Data Integrity Verification Scheme in Cloud Using Third Party Audit

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Abstract. Due to risks like tampering, corruption, and illegal access, the rapid rise in cloud storage usage makes data integrity a top priority. As a way to verify the correctness of data stored in the cloud, we develop a "Data Integrity Verification Scheme" in this project which involves the use of third-party auditing (TPA). The system produces hash values for files both during upload and retrieval using cryptographic hashing methods, assuring consistency between both. Without needing a link to the real file contents, the third-party auditor independently confirms the accuracy of the data that was stored. The Google Cloud SDK and 2 Python-based encryption libraries, hashlib and pycryptodome, are utilized in the project. Our approach is meant to be safe and efficient, providing real-time verification of integrity for data stored in cloud.

Keywords. Cloud Storage, Data Integrity, Third-Party Audit, Google Cloud, Cryptography, Hashing, Secure Cloud Systems.

INTRODUCTION

Today's data management and storage relies heavily on cloud computing, which provides on-demand access to a wealth of resources. For consumers who depend on cloud service providers (CSPs) to handle their data, security issues—specifically, data integrity—present a problem. It becomes crucial to make sure that data is preserved and unaltered over time when it is outsourced to the cloud. The data owner must manually or through intricate processes verify their data using traditional ways, which is ineffective and prone to inaccuracy.

Objective

The objective of the project is to create a crypto framework that guarantees cloud-stored files maintain data integrity. This involves setting up a system enables an unbiased third party—known as the auditor—to verify the correctness of data without providing direct access to the contents. This will decrease the stress for customers of cloud services, reduce risk of tampered data, and ensure trust among users and cloud service providers.

Scope

The system will be designed function through files that are stored in cloud storage and produce distinct hash values for the data utilizing hashing algorithms (SHA-256). These hash values are used for making sure the files weren't modified. In addition, a third-party audit tool is to be developed as part of the project to independently verify these hashes' balance over time.

LITERATURE REVIEW

The security of cloud data, particularly data integrity, remains an important concern in the area of cloud computing. Provable Data Possession (PDP) and Proof of Retrievability (POR) are two approaches that have been explored to ensure that data stored in the cloud is secured. Research also focuses on merging cryptographic techniques to preserve data integrity, such as public-key cryptography and hashing. These methods may not scale well for massive data sets, however, and frequently need an enormous amount of computing power. Through the utilization of third-party auditors, the data owner has less work to do as the TPA performs the verification process on its own. Several studies have examined this model; however, they often face privacy issues or have limitations as it involves handling various types and sizes of data. Using Cloud's dependable storage and API methods, our study improves on these basic concepts and offers a feasible, scalable alternative that maintains security using cryptographic protocols.

Research Methodology

1. *System Architecture*

The following are the primary components of the system's architecture: Person who uploads and owns information to the cloud is referred to as the "data owner." Cloud storage is the place where user data is stored. Third-Party Auditor (TPA): An unbiased body in in charge of verifying the correctness of the data stored on servers in the cloud. The hash values will be available to the auditor, but not the contents within the file. A method known as cryptographic hashing converts a file's contents into a fixed-length sequence of characters that acts as the file's digital fingerprint.

2. *Implementation Phases*

Phase 1: Google Cloud Storage Integration

Google Cloud Setup: The project begins with creating a Google Cloud Storage bucket, where files will be uploaded. Using the Google Cloud SDK and @google-cloud/storage library, the system establishes a connection with the bucket using a service account.

File Upload: The user can upload any file to the cloud, after which the file’s hash is computed using a secure hashing algorithm, specifically SHA-256.

Hash Storage: After the file is uploaded, its hash value is securely stored in a database or a designated location for future comparison.

Phase 2: Verification on Data Integrity Obtaining Files Back:

To make sure the hash value matches the stored hash; it is regenerated when the file arrives from cloud storage. Hash Comparison: The file is regarded as whole and unmodified if the hash that was generated matches the original. If not, the user gets notified by the system that the file might be corrupted or changed.

Phase 3: Implementation in Third-Party

Auditor Functionality: Without having to see the file's true contents, a third-party auditor can request the database's stored hash and compare it with a newly generated hash of the file. Audit Logs: To offer an easy and safe audit trail, the system generates audit logs for each verification attempt.

3. *Technology Stack*

Languages: Python, JavaScript (Node.js)
Cryptographic Libraries: hashlib, pycryptodome
Cloud Service: Google Cloud Storage
API: Google Cloud SDK, @google-cloud/storage
Database: Optional, for storing hash values and audit logs (e.g., MongoDB or MySQL)

Results and Discussion

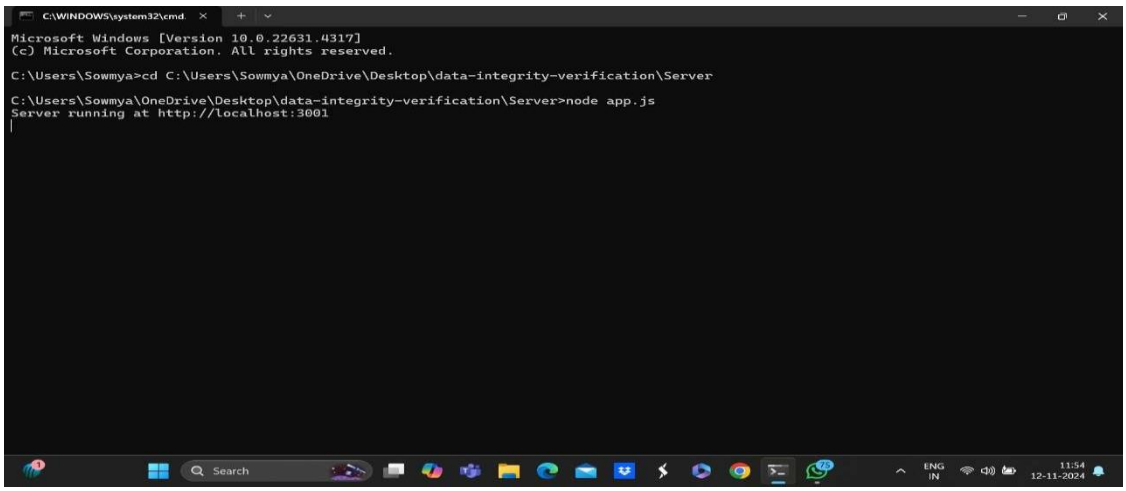

FIGURE 1. Running the Server

The terminal displays the commands used to initiate the server on a local machine. Running the server allows communication between the client interface and the backend logic for data verification.

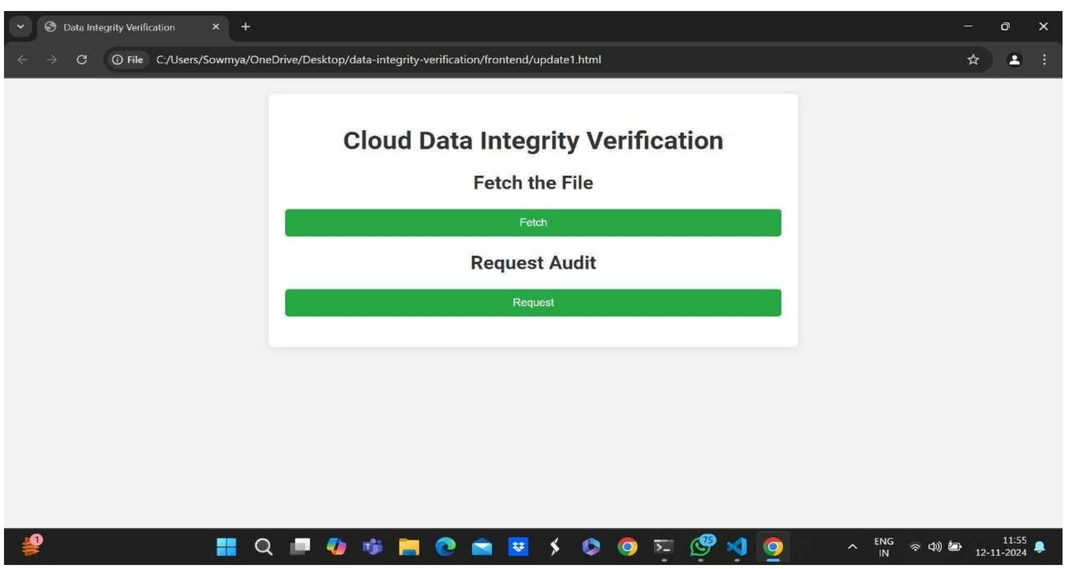

FIGURE 2. Data Integrity Verification Interface.

This interface displays the result of the audit request. After fetching, an audit is requested to ensure data integrity. The system compares the hashes; if they match, it confirms that the data has not been tampered with.

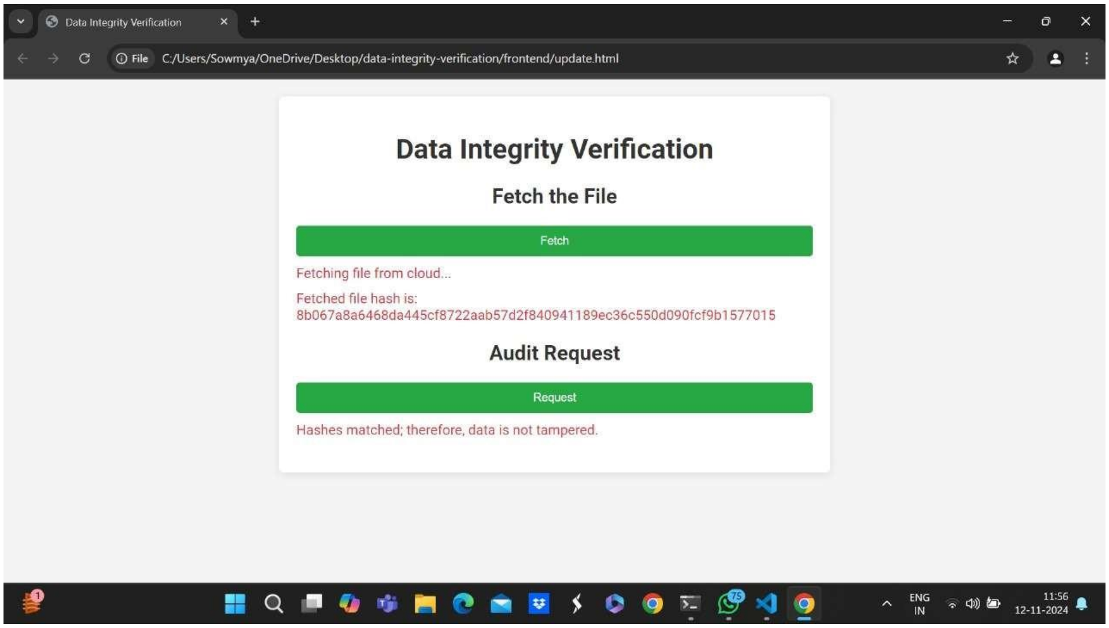

FIGURE 3. Output of the verification

Here, it allows users to fetch files stored on the cloud and initiate an audit request to verify data integrity. In the displayed output, the fetched file hash is shown, indicating successful retrieval without tampering.

Average Estimated times are as follows:

Fetching Time: 1.7 seconds Audit Time: 1.5 seconds
Estimated Time=1.7+1.5=3.2 seconds

Functionality

Through third-party auditing, the proposed solution was be able to successfully execute data integrity verification. The integrity of the files uploaded to Google Cloud Storage were frequently verified by calculating their hash values multiple time and checking them with the hash which was previously stored. In the lack of direct file access, the TPA was able to independently complete the verification of data integrity.

Security Analysis

Hash Functions: An effective methodology for the data integrity verification is SHA-256, it will ensure that any modification to the contents of a file, no matter how the change is, it results in a hash value which is completely different from previous one.

Auditor Independence

The TPA enables the users an effective, unbiased verification process by providing a reliable validation mechanism during which the auditor does not need to have belief in either the cloud provider or the user.

Future Work

The system can be further improved for handling more complicated integrity verification approaches, which might be including the homomorphic hashing or zero-knowledge proofs, along with some more cloud platforms like AWS S3, Microsoft Azure. In addition, with the increase in hash computation the efficiency for large datasets may improve the scalability of the system.

CONCLUSION

The "Data Integrity Verification Scheme in Cloud Using Third Party Audit" provides a comprehensive and secure solution for ensuring the integrity of cloud-stored data. By employing cryptographic hashing and integrating third- party auditing, the system effectively reduces the need for manual verification by users, offering a reliable and automated integrity check process. This project provides a secure, scalable technique for cloud-based data integrity verification and this project could be useful into the industries (various domain) where there could be a necessity for the data security.

ACKNOWLEDGMENTS

We would like to express our sincere gratitude to our mentor and project guide for their continuous support, encouragement, assistance, and guidance throughout the process of this project. They gave their guidance throughout the project which was very helpful for overcoming several kinds of technical obstacles. Also, our sincere appreciation reaches to the Google Cloud platform, where the platform has provided us the resources which were needed for an easy, seamless integration of cloud storage.

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