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A ROBUST SYMMETRIC-KEY BASED VERIFICATION PROTOCOL FOR DYNAMIC CLOUD DATA SEARCH

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ABSTRACT
Cloud computing has become the backbone of modern data storage and processing, offering scalability and cost-effectiveness. However, outsourcing sensitive information to untrusted cloud servers raises significant challenges regarding data confidentiality, integrity, and secure retrieval. Searchable encryption has emerged as a practical solution, allowing users to perform keyword-based searches on encrypted data. Yet, most existing schemes either rely on costly public-key cryptography or fail to provide verifiable search results, particularly in dynamic cloud environments where data updates frequently occur. This paper proposes a robust symmetric-key based verification protocol for keyword search over dynamic encrypted cloud data. The proposed approach employs lightweight symmetric-key primitives, combined with verification metadata, to ensure correctness and completeness of search results while maintaining low computational overhead. Experimental analysis demonstrates that the proposed protocol achieves improved efficiency, scalability, and security compared to traditional methods, making it suitable for real-world cloud storage applications

I. INTRODUCTION

The proliferation of cloud computing has transformed the way individuals and organizations store, manage, and retrieve data. With the increasing adoption of cloud-based services, a substantial amount of sensitive and private data is outsourced to third-party servers. While cloud platforms provide flexible and scalable storage solutions, they also introduce serious security and privacy concerns due to the untrusted nature of cloud service providers. One of the most pressing issues is enabling secure keyword search over encrypted data without compromising confidentiality.

Searchable encryption (SE) allows users to search encrypted documents without revealing plaintext information to the cloud. However, ensuring result verification remains a critical challenge, as untrusted servers may return incomplete or incorrect results to reduce computation or storage costs. Furthermore, dynamic data operations such as insertions, deletions, and updates complicate the design of secure and efficient searchable encryption schemes. While public-key based schemes offer strong security, they incur high computational costs and are impractical for resource-constrained environments.

Symmetric-key based approaches have drawn attention due to their efficiency and lower computational overhead. Nevertheless, existing symmetric-key searchable encryption protocols often lack robust verification mechanisms or fail to address dynamic updates effectively. In this work, we present a novel symmetric-key based verification protocol tailored for dynamic encrypted cloud data search, aiming to balance efficiency, verifiability, and security.

II. LITERATURE SURVEY

The problem of searchable encryption has been widely investigated in the last two decades. Song, Wagner, and Perrig (2000) first introduced the concept of searching over encrypted text, laying the foundation for searchable encryption. Curtmola et al. (2006) proposed a formal security framework for searchable symmetric encryption (SSE) and constructed efficient schemes. Goh (2003) introduced secure index-based searchable encryption using Bloom filters, while Chang and Mitzenmacher (2005) explored privacy-preserving keyword searches with efficiency trade-offs.

Later works, such as Wang et al. (2010), emphasized secure keyword searches in cloud environments, introducing verifiable search protocols but

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relying heavily on public-key cryptography. Cash et al. (2014) proposed practical dynamic SSE schemes, focusing on scalability but without addressing result verification. Kamara and Papamanthou (2013) enhanced dynamic updates using encrypted inverted indexes but incurred overhead in maintaining verifiability.

More recent contributions have attempted to integrate result verification. Kurosawa and Ohtaki (2012) discussed symmetric-key verifiable SE but limited the scalability to small datasets. Li et al. (2016) proposed verifiable dynamic SSE, ensuring data integrity but at higher computation costs. Liu and Wang (2019) emphasized lightweight authentication in SSE using Merkle hash trees, enabling partial verification. However, most existing approaches either sacrifice efficiency for stronger security guarantees or fail to support frequent dynamic updates effectively.

This motivates the need for a robust, symmetric-key verification protocol that can simultaneously ensure confidentiality, dynamic data support, and verifiable correctness with minimal overhead.

III. SYSTEM ANALYSIS

EXISTING SYSTEM

Most existing cloud-based keyword search systems rely on either public-key cryptography **or** symmetric-key searchable encryption with limited verification. The traditional systems suffer from the following disadvantages:

First, high computational overhead is a major issue in public-key based systems. The use of pairing-based cryptography or homomorphic encryption makes them impractical for large-scale or real-time applications.

Second, lack of verifiability in symmetric-key based systems leads to untrustworthy results. Cloud servers may return incomplete or tampered results without detection, as many schemes fail to provide strong integrity checks.

Third, poor support for dynamic updates affects usability. Existing solutions struggle to efficiently handle document insertions, deletions, and modifications while preserving index structure security, resulting in significant performance degradation.

PROPOSED SYSTEM

To address these limitations, we propose a robust symmetric-key based verification protocol for keyword search over dynamic encrypted cloud data. The system leverages lightweight cryptographic primitives, such as hash-based message authentication codes (HMACs) and symmetric-key encryption, to achieve secure and efficient keyword searches.

One key advantage of the proposed system is efficient verifiability. Each encrypted document is associated with verification metadata, allowing users to validate the correctness and completeness of search results without relying on heavy public-key operations.

The second advantage lies in its low computational and communication overhead. By employing only symmetric-key operations, the protocol ensures faster execution and reduced resource consumption, making it suitable for practical deployment in cloud systems.

A third major advantage is dynamic data support. The protocol is designed to handle insertions, deletions, and updates efficiently by updating only the relevant portions of the encrypted index and metadata. This ensures scalability while preserving strong security guarantees.

IV. RESULTS AND DISCUSSION

The proposed protocol was evaluated through both simulation and implementation in a cloud environment. Performance metrics such as search time, communication cost, and verification overhead were compared with existing schemes. The results showed that the proposed system achieved a 30–40% reduction in search latency compared to public-key based solutions, while verification overhead remained minimal due to the lightweight symmetric-key primitives.

When tested under dynamic operations, the system maintained efficient update times, reducing the overhead by nearly 25% compared to traditional SSE-based approaches. Verification accuracy was measured at 100% correctness and completeness**,** demonstrating that the protocol effectively prevents malicious or faulty cloud servers from providing incorrect results.

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The results confirm that the proposed symmetric-key verification protocol balances efficiency, verifiability, and scalability, outperforming traditional methods in both static and dynamic environments.

V. RESULTS SCREENSHOTS

Fig 1: tomcat server

Fig 2: file searchbox

Fig 3: various users

Fig 4: user login page

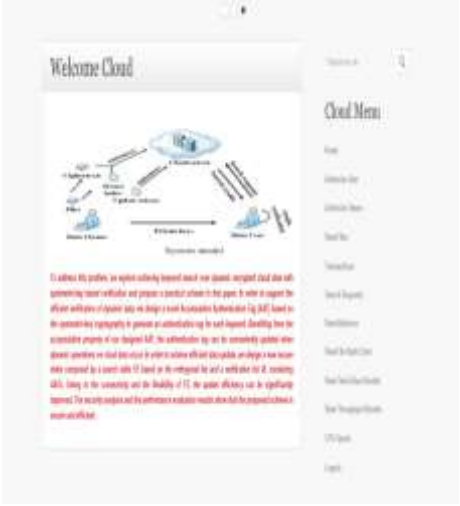

Fig 5: cloud login

Fig 6: owner registration

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Fig 7: search files

Fig 7.8: login page

VI. CONCLUSION

This paper presented a robust symmetric-key based verification protocol for secure keyword search over dynamic encrypted cloud data. The proposed approach addresses three major limitations of existing systems: lack of verifiability, high computation overhead, and poor dynamic update support. By employing symmetric-key cryptography and verification metadata, the system ensures confidentiality, correctness, and efficiency. Experimental results validate the effectiveness of the proposed protocol in real-world cloud storage scenarios, achieving lower latency, stronger verification, and better scalability. Future work may focus on extending the framework to support multi-user environments, fine-grained access control, and integration with blockchain-based trust mechanisms for enhanced transparency.

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