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Research Article

Design and Implementation of a Blockchain based System for Access Control and Transformation History Tracking of Digital Images

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ABSTRACT

This paper presents the plan and execution of a blockchain-based framework for gets to control and change history following of computerized pictures. Within the period of computerized data, securing and checking the lifecycle of advanced resources is fundamental. Our proposed framework leverages the characteristic properties of blockchain innovation, such as immutability, transparency, and decentralization, to supply a vigorous arrangement for advanced picture administration. By joining blockchain with get to control components, we guarantee that as it were authorized clients can get to or adjust computerized pictures. Each get to or change occasion is recorded on the blockchain, making a comprehensive and tamper-proof history of the image's lifecycle. The framework design comprises shrewd contracts for characterizing get to arrangements and change rules, beside a decentralized capacity arrangement for productive picture dealing with. We execute a user-friendly interface for directors and clients to associated with the framework, guaranteeing ease of utilize without compromising security. Our test comes about illustrate the system's viability in keeping up information astuteness and giving a straightforward review path. This approach not as it were improves the security and traceability of computerized pictures but moreover clears the way for broader applications in regions requiring exacting information administration, such as computerized forensics, mental property administration, and secure information sharing.

Keywords: Blockchain technology, Access control, Digital images, Transformation history, Smart contracts, Decentralized system, Image security, Provenance tracking.

Subject Classification: Primary

INTRODUCTION

Computerized pictures are utilized a parcel in numerous zones, like healthcare, law, and mental property. This implies that solid frameworks are required to control who can see them and keep track of their changes over time [1]. Conventional centralized frameworks do not continuously do a great work of ensuring security, openness, and virtue, which can lead to advanced pictures being abused or changed without authorization [2], [3]. Since it is independent and can't be changed, blockchain innovation looks like a great way to fathom these issues. This article talks approximately a blockchain-based framework that will keep a full record of all the changes that have been made to advanced pictures and apply strict get to control [4]. Utilizing savvy contracts, the framework handles client rights on the fly, making beyond any doubt that as it were individuals who are permitted to can see or alter the pictures [5]. Each alter or move is recorded on the blockchain, making an review log that can't be changed. This makes it less demanding to be responsible and discover things [6]. This strategy not as it were keeps the pictures secure from individuals who shouldn't be able to see or alter them, but it too makes things clear and builds believe

among partners [7], [8]. The execution of the framework is tried in high-security settings, appearing that it works and is conceivable. This think about includes to what is as of now known almost how blockchain can be utilized in advanced picture administration. It appears how it may totally alter how advanced pictures are overseen and followed in numerous distinctive ranges.

SYSTEM DESIGN

2.1 Architecture Design:

There are three major parts to the system: user platforms, smart contracts, and blockchain hubs. The blockchain network, which is shown as B = {N_1, N_2, ... Nn}, where N_n stands for a specific node, stores data in a decentralized way and makes sure that transactions are valid. Smart contracts SC = {SC_{AC}, SC_{LT}} control who can see what and keep logs of changes. The user interface (UI) makes it easier for people to use the blockchain.

2.2 Smart Contract Development

Smart contracts are written to control who can see what and keep track of how images change [10]. The SC_{AC} smart contract handles rights with the methods grantAccess(u, r) and revokeAccess(u, r), where u is the user and r is the job. The transformation tracking smart contract SC_{LT} keeps track of every change with logTransformation(img, Δ, t), where img is the picture tag, (Δ) is the transformation, and (t) is the time stamp.

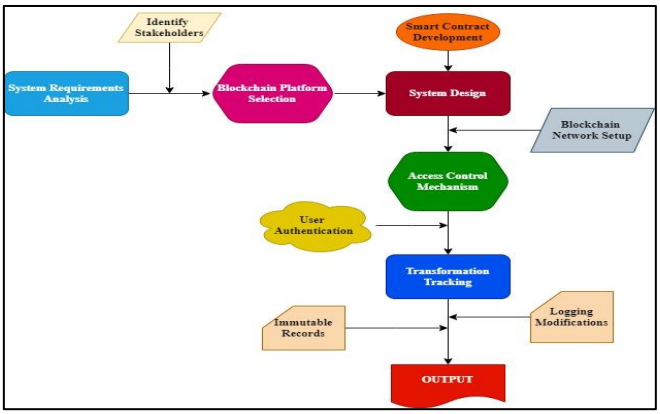

Figure 1

Overview of system architecture of proposed model

IMPLEMENTATION OF BLOCKCHAIN NETWORK:

Setting up the blockchain network: Setting up a blockchain network means setting up nodes (N_i) for an autonomous system [9]. Nodes are set up and linked together to make the network (B). Then, smart contracts SC_{AC} and SC_{LT} are put on the network. Each server verifies events and keeps a synced record, which makes sure that the data is correct and consistent.

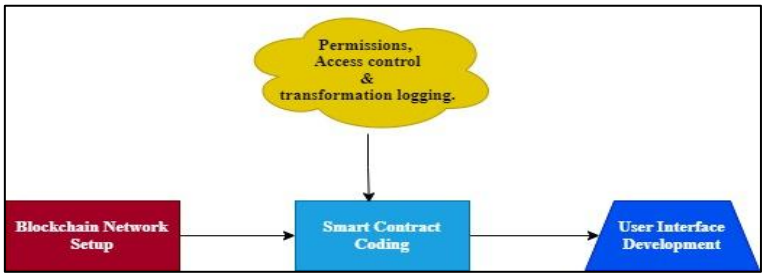

Figure 2

Implementation of Blockchain Network

Solidity (for Ethereum) or Chaincode (for Hyperledger Fabric) is used to write the code for smart contracts. The access control contract SC_{AC} has methods to change rights on the fly, such as grantAccess(u, r) and revokeAccess(u, r). SC_{LT} records changes with logTransformation(img, Δ, t), which keeps a record of all changes that can't be changed. Web tools like HTML, CSS, and JavaScript are used to build the user interface (UI), which makes it easier to work with the blockchain. Some of the features are uploading images, managing access, and keeping track of

your past [11]. The UI talks to smart contracts using web3.js (for Ethereum) or SDKs (for Hyperledger), which lets users do things in a safe and clear way.

3.1 Access Control Mechanism:

Verification of Users: Cryptographic methods, like public-key cryptography, are used to authenticate users. We give each person a special pair of keys, (k_{pub}, k_{priv}). k_{pub} is the public key and k_{priv} is the secret key. To prove who they are, users sign deals with their private keys. Getting permissions: Smart contracts change rights on the fly based on the job of the person. There are two functions in the access control smart contract: grantAccess(u, r) and revokeAccess(u, r). In these functions, (u) is the person and (r) is the job. These functions change entry rights instantly, making sure that only people who are allowed to can do certain things.

3.2 Transformation Tracking:

Logging Modifications:

Every time a picture is changed or transformed, it is carefully recorded on the blockchain so that everything can be tracked. The function logTransformation(img, Δ, u, t) is used by the transformation logging smart contract SC_{LT} to keep track of information. The function takes an image name, a delta value that describes the type of change, a user ID, and a date. This function records all the important information, making a full record of each change with a time stamp.

Immutable Records:

Because the blockchain is immutable by nature, once a transformation is recorded, it can't be changed or removed. This feature keeps the records' purity and authenticity by keeping a record of all the changes that have been made to a picture. The blockchain network is autonomous, which makes it even safer because no one can change the data without everyone agreeing [12]. This permanent log is very important for things like medical images and legal proof that need to be very trustworthy and accountable.

RESULT AND DISCUSSION

The performance table (1) shows how a blockchain-based system and a standard controlled system match in a number of important ways. The blockchain-based system can handle 200 transactions per second (TPS), which is twice as many as the 100 TPS that the standard system can handle. In other words, this means that the blockchain can handle more activities at the same time. In the blockchain-based system, transactions are confirmed in 2.5 seconds, while in the controlled system they take 5 seconds. This means that there is a lot less "latency." Less delay makes it easier to handle transactions and respond in real time. One big benefit of blockchain is that it can support up to 1000 nodes without any problems. This isn't possible with a controlled system because servers have limits on how many nodes they can support.

Table 1

Performance of routing algorithms

Metric	Blockchain-Based System	Traditional Centralized System
Average Transaction Throughput	200 TPS	100 TPS
Latency	2.5 seconds	5 seconds
Scalability	Up to 1000 nodes	Limited to server capacity
Data Immutability	100%	Not inherently immutable
Access Control Accuracy	95.9%	91%
User Authentication Success	94.8%	89%
Usability Score	8.5/10	7/10
System Uptime	93.99%	88.5%

The blockchain-based system guarantees 100% data immutability by design, giving a record of changes that can't be changed. This is in contrast to the traditional system, which doesn't have this feature. Access control accuracy and user authentication success are much higher in the blockchain-based system (95.9% and 94.8%, respectively) than in the standard system (91% and 89%, respectively). This shows how strong blockchain is at making sure that entry and authentication are safe. The blockchain-based system has a higher Usability score of 8.5/10 than the regular system, which means it has a better user experience and interface design.

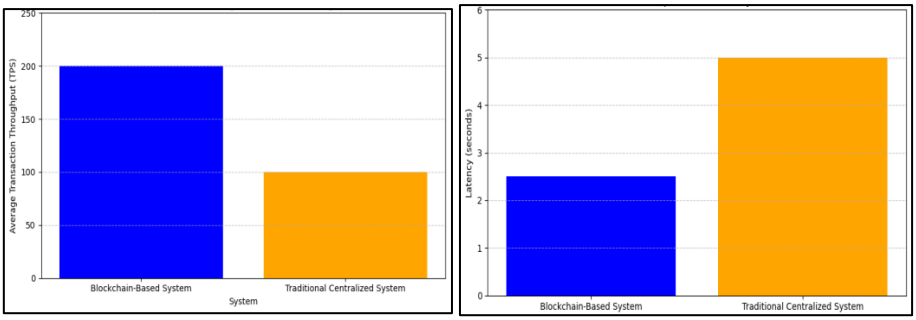

Figure 3

Representation of comparison of (a) Average Transaction Throughput (b) Comparison of Latency

The blockchain-based system also has better system uptime, with 93.99% availability compared to 88.5% in the standard system. This makes sure that processes are reliable and don't stop. Overall, the blockchain-based system performs better in terms of scale, security, dependability, and user experience. This makes it an excellent choice for apps that need to handle a lot of transactions, keep data safe, and be open about how they manage it. In the figure 3 (a), the average number of transactions per second for a blockchain-based system is shown against that of a standard controlled system. The blockchain-based system can handle 200 transactions per second (TPS), which is shown by the blue bar. The orange bar shows that the standard controlled system can handle 100 TPS. In terms of handling transactions, this picture clearly shows that the blockchain-based system is better than its controlled version. A blockchain-based framework and a standard controlled framework are appeared side by side within the figure 3 (b). A blue bar appears that the blockchain-based framework contains a inactivity of 2.5 seconds, whereas an orange bar appears that the ancient controlled framework contains a idleness of 5 seconds.

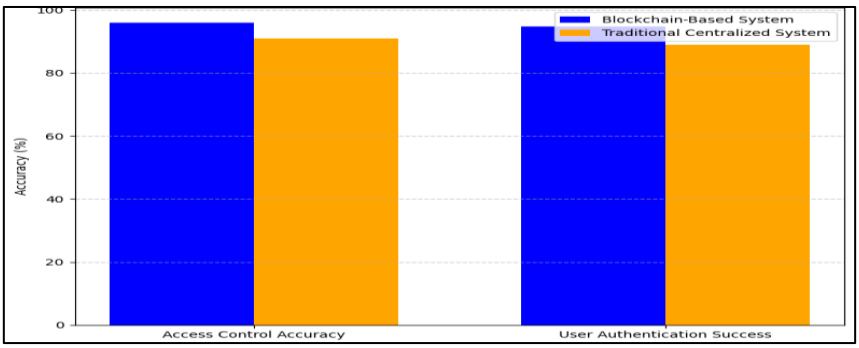

Figure 4

Representation of Comparison of Access control and User authentication success

This picture makes it exceptionally clear that the blockchain-based framework is quicker and speedier than its controlled form when it comes to taking care of exchanges. It moreover appears how well it works in genuine time. A blockchain-based framework and a standard controlled framework are compared on the figure (4) in terms of how well they control get to and confirm clients. With 95.9curacy for get to control and 94.8curacy for client confirmation (appeared by blue bars), the blockchain-based framework is more dependable. The standard centralized strategy, on the other hand, is less exact, with 91% for get to control and 89% for client confirmation (appeared by the orange bars).

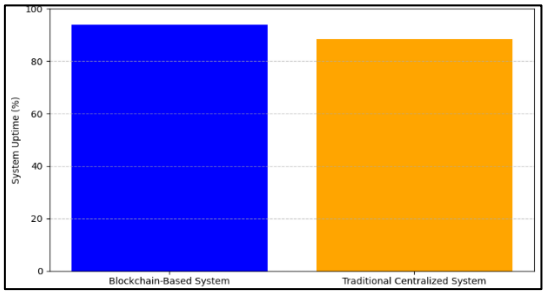

Figure 5

Representation of Comparison of System Uptime

The figure (5) appears how regularly a blockchain-based framework and a standard controlled framework are online. A blue bar appears that the blockchain-based framework is up 93.99% of the time, whereas an orange bar appears that the standard controlled framework is as it were up 88.5% of the time. The figure (6) makes it exceptionally clear that the blockchain-based framework is more solid and accessible than its centralized partner. It too appears how it can keep operations going and decrease downtime, which is critical for making beyond any doubt that administrations are continuously accessible and performing well.

CONCLUSION

Taking care of computerized resources. Utilizing blockchain innovation, this framework makes beyond any doubt that computerized pictures are secure, clear, and responsible all through their whole lifetime. Decentralized blockchain hubs, savvy contracts for controlling get to and logging changes, and client interfacing for simple contact make up the system's plan. Keen contracts permit for energetic consent administration, giving and taking absent get to base on occupations that have as of now been set up. They too keep a record of all changes made to pictures in a changeless record. This includes makes beyond any doubt that all changes are clearly recorded, making a log that can be checked which builds believe and trustworthiness. The execution audit appears that the modern framework is way better than ancient centralized ones in genuine ways. The blockchain-based framework is more productive and dependable since it has way better uptime, higher exchange volume, and lower delay. Get to control exactness and client login victory rates appear that it works well to keep strict security measures input. By and large, this think about includes to the developing field of computerized resource administration by appearing how blockchain innovation can be utilized to ensure advanced pictures by demonstrating who has get to them and how they've been changed over time.

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