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Enhancing Privacy and Security In Cloud-Based Personal Health Records Sharing Through Sesphr Methodology

V. Aadharsh[1]*, Mr N. Sakthivel* [2]

[1]Dept of Computer Applications
[2]Assistant Professor Dept of Computer Applications
[1, 2] Adhiyamaan College of Engineering (Autonomous), Hosur, Tamil Nadu, India.

ABSTRACT :

The rapid adoption of cloud computing in healthcare has led to significant concerns regarding the privacy and security of Personal Health Records (PHRs). Traditional cloud-based PHR storage systems are vulnerable to unauthorized access, data breaches, and integrity issues, necessitating robust security frameworks. This paper proposes the SESPHER (Secure and Efficient Sharing of Personal Health Records) methodology, which integrates attribute-based encryption (ABE) for fine-grained access control and blockchain technology for immutable and transparent access logging. The proposed approach ensures that only authorized users can access specific health data while maintaining a secure and verifiable transaction history.

SESPHER enhances data confidentiality, integrity, and availability in cloud-based PHR sharing, reducing computational overhead while improving security. Through efficient key management and cryptographic techniques, the system mitigates risks associated with unauthorized data modifications and privacy breaches. Performance evaluations indicate that SESPHER provides a scalable and secure framework for healthcare applications, ensuring trust in cloud-based PHR management. The proposed methodology offers a practical and efficient solution for enhancing privacy and security in modern cloud-based healthcare systems.

I. INTRODUCTION :

Cloud computing has transformed the healthcare industry by enabling efficient storage and management of Personal Health Records (PHRs). Cloud-based systems allow patients to access and share their medical data conveniently; however, these benefits come with significant security risks. Unauthorized access, data breaches, and privacy violations are major challenges that hinder the adoption of cloud-based PHR systems. Traditional encryption techniques provide basic security but often lack fine-grained access control and efficient key management.

To address these challenges, we introduce the SESPHR (Secure and Efficient Sharing of Personal Health Records) methodology. SESPHR ensures that patients retain full control over their health records while maintaining strict security and privacy policies. By employing advanced encryption, selective sharing, and role-based access control, SESPHR prevents unauthorized entities from accessing sensitive health data. Additionally, the incorporation of Setup and Re-encryption Server (SRS) and High-Level Petri Nets (HLPN) enhances security while minimizing computational overhead.

II. RELATED WORK :

Several studies have proposed security mechanisms for cloud-based PHR sharing. Attribute-Based Encryption (ABE) has been widely used to enforce fine-grained access control, but it suffers from computational inefficiency. Role-Based Access Control (RBAC) has also been explored, but traditional implementations fail to prevent statistical inference attacks. Recent advancements in re-encryption techniques have improved data security, yet challenges remain in key management and preventing unauthorized access.

Blockchain technology has been introduced as a potential solution for maintaining secure and transparent access logs. However, its integration with cloud-based PHR systems introduces scalability concerns. Existing methodologies either compromise security for usability or impose high computational costs. SESPHR addresses these gaps by combining ABE, role-based policies, re-encryption mechanisms, and HLPN-based validation to enhance both security and efficiency.

III METHODOLOGY :

A. Secure and Efficient Sharing of PHR (SESPHR) Framework

SESPHR provides patient-driven control over health records while ensuring robust security measures. The framework enables patients to store encrypted PHRs in an untrusted cloud environment without exposing sensitive data to unauthorized users. The key components of SESPHR are:

1. **Setup and Re-encryption Server (SRS):** Generates encryption keys and facilitates re-encryption to enforce fine-grained access control.

2. **Attribute-Based Encryption (ABE):** Ensures that only authorized users can access specific portions of PHR data.
3. **Role-Based Access Control (RBAC):** Defines access policies for data attributes to restrict unauthorized users.
4. **Statistical Inference Attack Prevention:** Prevents pattern-based attacks that could reveal sensitive patient information.
5. **Cloud Storage and Retrieval Mechanism:** Ensures encrypted storage and secure data retrieval without revealing access patterns.

B. Key Management and Access Control

SESPHR implements forward and backward security to protect PHR data even if encryption keys are compromised. The SRS manages encryption keys dynamically, ensuring seamless access transitions for authorized users while preventing access to revoked users. Role-based access control policies define granular access levels, ensuring privacy preservation while maintaining usability.

C. Security Verification Using HLPN

To formally validate SESPHR, we employ **High-Level Petri Nets (HLPN)** for security analysis. HLPN models:

- Verify access control mechanisms.
- Identify potential security vulnerabilities.
- Ensure encryption and re-encryption processes are implemented correctly.
- Demonstrate resistance to insider threats and unauthorized access attempts.

IV DISCUSSION :

SESPHR provides a balanced approach to **security, privacy, and efficiency** in cloud-based PHR management. The methodology allows patients to securely store and share health records while mitigating privacy risks. Key advantages include:

- **Improved Security:** Strong encryption, re-encryption, and role-based policies prevent unauthorized data access.
- **Privacy Protection:** Statistical inference attack prevention ensures sensitive data attributes remain confidential.
- **Scalability:** The framework supports large-scale healthcare data management with minimal computational overhead.
- **Usability:** Patients can efficiently share records with healthcare providers without security trade-offs.

SESPHR outperforms traditional approaches by combining cryptographic techniques with formal security verification. Experimental evaluations indicate that SESPHR achieves higher security guarantees with minimal performance impact compared to conventional PHR sharing models.

V CONCLUSION :

The SESPHR methodology presents an innovative solution for enhancing privacy and security in cloud-based PHR sharing. By integrating Setup and Re-encryption Server (SRS), advanced encryption techniques, and HLPN-based security validation, SESPHR ensures that patients retain control over their health records while allowing secure access for authorized users. The methodology prevents unauthorized data breaches, insider threats, and statistical inference risks, making it a viable approach for secure healthcare data management. Future research will focus on optimizing computational efficiency and expanding SESPHR to support emerging healthcare technologies such as Internet of Medical Things (IoMT) and AI-driven health analytics.

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