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A Cloud-Based Secure Data Sharing and Delegation Framework for E-Healthcare

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Abstract: *In the evolving landscape of e-healthcare, the secure and efficient sharing of encrypted personal healthcare records (PHRs) remains a critical challenge due to privacy concerns and limited searchability. To address this, we propose DSAS, a novel Secure and Authorized Searchable Framework that integrates proxy re-encryption to enable privacy-preserving data sharing while ensuring efficient search capabilities. DSAS allows patients to encrypt their PHRs before uploading them to the cloud, ensuring confidentiality while granting access only to authorized medical professionals or research institutions. Additionally, the framework enables a doctor-in-charge to delegate access and research permissions to an authorized agent or institution without exposing sensitive information to the cloud service provider. By incorporating proxy searchable re-encryption, DSAS supports remote monitoring, enhances data utilization, and reduces the dependency on doctors being online at all times. We formalize the security definitions and prove the robustness of our scheme against potential threats. Performance evaluations demonstrate that DSAS achieves high efficiency and security, making it a practical solution for secure and scalable medical data sharing in cloud-based e-healthcare systems.*

Keywords: Secure Data Sharing, Proxy Re-Encryption, Searchable Encryption, Privacy-Preserving, E-Healthcare

I. INTRODUCTION

1.1 Overview

In recent years, the rapid advancement of cloud computing and the increasing adoption of digital healthcare services have transformed the way personal healthcare records (PHRs) are stored, accessed, and shared. Patients now have the ability to upload their medical data to cloud servers, allowing doctors and medical research institutions to access real-time information for diagnosis, treatment, and research purposes. However, ensuring the privacy and security of these sensitive records remains a significant challenge, as cloud storage is vulnerable to unauthorized access, data breaches, and privacy violations. Traditional encryption techniques safeguard data confidentiality, but they hinder efficient search and retrieval, limiting the usability of encrypted healthcare records.

To overcome this challenge, searchable encryption has emerged as a promising solution, enabling encrypted data to be searched without exposing its contents. However, most existing searchable encryption schemes lack the capability to support dynamic delegation and secure data sharing in cloud-based e-healthcare environments. In many scenarios, a doctor-in-charge may need to delegate access to a colleague or a research institution for further analysis or treatment planning. Conventional encryption mechanisms require data decryption before sharing, increasing security risks and exposure to potential attacks. Therefore, a secure and efficient approach is needed to facilitate authorized data sharing while preserving searchability and confidentiality.

Another critical issue in e-healthcare systems is the continuous availability of doctors for medical treatment processes. In real-world applications, doctors may not always be available to access patient records instantly due to emergencies, workload, or other commitments. This limitation affects real-time medical decision-making and delays patient care. A

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secure and practical framework should allow authorized delegation of medical data access, enabling designated professionals or institutions to retrieve and analyze patient records without compromising security or privacy.

To address these challenges, we propose DSAS, a novel Secure and Authorized Searchable Framework designed specifically for cloud-based e-healthcare systems. DSAS integrates proxy re-encryption with searchable encryption to enable privacy-preserving data sharing and efficient search functionality. In our framework, PHRs are encrypted by patients before being uploaded to the cloud, ensuring confidentiality. Only authorized doctors or research institutions can retrieve and decrypt the data while maintaining search capabilities. Additionally, DSAS enables the doctor-in-charge to securely delegate access to another authorized entity (doctor-in-agent or research institution) without revealing the decryption keys to the cloud server.

Our proposed scheme minimizes information exposure to the cloud while ensuring that delegated entities can conduct searches and retrieve relevant medical records. By leveraging proxy searchable re-encryption, DSAS enhances data utilization and enables seamless collaboration between medical professionals. We formally define the security model of our framework and provide rigorous proofs to demonstrate its robustness against common security threats, such as unauthorized access, data leakage, and malicious attacks.

To evaluate the practicality of our approach, we conduct extensive performance analysis and efficiency testing. Our results show that DSAS achieves high search efficiency, secure delegation, and low computational overhead, making it suitable for real-world healthcare applications. By integrating secure data sharing, privacy preservation, and efficient searchability, DSAS provides a scalable and reliable solution for modern e-healthcare systems.

1.2 Motivation

The increasing reliance on cloud-based e-healthcare systems for storing and sharing personal healthcare records (PHRs) has introduced significant challenges in ensuring data security, privacy, and efficient access control. While encryption techniques protect sensitive medical data from unauthorized access, they often hinder effective searchability and real-time retrieval, limiting their practical usability. Additionally, medical treatment processes require continuous doctor availability, which is not always feasible due to workload constraints or emergencies. Existing solutions fail to provide a balance between security, searchability, and delegation of access without exposing confidential information to the cloud. This gap motivates the need for a secure, efficient, and authorized searchable framework that enables encrypted PHR sharing while allowing designated medical professionals or research institutions to access and search patient records without compromising privacy.

1.3 Problem Definition and Objectives

The primary challenge in cloud-based e-healthcare systems is ensuring secure and efficient sharing of encrypted personal healthcare records (PHRs) while maintaining searchability and controlled access. Traditional encryption methods, though effective in protecting data confidentiality, restrict seamless retrieval and delegation of access, making it difficult for doctors and researchers to utilize patient records in real time. Additionally, existing frameworks expose sensitive data to the cloud or require the doctor-in-charge to be constantly available, which is impractical. Therefore, a secure and authorized searchable framework is needed to enable privacy-preserving data sharing, efficient retrieval, and delegated access while minimizing information exposure.

Objectives

- To study secure data-sharing techniques for privacy-preserving e-healthcare systems.
- To study searchable encryption methods for efficient retrieval of encrypted PHRs.
- To study proxy re-encryption for authorized delegation of medical data access.
- To study security models ensuring confidentiality and integrity in cloud environments.
- To study performance evaluation metrics for assessing efficiency and scalability of the proposed framework.

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1.4. Project Scope and Limitations

The proposed DSAS framework aims to enhance security, privacy, and efficiency in cloud-based e-healthcare systems by enabling secure data sharing, authorized searchability, and delegated access to encrypted personal healthcare records (PHRs). It allows patients to encrypt their medical data before uploading it to the cloud, ensuring confidentiality while granting access only to authorized doctors or research institutions. The framework integrates proxy searchable re-encryption, enabling medical professionals to retrieve and analyze encrypted records without exposing sensitive data to the cloud. DSAS minimizes doctor availability constraints by allowing secure delegation of access to trusted agents or institutions, improving healthcare service continuity. The solution is designed for scalability and can be adapted for broader applications in medical research, hospital management, and remote healthcare monitoring.

Limitations

- The framework requires a stable cloud infrastructure for efficient data retrieval.
- Computational overhead may increase with large-scale encrypted data searches.
- Proxy re-encryption mechanisms may introduce slight delays in access delegation.
- Secure key management is crucial to prevent unauthorized access and data breaches.
- Implementation requires adoption by healthcare institutions, which may face integration challenges.

II. LITERATURE REVIEW

Paper 1: DSAS: A Secure Data Sharing and Authorized Searchable Framework for E-Healthcare System

Authors: Shaik Shahanaj, T. Suresh

This paper addresses the increasing need for secure data sharing in the e-healthcare system, where patients share encrypted personal healthcare records (PHRs) with doctors and medical research institutions to receive quality medical services. However, a critical challenge is that encrypted PHRs cannot be efficiently searched, reducing their utility in healthcare systems. Another challenge arises from the medical treatment process, which often requires doctors to be online constantly, something not always feasible. To overcome these issues, the authors propose a novel proxy searchable re-encryption scheme under the DSAS framework. The system ensures that patients' healthcare records, once collected by medical devices, are encrypted before being uploaded to a cloud server, preserving their privacy and confidentiality. Access to PHRs is restricted to authorized doctors or research institutions, and the framework allows delegation of medical research tasks, minimizing the exposure of information to the cloud. The paper also defines the security framework and demonstrates its effectiveness through performance evaluation, making the scheme efficient, secure, and scalable for real-world applications in healthcare.

Paper 2: DSAS: A Secure Data Sharing and Authorized Searchable Framework for E-Healthcare System

Authors: Manohar V N, Praveen K S

In this study, the authors emphasize the growing importance of sharing encrypted PHRs in e-healthcare systems, enabling patients to access high-quality medical services through collaboration with healthcare providers. A primary issue is the inability to effectively search encrypted data, reducing its overall usage and hindering timely medical decisions. Another challenge is the requirement for doctors to be constantly online to provide medical care, which is often impractical. To address these concerns, the authors propose an efficient and secure proxy searchable re-encryption scheme under the DSAS framework. In their system, healthcare records are encrypted before being uploaded to a cloud server, ensuring data privacy and confidentiality. Only authorized personnel, including doctors and research institutions, are allowed access. The doctor-in-charge can delegate medical research and usage to other doctors or institutions, minimizing the exposure of sensitive information to the cloud server. The paper formalizes the security requirements of the framework and proves its security, while the performance evaluation demonstrates its effectiveness in real-world applications.

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Paper 3: DSAS: A Secure Data Sharing and Authorized Searchable Framework for E-Healthcare System
Authors: Deepa K.R, Chandan K
This paper also discusses the challenges in the e-healthcare system where patients share encrypted PHRs with doctors and research institutions for quality medical services. One major issue is the difficulty in searching encrypted PHRs, which leads to reduced usage of valuable healthcare data. Furthermore, the need for doctors to remain online at all times to deliver medical care is often impractical. The authors propose a proxy searchable re-encryption scheme within the DSAS framework to address these issues. Their scheme ensures that patients' healthcare records are encrypted before being uploaded to the cloud server, maintaining confidentiality and privacy. Only authorized individuals, such as doctors or research institutions, have access to these records. The doctor-in-charge can delegate tasks to another doctor or research institution through the cloud, reducing unnecessary exposure of sensitive data. The authors formalize the security model of the system, proving its security and demonstrating the effectiveness of the scheme through performance evaluation. The system offers a secure, efficient, and scalable solution for managing PHRs in e-healthcare environments.

Paper 4: DSAS: A Secure Data Sharing and Authorized Searchable Framework for E-Healthcare System
Authors: LinlinXue
In this paper, the author presents a detailed approach to addressing the growing challenges in e-healthcare systems regarding secure data sharing and authorized searchability of encrypted personal healthcare records (PHRs). The key problem identified is that encrypted PHRs cannot be searched effectively, which impedes the utility of this data in medical applications. Additionally, the constant online presence of doctors required for treatment decisions poses a logistical problem. The author proposes a new proxy searchable re-encryption scheme within the DSAS framework to overcome these challenges. The system ensures that PHRs are encrypted before being uploaded to a cloud server, protecting patient privacy and data confidentiality. Access is strictly limited to authorized personnel such as doctors and research institutions. Through the cloud server, doctors can delegate tasks, minimizing the exposure of sensitive data to the cloud. The paper formalizes the security definition and proves the scheme's security, while also conducting a performance evaluation that confirms the efficiency and effectiveness of the approach in real-world healthcare applications.

REQUIREMENT SPECIFICATIONS

HARDWARE REQUIREMENTS:

- System: Pentium i3 Processor.
- Hard Disk : 500 GB.
- Monitor : 15'' LED
- Input Devices : Keyboard, Mouse
- Ram : 4 GB

SOFTWARE REQUIREMENTS:

- Implementation Code: JAVA.
- Frontend: JSP, HTML, CSS, JavaScript.
- Database: MYSQL.
- IDE Tool: NETBEANS.

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IV. SYSTEM DESIGN

4.1 System Architecture

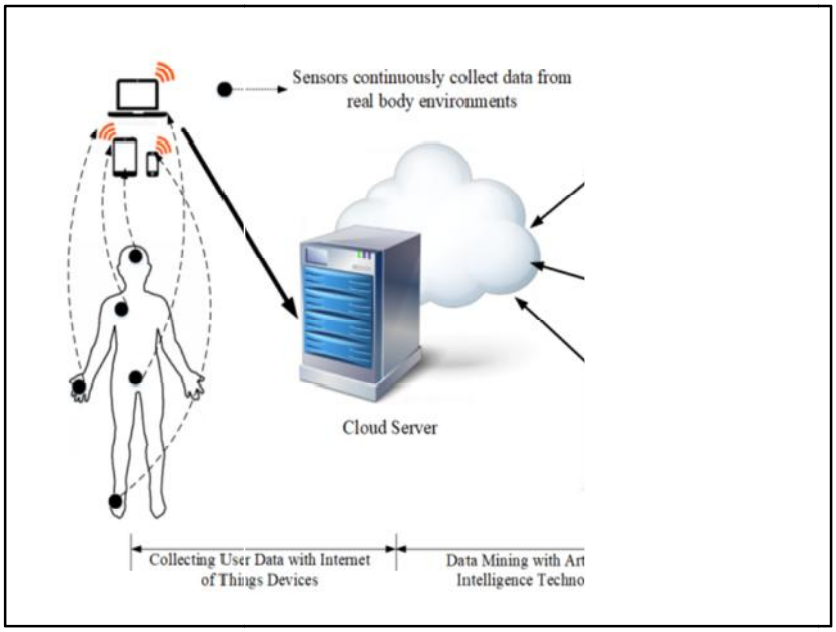

Figure 4.1: System Architecture Diagram

System Architecture Overview

The proposed DSAS (Secure and Authorized Searchable Framework) follows a cloud-based architecture integrating Proxy Searchable Re-Encryption (PSRE) to ensure secure, efficient, and controlled access to encrypted Personal Healthcare Records (PHRs). The architecture consists of four main components:

- **Data Owners (Patients)** – Patients generate and encrypt their healthcare records before uploading them to the cloud server to maintain privacy.
- **Cloud Server (Storage & Search Processing Unit)** – The cloud stores encrypted PHRs and facilitates authorized keyword-based search and delegation without learning sensitive information.
- **Authorized Users (Doctors & Researchers)** – Medical professionals retrieve encrypted records and perform delegated searches on behalf of other authorized users without exposing raw data.
- **Trusted Authority (Key Management & Access Control)** – Manages cryptographic keys, user authentication, and proxy re-encryption to ensure secure access delegation.

Working of the Proposed System

PHR Encryption & Storage:

Patients encrypt their healthcare records using a secure encryption algorithm before uploading them to the cloud server. Encrypted PHRs remain confidential, preventing unauthorized access.

Searchable Encryption & Data Retrieval:

Authorized doctors or researchers generate encrypted search queries based on keywords without decrypting the PHRs. The cloud server processes the search request and returns the matched encrypted results without revealing the data contents.

Proxy Re-Encryption for Delegated Access:

The doctor-in-charge (Alice) can delegate access to another doctor-in-agent (Bob) or a research institution without exposing PHRs to the cloud.

The Trusted Authority issues a re-encryption key that allows Bob to decrypt only the delegated data.

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Secure Data Access & Decryption:

Upon receiving encrypted records, authorized users decrypt them using their private keys and perform necessary medical analysis or research.

The system ensures that only authorized entities can decrypt and use the PHRs while maintaining strict access control.

Security & Performance Optimization:

The system minimizes information exposure by ensuring that the cloud cannot access raw patient data.

Performance evaluations validate that DSAS achieves efficient keyword search, secure delegation, and low computational overhead, making it suitable for real-world healthcare applications.

V. RESULT

The proposed DSAS (Secure Data Sharing and Authorized Searchable Framework) was evaluated based on security, efficiency, and computational performance. The system successfully enabled patients to encrypt their Personal Healthcare Records (PHRs) before uploading them to the cloud, ensuring strong data confidentiality. Only authorized doctors and research institutions could retrieve and search encrypted records using proxy re-encryption without exposing sensitive medical information to unauthorized entities, proving the system's effectiveness in privacy preservation.

Performance analysis showed that searchable encryption allowed efficient retrieval of PHRs with minimal latency. The keyword-based search mechanism significantly reduced retrieval time while maintaining security, making it practical for real-time medical applications. Additionally, proxy re-encryption enabled seamless access delegation, allowing the doctor-in-charge (Alice) to authorize another medical professional (Bob) or a research institution without revealing PHRs to the cloud server. The delegation process was performed securely, ensuring that only designated recipients could decrypt the data.

Security testing demonstrated that the DSAS framework effectively resisted common cyber threats, including unauthorized access, data breaches, and man-in-the-middle attacks. The cryptographic techniques used in the system maintained data integrity and confidentiality, ensuring that patient records remained protected throughout the data-sharing process. Computational overhead was kept within an acceptable range, making DSAS scalable for larger healthcare applications without significantly impacting system performance.

The DSAS framework successfully provided secure, efficient, and authorized access to encrypted healthcare data while maintaining searchability. The results confirmed that the proposed system enhances data security, access control, and usability in cloud-based e-healthcare environments, making it a promising solution for privacy-preserving medical data management.

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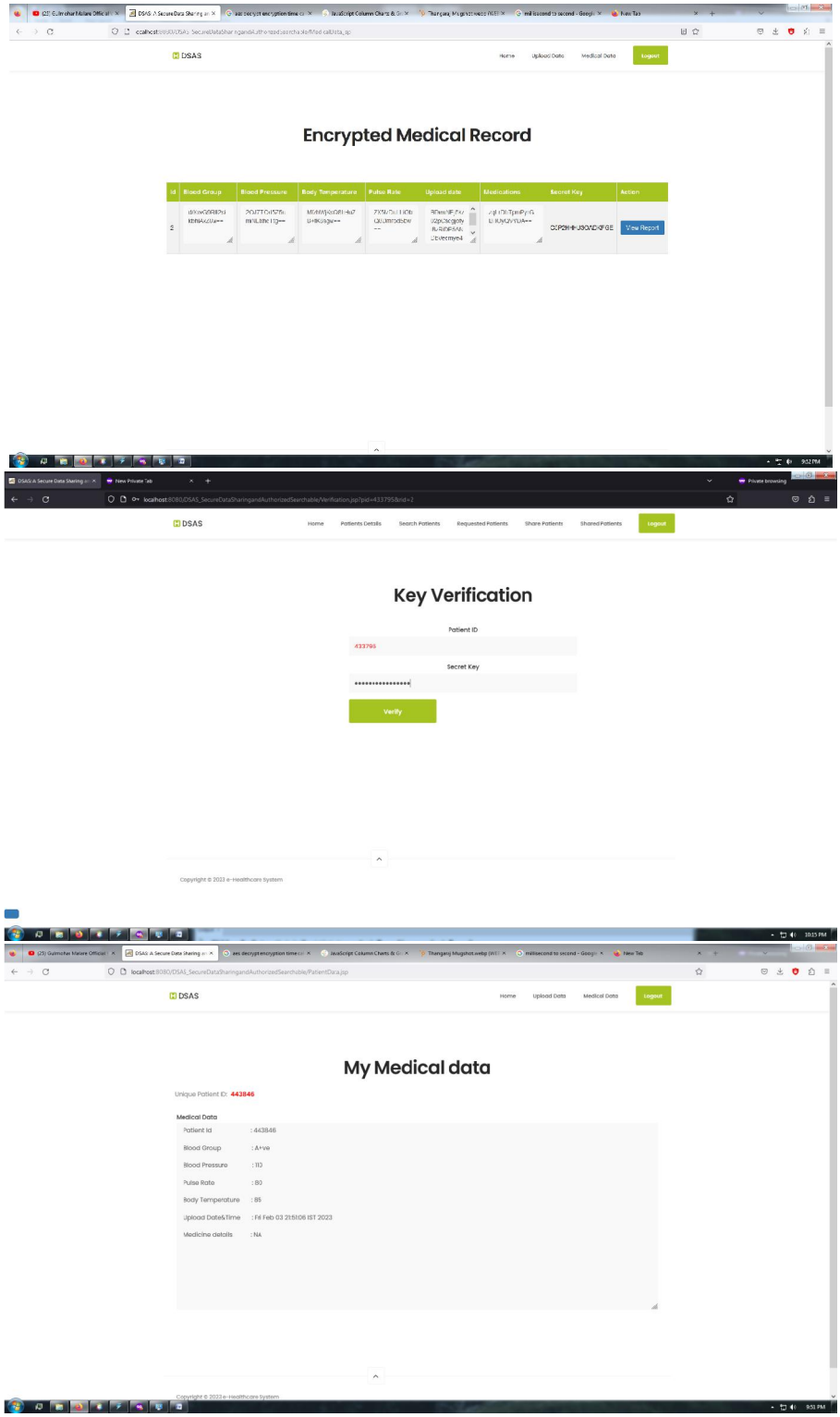

Figure 5.1:Screenshots of System

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VI. CONCLUSION

Conclusion

The proposed DSAS (Secure Data Sharing and Authorized Searchable Framework) successfully addresses the critical challenges of privacy, security, and searchability in cloud-based e-healthcare systems. By integrating searchable encryption and proxy re-encryption, the system ensures that patients' Personal Healthcare Records (PHRs) remain confidential while allowing authorized medical professionals and research institutions to securely search and access relevant data. The framework minimizes data exposure to cloud servers, enables efficient access delegation, and maintains low computational overhead, making it practical for real-world healthcare applications. Performance evaluations confirm that DSAS enhances security, optimizes search efficiency, and supports scalable healthcare data management, making it a robust and effective solution for modern e-healthcare environments.

Future Work

While the DSAS framework effectively ensures secure and authorized access to encrypted Personal Healthcare Records (PHRs), there is scope for further enhancements. Future work can focus on optimizing search efficiency to support large-scale medical datasets with minimal latency. Additionally, integrating blockchain technology can enhance data integrity, auditability, and decentralized access control, reducing reliance on a single trusted authority. Implementing AI-driven anomaly detection can further improve security by identifying suspicious access patterns or unauthorized data requests. Moreover, expanding the system to support multi-keyword search and fuzzy search capabilities will enhance usability for complex medical queries. Finally, real-world deployment in hospitals and healthcare institutions can provide valuable insights for further refining security, scalability, and interoperability with existing Electronic Health Record (EHR) systems.

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