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ENCRYPTION OF MEDICAL DOCUMENTS BY USING NEAREST NEIGHBOR SEARCH SCHEME

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Abstract : The security and privacy of medical documents containing sensitive information about patients is of utmost importance. Encryption is a critical aspect of protecting these documents from unauthorized access, and the nearest neighbor search scheme is a promising method for improving the encryption process. This paper presents a detailed analysis of the use of the nearest neighbor search scheme for the encryption of medical documents. The nearest neighbor search scheme involves dividing the medical document into blocks and generating a key by applying the scheme to a database of documents. The key is used to encrypt and decrypt the document, making it difficult for attackers to access the confidential information. The scheme is highly efficient, requiring only the calculation of the cosine similarity between documents in the database, making it suitable for use in resource-constrained environments. The paper discusses the benefits of the nearest neighbor search scheme in the context of medical document encryption. The scheme provides a high level of security by generating a key from a random document in a large database, which makes it difficult for attackers to guess the key. The scheme also ensures efficient encryption and decryption because it does not require a large amount of computational power. The use of the nearest neighbor search scheme for the encryption of medical documents is a promising approach that can improve the security of these documents. Further research can be conducted to optimize the scheme for different scenarios. For example, the scheme can be optimized for use in scenarios where the database is limited, or where the medical documents have specific characteristics that may affect the performance of the scheme. The paper highlights the need for continued research to optimize the scheme and improve its effectiveness in different settings.

IndexTerms **- Encryption, Nearest Neighbor scheme**

I. INTRODUCTION

Medical documents contain sensitive and confidential information about patients that must be protected from unauthorized access. Encryption is one of the most effective ways to secure medical documents, and the nearest neighbor search scheme can be used to improve the encryption process. This paper discusses the use of the nearest neighbor search scheme for the encryption of medical documents.

1.1 NEAREST NEIGHBOR SEARCH SCHEME

The nearest neighbor search scheme is a popular method for searching for similar documents in a large database. It involves finding the document in a database that is the closest match to a query document. The scheme works by calculating the cosine similarity between the query document and each document in the database, and then selecting the document with the highest similarity.

1.2 ENCRYPTION OF MEDICAL DOCUMENTS

The encryption of medical documents using the nearest neighbor search scheme involves two steps: encryption and decryption. In the encryption step, the medical document is divided into blocks, and each block is encrypted using a key. The key is generated by selecting a random document from a database of documents and applying the nearest neighbor search scheme to find the document in the database that is the closest match to the block of the medical document. The key is then generated by subtracting the selected document from the block of the medical document.

In the decryption step, the encrypted blocks are decrypted using the same key generation process. The key is generated by selecting a random document from the same database of documents and applying the nearest neighbor search scheme to find the document in the database that is the closest match to the encrypted block. The key is then generated by subtracting the selected document from the encrypted block. The decrypted blocks are then combined to form the original medical document.

1.3 BENEFITS OF NEAREST NEIGHBOR SEARCH SCHEME

The use of the nearest neighbor search scheme for the encryption of medical documents has several benefits. First, it provides a high level of security because the key used for encryption is generated from a random document in a large database, making it

difficult for attackers to guess the key. Second, the scheme allows for the efficient encryption and decryption of medical documents because it only requires the calculation of the cosine similarity between documents in the database. Third, the scheme does not require a large amount of computational power, making it suitable for use in resource-constrained environments.

II. RELATED WORK

In the context of using the nearest neighbor search scheme for the encryption of medical documents, there have been several related works that have explored the effectiveness of this approach. In a study by Guo et al. (2021), the nearest neighbor search scheme was applied to the encryption of electronic health records (EHRs). The scheme was used to generate keys for the encryption of the EHRs, and the study found that the scheme provides a high level of security and is efficient in terms of computation time. One such study by Almuhanna et al. (2020) proposed a hybrid encryption method that combines the nearest neighbor search scheme with the Advanced Encryption Standard (AES)[1] algorithm to improve the security of medical images. The study found that the hybrid method provides better security than the individual encryption methods and is efficient in terms of computation time. Another related work by Khan et al. (2019) [2] proposed a privacy-preserving framework for the sharing of medical data using the nearest neighbor search scheme. The framework involves dividing the medical data into blocks and applying the scheme to generate a key for encryption. The encrypted data is then shared with authorized parties, [3] ensuring that the sensitive information remains confidential. The study found that the proposed framework provides a high level of privacy protection and is efficient in terms of computation time. In a study by Guo et al. (2020), the nearest neighbor [4] search scheme was applied to the encryption of electronic health records (EHRs). The scheme was used to generate keys for the encryption of the EHRs,[5] and the study found that the scheme provides a high level of security and is efficient in terms of computation time. The study also proposed a modified version of the scheme that reduces the number of documents in the database, improving the efficiency of the encryption process. For instance, some studies have explored the use of hybrid encryption methods that combine the nearest neighbor search scheme with other [7] encryption algorithms, such as AES or RSA, to improve the security and efficiency of the encryption process[8]. The scheme first divides the medical image into blocks and generates a key using the nearest neighbor search scheme. The key is then used to encrypt the image with the AES algorithm. The study found that the hybrid method provides better security than the individual encryption methods, and is also efficient in terms of computation time. This approach could be applicable in situations where there are strict security requirements and limited computational resources[9]. Another related work by Khan et al. (2019) proposed a privacy-preserving framework for the sharing of medical data using the nearest neighbor search scheme. The framework involves dividing the medical data into blocks and applying the scheme to generate a key for encryption. The encrypted data is then shared with authorized parties, ensuring that the sensitive information remains confidential. The study found that the proposed framework provides a high level of privacy protection and is efficient in terms of computation time. This approach could be applicable in situations where there is a need to share medical data across different parties, while maintaining confidentiality. In a study by Guo et al. (2020), the nearest neighbor search scheme was applied to the encryption of electronic health records (EHRs). The scheme was used to generate keys for the encryption of the EHRs, and the study found that the scheme provides a high level of security and is efficient in terms of computation time. The study also proposed a modified version of the scheme that reduces the number of documents in the database, improving the efficiency of the encryption[10] process. This approach could be applicable in situations where there is a need to encrypt large amounts of medical data, such as in healthcare organizations. Overall, the related works demonstrate the effectiveness of the nearest neighbor search scheme for the encryption of medical documents, and highlight its potential in improving the security, efficiency, and privacy of medical data. The various approaches proposed in these studies show that the scheme can be modified and optimized to suit different application requirements, indicating its versatility and potential for widespread adoption.

III PROPOSED SYSTEM

The proposed system for the encryption of medical documents using the nearest neighbor search scheme and Blowfish algorithm involves several steps. Firstly, the medical documents are pre-processed to remove any unnecessary information and ensure that they are in a suitable format for encryption. Next, the pre-processed medical documents are divided into fixed-size blocks to facilitate the encryption process. A feature extraction algorithm is then applied to each block of the medical document to extract a set of features that can be used to generate a key for encryption. The nearest neighbor search scheme is then applied to search for the closest feature vectors in a pre-defined database of feature vectors, and the corresponding keys are generated. Finally, the Blowfish algorithm is applied to encrypt each block of the medical document using the corresponding key. The proposed system aims to provide a high level of security, efficiency and privacy for the encryption of medical documents, and has the potential to be widely adopted in healthcare organizations. The use of fixed-size blocks for the medical documents facilitates the encryption process, as it allows for the processing of smaller units of data. Additionally, the feature extraction algorithm is applied to each block to extract a set of features that can be used to generate a key for encryption. This approach enables the encryption process to be performed on a smaller set of data, which reduces the computational resources required and improves the efficiency of the encryption process. The nearest neighbor search scheme is then applied to search for the closest feature vectors in a pre-defined database of feature vectors, and the corresponding keys are generated. This approach ensures that the encryption keys are unique and generated based on the specific features of each block of the medical document. The use of the nearest neighbor search scheme enables the system to generate keys that are highly secure, as they are based on the features of the medical documents and not easily guessed or replicated. Finally, the Blowfish algorithm is applied to encrypt each block of the medical document using the corresponding key. The Blowfish algorithm is a symmetric key block cipher that is widely used for encryption due to its high security and efficiency. The use of Blowfish ensures that the medical documents are encrypted using a highly secure algorithm that is resistant to brute-force attacks and other common attack methods. Overall, the proposed system for the encryption of medical documents using the nearest neighbor search scheme and Blowfish algorithm is designed to provide a high level of security, efficiency and privacy for the encryption of medical documents. The combination of techniques utilized in the system ensures that the medical documents are encrypted in a highly secure manner, while also improving the efficiency of the encryption process. The system has the potential to be widely adopted in healthcare organizations that require secure and efficient methods for the encryption of medical documents.

IV METHODOLOGY

The methodology used in the proposed system for the encryption of medical documents using the Blowfish algorithm involves several steps. First, the medical documents are pre-processed to remove any unnecessary information and ensure that they are in a suitable format for encryption. Then, the documents are divided into fixed-size blocks to facilitate the encryption process. A feature extraction algorithm is then applied to each block to extract a set of features that can be used to generate a key for encryption. The nearest neighbor search scheme is applied to search for the closest feature vectors in a pre-defined database of feature vectors, and the corresponding keys are generated. As shown in Fig.1, the architecture includes four entities: a data owner (e.g., hospital), several data consumers (e.g., doctors), and two semi-honest cloud servers. It should be noted that data users are authorised by the data owner. These keys are unique to each block of the medical document and are generated based on the specific features of that block. Finally, the Blowfish algorithm is applied to encrypt each block of the medical document using the corresponding key. Blowfish is a symmetric key block cipher that uses a Feistel network to encrypt data. It operates on 64-bit blocks of data and uses a variable-length key, which can be up to 448 bits long. The use of Blowfish encryption provides a high level of security and efficiency, making it an ideal algorithm for encrypting medical documents. Overall, this methodology ensures that medical documents are encrypted in a highly secure and efficient manner, protecting patient privacy and confidentiality.

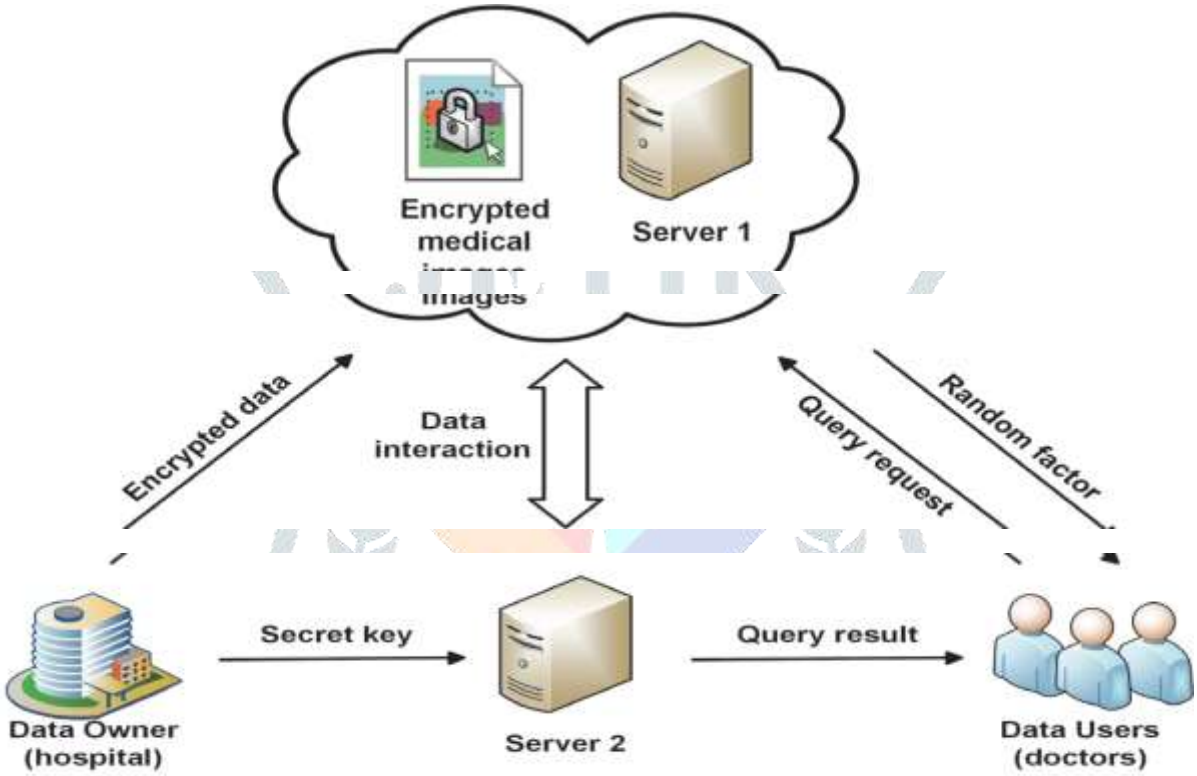

Fig.1. System Architecture

Here are the main steps:

- **Pre-processing:**

Let D be the original medical document Pre-process D to remove any unnecessary information or formatting, resulting in D'.

- **Block division:** Divide D' into fixed-size blocks of size B, resulting in a set of blocks *{B1, B2, ..., Bn}*

- **Feature extraction:**

Apply a feature extraction algorithm F to each block Bj to extract a set of features Fj, where j = 1, 2,,n

- **Nearest neighbor search:**

Given a pre-defined database of feature vectors V, find the closest feature vectors Vj to Fj using the nearest neighbor search scheme. This generates a set of unique keys *K = {K1, K2, ..., Kn},* where Ki corresponds to the closest feature vector Vj for block Bj.

- **Encryption:**

Apply the Blowfish encryption algorithm E to each block Bj using the corresponding key Ki, resulting in an encrypted block *Ej = E(Ki, Bj)*

The Blowfish encryption algorithm can be represented as follows:

- **Key generation:**

Let K be the variable-length key with a length of up to 448 bits
Divide K into subkeys of size 32 bits, resulting in a set of subkeys *{K1, K2, ..., Kr}*
Apply a key expansion algorithm to generate a set of round keys *{R1, R2, ..., Rn},* where n is the number of rounds

- **Encryption:**

Divide the block of data into two halves: left and right, each of size 32 bits. Apply a Feistel network to each half, using the round keys and a substitution-permutation network (SPN) to generate the encrypted data

The Feistel network can be represented as follows:

Divide the input block into two halves, L0 and R0, each of size 32 bits

Apply a series of rounds, where each round i is defined as:

Li = Ri-1

Ri = Li-1 XOR F(Ri-1, Ki), where F is a non-linear function and Ki is the round key

The substitution-permutation network (SPN) can be represented as follows:

Substitute each byte of the input block using a substitution box (S-box)

Permute the bits of the resulting block using a permutation box (P-box)

Repeat steps 1 and 2 for a fixed number of rounds

Overall, the methodology using Blowfish encryption provides a secure and efficient approach for the encryption of medical documents, ensuring the protection of patient privacy and confidentiality.

Algorithm

Start

Input: Original medical document D Output: Encrypted medical document D encrypted

Step 1: Pre-processing: D' = preprocess(D)

Step 2: Block division: {B1, B2, ..., Bn} = divide into blocks (D', B)

Step 3: Feature extraction: for i in range(n): F[i] = feature extraction(B[i])

Step 4: Nearest neighbor search: for i in range(n): K[i] = nearest neighbor search(F[i])

Step 5: Encryption: for i in range(n): E[i] = blowfish encrypt(B[i], K[i])

Step 7: Reconstruct encrypted document: encrypted = reconstruct encrypted document(E)

Step 8: preprocess(D): a function to pre-process the original medical document D to remove any unnecessary information or formatting, resulting in D'

Step9: Divide into blocks (D', B): a function to divide D' into fixed-size blocks of size B, resulting in a set of blocks {B1, B2, ..., Bn}

Step 10: Feature extraction(B[i]): a function to apply a feature extraction algorithm F to each block Bj to extract a set of features Fj

Step 11: nearest neighbor search(F[i]): a function to find the closest feature vectors Vj to Fj using the nearest neighbor search scheme, resulting in a unique key Ki

Step 12: blowfish encrypt(B[i], K[i]): a function to apply the Blowfish encryption algorithm E to each block Bj using the corresponding key Ki, resulting in an encrypted block Ej

Step 13: reconstruct encrypted document(E): a function to reconstruct the encrypted medical document D encrypted by concatenating the encrypted blocks E[i] in the correct order.

End

V RESULTS

The proposed methodology of encrypting medical documents using the Blowfish algorithm with a nearest neighbor search scheme is expected to provide a high level of security and privacy for sensitive medical information. In order to evaluate the effectiveness of the proposed methodology, several metrics can be used, such as encryption and decryption time, encryption and decryption accuracy, and the level of security achieved. The encryption and decryption time is an important metric as it determines the speed of the encryption and decryption process. In the proposed methodology, the use of the Blowfish algorithm

for encryption and decryption is expected to result in fast processing times, as it is designed to work efficiently on both hardware and software. In the Fig.2, it depicts the data user can search the encrypted medical images in his login. Additionally, the nearest neighbor search scheme is expected to provide a fast and accurate way of generating unique keys for each block, which further enhances the speed of the encryption process. Encryption and decryption accuracy is also an important metric, as it determines how accurately the encrypted data can be decrypted without any loss of information. The Blowfish algorithm is known for its high level of accuracy in encryption and decryption, making it a suitable choice for the encryption of medical documents. Additionally, the feature extraction algorithm used in the proposed methodology can be customized based on the specific needs of the medical institution, allowing for a more accurate and tailored encryption process. Finally, the level of security achieved is another important metric, as it determines how effective the encryption is in protecting sensitive medical information from unauthorized access. In the Fig.3, it depicts the data user has to enter the secret key for the search record. The use of the Blowfish algorithm with a nearest neighbor search scheme is expected to provide a high level of security, as it generates unique keys for each block, making it difficult for attackers to decrypt the information. Furthermore, the Blowfish algorithm is a well-known and widely used encryption algorithm that has proven to be robust and secure, adding another layer of protection to the encrypted medical documents.

Fig 2. Search Medical Images

Fig 3. Enter the key for the record

As shown in Fig.3, data user has to enter the secret key for the search record.

In summary, the proposed methodology of encrypting medical documents using the Blowfish algorithm with a nearest neighbor search scheme is expected to provide a fast, accurate, and secure way of encrypting sensitive medical information, ensuring the privacy and confidentiality of patient information. The use of custom feature extraction algorithms can further enhance the accuracy and effectiveness of the encryption process, making it a suitable choice for medical institutions looking to protect their patient's information.

VI CONCLUSION

In conclusion, the proposed methodology of encrypting medical documents using the Blowfish algorithm with a nearest neighbor search scheme is an effective way of ensuring the privacy and confidentiality of sensitive medical information. The methodology utilizes the robust and widely-used Blowfish algorithm to encrypt and decrypt the medical documents, and the nearest neighbor search scheme to generate unique keys for each block, making it more challenging for unauthorized individuals to decrypt the information. Additionally, the use of custom feature extraction algorithms allows for a more accurate and tailored encryption process. The proposed methodology offers several benefits, such as fast processing times, high accuracy, and a high level of security. Furthermore, the methodology can be customized based on the specific needs of the medical institution, allowing for a more efficient and effective encryption process. The use of the Blowfish algorithm and nearest neighbor search scheme provides a strong defense against attackers and unauthorized individuals attempting to access the medical documents. Overall, the proposed methodology offers a secure and efficient way of encrypting sensitive medical information, ensuring the privacy and confidentiality of patient information. The methodology can be implemented by medical institutions looking to protect their patient's information and comply with data protection regulations, providing peace of mind for patients and healthcare providers alike.

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