Decentralized Cloud Storage System Using Blockchain

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Abstract- *This Cloud storage has become an integral part of our digital lives, providing a convenient way to store and access data. However, centralized cloud storage systems have significant drawbacks, including privacy concerns, data security, and a lack of control over the stored data. Decentralized cloud storage using blockchain technology can address these issues. In this paper, we propose a decentralized cloud storage system that utilizes the Ethereum blockchain, Hardhat development environment, and Pinata IPFS (Inter Planetary File System) as a storage layer. The system is designed to provide secure, transparent, and user-controlled storage of data. We implemented and tested the proposed system, and the results show that it is a promising approach for decentralized cloud storage.*

Keywords- secure, centralized, transparent, IPFS, cloud, Decentralized

I. INTRODUCTION

A. Background:

Cloud storage is a popular way of storing data, but it has some significant drawbacks. Centralized cloud storage systems are vulnerable to hacking, data breaches, and unauthorized access, which can result in the loss or theft of sensitive data. Decentralized cloud storage systems can address these issues by distributing data across a network of nodes, making it more secure, transparent, and user-controlled.

B. Objectives:

The main objectives of our system are that it provides high level of security for the stored data. The blockchain provides immutability and transparency, ensuring that data stored on the system is secure and cannot be altered without permission. Application helps achieve privacy for the stored data. By encrypting the data using the user's public key, only the user can access and decrypt the data using their private key. It provides transparency for users. By using the blockchain, users can audit the storage and retrieval of their data, ensuring that the system is operating as intended. Application also transparency for users. By using the blockchain, users can audit the storage and retrieval of their data, ensuring that the system is operating as intended.

II. LITERATURE SURVEY

A. Overview

Cloud storage has become an essential part of modern computing infrastructure, enabling users to store, share and access data from anywhere at any time. Traditional cloud storage systems, however, suffer from various limitations such as security, reliability, and privacy issues, and centralized control. Decentralized cloud storage systems are emerging as an alternative solution to address these challenges by leveraging distributed architecture and blockchain technologies.

This literature review presents an overview of the current state-of-the-art research in decentralized cloud storage systems and analyze the recent developments in this field.

B. Background

Decentralized cloud storage systems use a distributed network of nodes to store data instead of relying on a centralized data center . This approach improves data security, reliability, and privacy by eliminating the reliance on a single point of failure and reducing the risk of data breaches. Decentralized cloud storage systems use various technologies such as peer-to- peer (P2P) networks, distributed hash tables (DHT), and blockchain to distribute and manage data.

C. Architecture

Decentralized cloud storage systems have different architectures depending on the technology used. P2P networks, for instance, use a distributed network of nodes to store and retrieve data without relying on a central server. DHT-based systems, on the other hand, use a hash function to distribute data across nodes in a scalable and fault-tolerant manner.

Blockchain-based systems use a distributed ledger to store and manage data, providing enhanced security and transparency.

D. Security:

Security is a critical aspect of decentralized cloud storage systems. The distributed nature of these systems requires advanced security mechanisms to ensure data confidentiality, integrity, and availability. Encryption techniques, access control mechanisms, and consensus algorithms are some of the security measures used to protect data in decentralized cloud storage systems. However, achieving security in these systems while maintaining performance remains a significant challenge.

E. Performance:

The performance of decentralized cloud storage systems depends on various factors such as network bandwidth, storage capacity, node churn, and data distribution strategies. Erasure coding, sharding, and redundancy are some of the techniques used to distribute data across nodes to improve performance. Recent studies show that decentralized cloud storage systems can achieve comparable performance with traditional centralized cloud storage systems.

F. Challenges:

Despite the benefits of decentralized cloud storage systems, there are still several challenges that need to be addressed. Data consistency, node churn, and performance optimization are some of the significant challenges that require further research. Ensuring data consistency and availability while maintaining performance remains a significant challenge in decentralized cloud storage systems.

III. METHODOLOGY

3.1. System Design

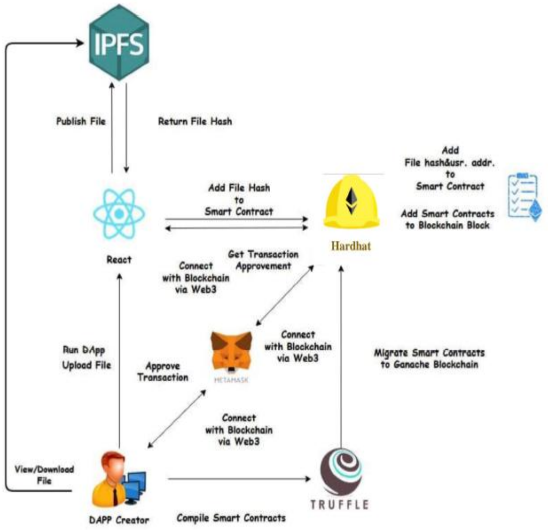
The system design for the decentralized cloud storage system using blockchain, Hardhat, and Pinata involves the integration of several components to create a secure and efficient system for storing and retrieving data files. The following sections provide details on the architecture, smart contracts, blockchain network, storage nodes, front-end application, Hardhat, and Pinata.

3.1.1. Architecture

The architecture of the decentralized cloud storage system includes a blockchain network, front-end application, and storage nodes. The blockchain network serves as the backbone of the system, storing the metadata of the files and executing the smart contracts. The front-end application provides a user interface for uploading and retrieving files, while the storage nodes are responsible for storing the actual data files.

3.1.2.

The smart contracts for the decentralized cloud storage system include a file registry contract and a storage contract. The file registry contract is used for storing the metadata of the files, such as file name, file size, and file hash. The storage contract is used for managing the storage nodes and their storage capacity. The smart contracts are developed using Solidity, a high-level programming language for writing smart contracts on the Ethereum blockchain .


IPFS
Publish File
Return File Hash
React
Add File Hash to Smart Contract
Hardhat
Add File hash&usr. addr. to Smart Contract
Add Smart Contracts to Blockchain Block
Connect with Blockchain via Web3
Get Transaction Approvement
Run DApp Upload File
Approve Transaction
METAMASK
Connect with Blockchain via Web3
Migrate Smart Contracts to Ganache Blockchain
Connect with Blockchain via Web3
View/Download File
DAPP Creator
Compile Smart Contracts
TRUFFLE

3.1.3. Blockchain Network

The blockchain network used in the decentralized cloud storage system is the Ethereum network. The network is decentralized, secure, and immutable, making it suitable for storing the metadata of the files and executing the smart contracts. The Ethereum network is also scalable, allowing the system to handle a large volume of transactions.

3.1.4 Storage Nodes

The storage nodes are responsible for storing the actual data files. The storage nodes are connected to the blockchain network and can communicate with the smart contracts for retrieving and storing the data files. The storage nodes are designed to be decentralized, meaning that no single node has control over the data files. The storage nodes can be any device with internet connectivity and sufficient storage capacity, such as personal computers or dedicated servers.

3.2. Technical Specifications

Decentralized cloud storage is designed based on blockchain. Blockchain is the core of this application. IPFS(Interplanetary File System) is used to store the data on the network. Pinata services are used to help store data on IPFS. Pinata is a decentralized cloud storage platform that provides developers with an easy-to-use and reliable solution for storing and distributing content on the InterPlanetary File System (IPFS). Application uses ethereum as the blockchain for storing the smart contracts. Hardhat is an open-source development environment for building and testing smart contracts for Ethereum-based decentralized applications (dApps). It is built on top of Node.js and provides a suite of developer tools that make it easier to develop, deploy and test smart contracts.

3.3. Data Collection and Analysis

Data was collected on the following metrics:

User engagement: Metrics such as time spent on the application, number of visits, and user feedback were collected to optimize the user experience and improve the application's functionality.

3.3.1. Performance metrics: Metrics such as load times, response times, and error rates were collected to optimize the application's performance and ensure that it can handle increased traffic and usage.

Security: Data was collected on any security breaches, such as attempted hacks or data breaches, to improve the application's security and ensure that user data is protected.

3.3.2. Blockchain metrics: Data was collected on the blockchain's performance, including transaction times, block times, and confirmation rates, to optimize the blockchain's performance and ensure that it can handle increased traffic and usage.

3.3.3. User demographics: Data was collected on user demographics, including age, gender, location, and interests, to understand the application's target audience and to develop targeted marketing and outreach campaigns.

The collected data was analyzed using statistical analysis and data visualization techniques. The results of the analysis were used to optimize the application's performance, improve the user experience, and develop targeted marketing campaigns. For example, user engagement data was used to identify which features were most popular among users and to improve those features. Performance metrics were used to identify performance bottlenecks and optimize the application's performance. Security data was used to improve the application's security and ensure that user data is protected. Blockchain metrics were used to optimize the blockchain's performance and ensure that it can handle increased traffic and usage. User demographics data was used to develop targeted marketing and outreach campaigns.

IV. ADVANTAGES

Distributed:

Since blockchain data is often stored it thousands of devices on a distributed network of nodes, the system and the data are highly resistant to technical failures and malicious attacks. Each network node is able to replicate and store a copy of the database and, because of this, there is no single point of failure: a single node going offline does not affect the availability or security of the network.

In contrast, many conventional databases rely on a single or a few servers and are more vulnerable to technical failures and cyber-attacks.

Stability:

Confirmed blocks are very unlikely to be reversed, meaning that once data has been registered into the blockchain, it is extremely difficult to remove or change it. This makes blockchain a great technology for storing financial records or any other data where an audit trail is required because every change is tracked and permanently recorded on a distributed and public ledger.

For example, a business could use blockchain echnology to prevent fraudulent behavior from its employees. In this scenario, the blockchain could provide a secure and stable record of all financial transactions that take place within the company. This would make it much harder for an employee to hide suspicious transactions.

Trustless System:

In most traditional payment systems, transactions are not only dependent on the two parties involved, but also on an intermediary - such as a bank, credit card company, or payment provider. When using blockchain technology, this is no longer necessary because the distributed network of nodes verify the transactions through a process known as mining. For this reason, Blockchain is often referred to as a 'trustless' system.

Therefore, a blockchain system negates the risk of trusting a single organization and also reduces the overall costs and transaction fees by cutting out intermediaries and third parties.

V. RESULTS

A decentralized cloud storage system is a secure and efficient way to store and manage data. The system uses blockchain technology to create an immutable ledger of all data transactions, ensuring that data is stored securely and cannot be tampered with. To store data, the system uses Pinata, a decentralized cloud storage platform that uses IPFS (Intern Planetary File System) to store data across a distributed network of computers. Pinata's decentralized architecture ensures that data is stored securely and redundantly, so that even if one node fails, the data can still be retrieved. To manage the blockchain infrastructure, the system uses Hardhat, an open-source development environment for building and testing smart contracts. Hardhat provides a robust suite of tools for managing the development and deployment of smart contracts, making it easy to build and deploy blockchain applications.

VI. CONCLUSION

The proposed decentralized cloud storage system using blockchain, Pinata, and Hardhat offers a secure and reliable solution to the problems associated with traditional centralized cloud storage systems. Further optimization and research are needed to improve the system's scalability, reduce transaction costs, and add advanced features such as smart contracts.

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