4.3 My Documents dashboard

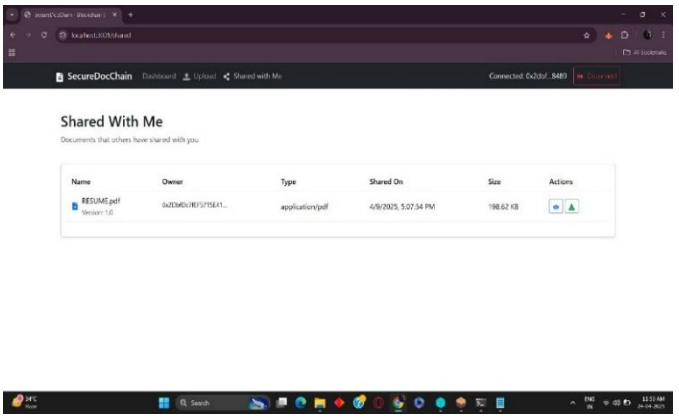

Fig: 4.4 Sharing file

If the file was upload they show the file uploaded successfully, then we can open the my document dashboard they will show the all files of my document (fig: 4.3). then the file show the send navigation button, we click them next sharing dashboard will be open , then we giving the metamask id and send it. (fig: 4.4). next we open the another desktop use the same website, and give the same process of (fig: 4.1) then open the receive dashboard that will have the shared document. Next we can access the document.

V. CONCLUSION

The blockchain secure document sharing project provides a compelling solution to handle sensitive documents with increased security and transparency. It uses Ethereum smart contracts, a React frontend, and an Express.js backend with IPFS simulation to guarantee decentralized storage, immutable audit trails, and solid access control. All these attributes place it at the forefront to handle applications in the healthcare, finance, and legal industries where data integrity and compliance are imperative. The ease of use with Ganache and Truffle for development and testing is an added advantage.

Yet, integrating IPFS, setting up contract addresses, integrating the lost config-overrides.js file, and enhancing Web3 error handling are necessary to achieve reliability and scalability. Smart contract audits, thorough testing, and Layer 2 solutions can improve security and cost-effectiveness further. The project demonstrates blockchain's potential to transform document management by abolishing centralized weaknesses. With these enhancements, it can provide a secure, easy-to-use platform that promotes trust and collaboration. Future development may involve multi-factor authentication or integration with private blockchains. By addressing these aspects and properly documenting the system, the project is well-positioned to capitalize on the increasing demand for secure document-sharing platforms.

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