Decentralized Disk Space Allocation using Blockchain Technology on Cloud Environment

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Abstract - *Decentralized disk space allocation using blockchain technology in cloud environment is a new scheme that allows enterprises to securely transfer excess hard disk space through a decentralized network, ensures data integrity through Hash Pointers and maintains security if high quality by providing only service provider access to data content this fragmentation and data storage makes it more efficient. The system is designed to revolutionize storage methods by providing a secure and efficient system for managing disk space, using blockchain security features to prevent data loss and unauthorized access It has a module two main ones: admin, which manages access, location, network settings and authentication checks. This system, which supports profile management, space rental, and transactions, provides a reliable storage solution that removes the pitfalls of traditional centralized systems by enhancing security, improving data distribution, and monitoring a it will provide the transparent performance*

Key Words*: *Disk Space Allocation, Blockchain Technology, Hash Pointers, Decentralized, Data Integrity, Security, Privacy.

1.INTRODUCTION

Decentralized disk space allocation using blockchain technology in a cloud environment provides a revolutionary way to store data by enabling companies to securely occupy excess hard disk space If you use a decentralized network enabled by Hash Pointers implementation ensures data integrity and increases security, especially in hostile environments. It maximizes privacy by fragmenting and distributing data across locations, only the service provider can access the content of the data The system is organized in admin-user modules, handling functions such as access, location, connectivity management, and process integrity assessment. Other features include user authentication, admin settings, disk space cataloguing, request management, usage tracking, payment processing, data validation, redundancy, blockchain integration This architecture addresses the shortcomings of centralized storage systems through security providing improved, data efficiency and transparent operations

1.1 Block Chain Technology

Blockchain technology, which began with Bitcoin in 2008, is a decentralized ledger that provides data integrity and transparency without central control by recording transactions across network members Its rigid design resists manipulation, while cryptographic security and open ledger prevents fraud. Under blockchain, smart contracts automate processes, reduce the need for intermediaries, and reduce the risk of fraud. In addition to cryptocurrencies, blockchain is increasingly being used in supply chain management, secure digital elections, human authentication, health records and real estate transactions, which means it has the potential to drive innovation across industries

1.2 Cloud Computing

Cloud computing is transforming the use of technology, providing scalable and searchable computing resources via the Internet. Its three main service models: IaaS, PaaS, and SaaS provide virtualized resources, development tools, and software applications, respectively. Users benefit from flexibility, scalability and cost savings, scaling services to suit needs and source them from anywhere. Cloud computing eliminates upfront hardware investments and IT resources to focus on core business functions. Essential in digital transformation processes around the world, it fosters innovation, agility and competitive advantage, and empowers businesses in the digital age Cloud computing is revolutionizing consumer technology, providing scalable and searchable computing resources via the Internet. Its three main service models: IaaS, PaaS, and SaaS provide virtualized resources, development tools, and software applications, respectively. Cloud computing eliminates upfront hardware investments and IT resources to focus on core business functions. Essential in digital transformation processes around the world, it fosters innovation, agility and competitive advantage, and empowers businesses in the digital age.

2. METHODOLOGY

In a decentralized and secure ecosystem, peer-to-peer networks eliminate dependency, while smart contracts automate contracts , and cryptocurrency facilitates secure payments Decision trees and corruption algorithms are implemented to efficiently allocate resources, with cost-effective solutions Provide data security through content collaborative filtering the best combination of dynamic programming, blockchain to protect sensitive data, and anomaly detection to prevent threats The modular design of the System supports scalability and sustainability, including concepts such as Proof of Stake . The algorithm balances energy efficiency with security. A decentralized name system, combined with cryptography and access control, ensures transparency and accountability, and builds trust between users and providers

3. REQUIREMENTS

The software package requires a Windows OS (7 or higher), an Intel i3 processor, 4GB of RAM, and 100GB of storage. It uses Python, Sublime Text, VS Studio, and XAMPP for efficient development and testing.

3.1 Hardware Requirements

Operating System: Windows 7 or newer versions like Windows 10 or 11 are required for running the software. ensuring seamless performance and software support.
Processor: An Intel i3 processor or any processor with similar performance is recommended for smooth operation.
RAM: A minimum of 4 GB of RAM is needed to run the software without lags. More RAM is better for multitasking.
Storage: At least 100 GB of storage space is required to install the software and store your files.

3.2 Software Requirements

Python is a versatile, open-source language ideal for web development and data analysis, while Sublime Text delivers a multi-feature coding experience designed for Python Microsoft VS Studio provides powerful debugging and code completion tools for Python, and XAMPP Facilitate local web application testing with packages such as MySQL and PHP.

4. IMPLEMENTATION

Several modules are available to make the operation of the system very easy. These include a user authentication module, which ensures secure access for users. The Admin Management Module facilitates administrative tasks and user management. The Disk Space Listing Module provides a comprehensive view of available disk space. Users send requests through the request management module, while the role management module manages the resources. The payment module effectively handles financial transactions. For data protection, the Data Duplication and Redundancy Module ensures backup and error prevention. Finally, the Blockchain Integration Module incorporates blockchain technology to ensure data integrity and security throughout the system. Together, these modules form a unified system for efficiently managing disk space allocation.

4.1 User Authentication Module

It tracks user registration, login, and authentication, and provides account creation, password management, and session control functionality. It ensures secure access to the system by effectively managing login sessions through user identity, which enhances both security and user experience.

4.2 Admin Management Module

The Admin Management module empowers admins with the necessary tools to manage the system. It facilitates admin access, enables processing of user requests (accept or deny), monitors system activities such as connections, billing, and disk usage, and includes methods for identifying and any changes or errors that may occur in the system are dealt with. The Admin Management Module provides a comprehensive set of tools to manage the system, ensure a smooth operation and quickly resolve any problems or anomalies that may occur in the system

4.3 Disk Space Listing Module

The Disk Space Listing Module enables users to search and browse available disk space options. It provides a database that displays information such as capacity, price, and location, empowering users to make informed decisions about their storage needs.

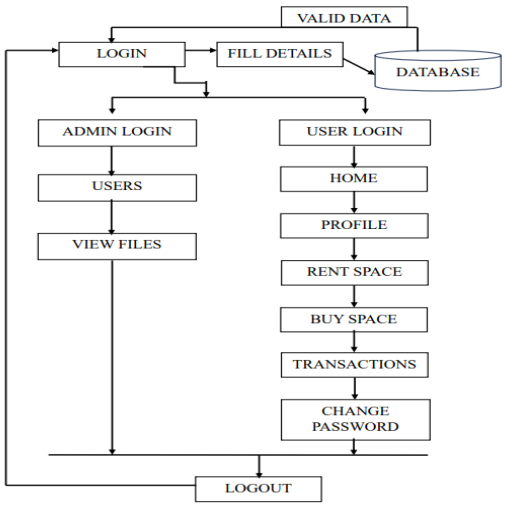

Fig-1: System Architecture

4.4 Payment Processing Module

The payment processing module facilitates seamless financial transactions between users and space owners within the system. It enables payment processing by freeing up disk space, helps streamline payment method management, and generates invoices to ensure transparency and accountability throughout the payment process, and provides users overall job satisfaction increases.

4.5 Request Management and Usage Monitoring

The request management module simplifies freeing up disk space, allowing users to submit requests for specific allocations that can be reviewed and approved or denied Additionally, users can track their disk space usage with indicators of overall usage, occupied space and available capacity, ensuring efficient use of resources.

4.6 Data Duplication and Redundancy Module

The Data Duplication and Redundancy Module protects against data loss by duplicating data across multiple nodes. It ensures multitasking by storing data copies in different locations, thus increasing fault tolerance and reliability. This approach ensures data integrity and reduces data loss in case of node failure. In addition, the Data Duplication and Redundancy module reduces the risk of data loss, by maintaining multiple copies of the data.

4.7 Block Chain Integration Module

The Blockchain Integration Module incorporates blockchain technology into the system, efficiently managing transactions. It uses hash pointers for data validation, ensuring the integrity of the information stored. Leveraging the immutability of the blockchain, the module establishes a tamper-resistant environment, increasing trust and confidence in the system.

5. RESULT AND DISCUSSION

Data integrity refers to the accuracy, reliability, and accuracy of the data stored and processed in a system or database. It ensures that data is not continuously changed and corrupted throughout its lifecycle, from creation to storage to retrieval and processing.

Define Individual Metrics:

Accuracy (A) = (Number of Correct Data Points / Total Data Points) * 100%

Reliability (R) = (Number of Successful Data Retrievals / Total Data Retrieval Attempts)

Consistency (C) = 1 - (Standard Deviation of Data Values / Average Data Value)

Combine Metrics:

Data Integrity (DI) = (w1 * Accuracy (A)) + (w2 * Reliability (R)) + (w3 * Consistency (C))

w1, w2, w3: Weights for Accuracy, Reliability, and Consistency.

Table - 1 Decentralized System vs. Centralized System Data Integrity

Months	Decentralized system data integrity		Centralized system data integrity	
	User 1	User 2	User 1	User 2
1	94.12%	93.56%	91.23%	90.67%
2	92.34%	95.23%	90.45%	91.01%
3	95.20%	94.78%	92.01%	90.56%
4	93.45%	95.12%	90.89%	92.10%
5	95.67%	94.89%	91.67%	91.78%
6	94.01%	96.00%	90.90%	93.21%

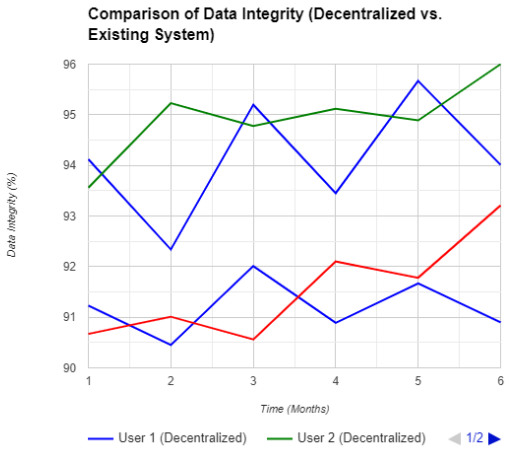

Fig -2: Comparative Analysis of Data Integrity over months for Decentralized System vs. Centralized System

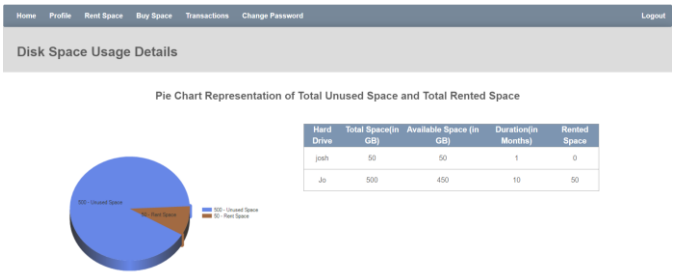

Fig - 3: User Dashboard

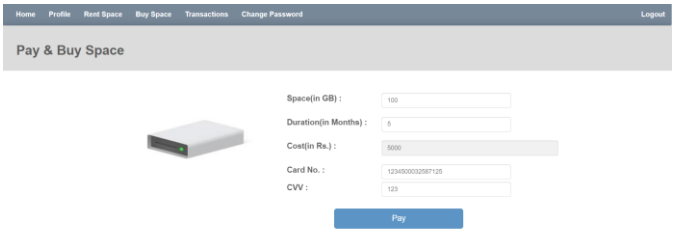

Fig - 4: Disk Space Renting

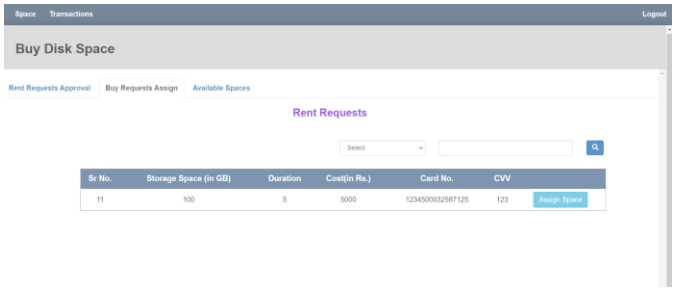

Fig - 5: Admin Approval for Request

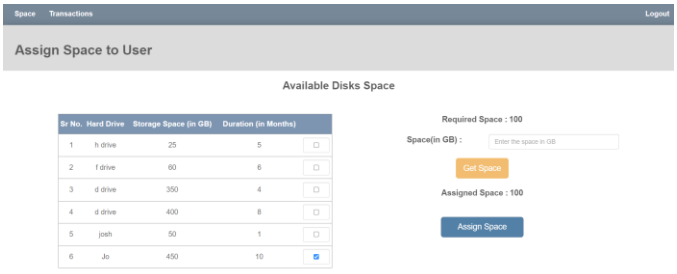

Fig - 6: Disk Space Allocation

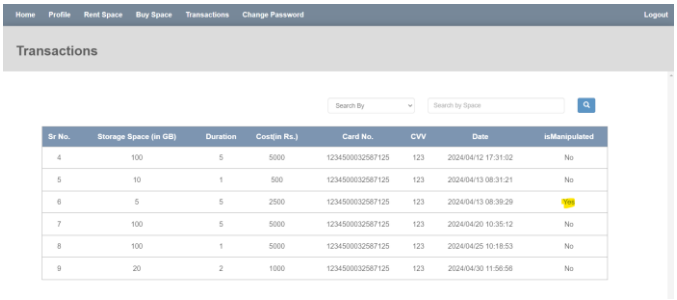

Fig - 7: Block Chain Integration

6. CONCLUSIONS

A decentralized disk space allocation system promotes an economic model that encourages users to allocate unused disk space, and encourages network growth and reliability Smart contracts make leasing agreements work in a way that it's efficient, and reduces administrative overhead. Resilient to network failures and cyberattacks, data is distributed across nodes, minimizing data loss and breaches. Transparent blockchain recording ensures auditability, fostering trust and compliance. Designed for future technologies, it is ready to efficiently meet IoT and AI data demands. One of the most important innovations in cloud storage is the integration of blockchain for decentralized data management, addressing security, privacy and efficiency.

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