

Health Chain Sync Android application

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Abstract - Health Chain Sync is a dual-role Android application developed for doctors and patients to provide secure and intelligent healthcare data management. The system uses Blockchain technology, SHA-256 hashing, Firebase Realtime Database, and Firebase Cloud Storage to ensure secure, transparent, and tamper-proof medical record storage. Developed using Java/XML, the application allows users to upload, access, and manage healthcare documents efficiently.

The application also integrates an AI-powered health assistant using Natural Language Processing (NLP) and generative AI to help users understand symptoms, interpret medical reports, and access trusted healthcare information. Additionally, educational health videos and government healthcare scheme details are provided through WebView integration to improve healthcare awareness and accessibility.

Health Chain Sync combines blockchain security, cloud computing, and artificial intelligence to create a reliable and user-friendly digital healthcare ecosystem that enhances patient-doctor communication and secure medical data management.

Key Words: Blockchain, SHA-256, Android Application, Firebase, Healthcare Management, Artificial Intelligence, NLP, Medical Record Security, Cloud Storage, Digital Healthcare.

1.INTRODUCTION

The rapid growth of digital healthcare systems has increased the need for secure, transparent, and intelligent medical data management solutions. Traditional healthcare systems often face challenges such as

unauthorized access, data tampering, lack of transparency, and inefficient patient-doctor communication. Recent studies have shown that technologies like Blockchain, Artificial Intelligence (AI), cloud computing, and Federated Learning can significantly improve healthcare security and accessibility [1,2,3].

Blockchain technology provides decentralized and tamper-proof storage of healthcare records, ensuring

data integrity and transparency in medical data management [4,5]. SHA-256 cryptographic hashing further strengthens security by generating unique hash values for healthcare documents, helping prevent unauthorized modifications [6]. Researchers have also highlighted the importance of AI and Natural Language Processing (NLP) in healthcare systems for symptom analysis, medical report interpretation, and intelligent healthcare assistance [7,8].

Health Chain Sync is a dual-role Android application developed for both doctors and patients to provide secure and intelligent healthcare data management. The application is developed using Java/XML and integrates Firebase Realtime Database and Firebase Cloud Storage for secure cloud-based storage and real-time data access. The system uses Blockchain technology and SHA-256 hashing to secure uploaded medical records and maintain tamper-proof healthcare data.

The application also includes an AI-powered health assistant using NLP and generative AI techniques to help users understand symptoms and access trusted healthcare information. In addition, educational health videos and government healthcare scheme information are provided through WebView integration to improve healthcare awareness and accessibility [9,10].

2. LITERATURE REVIEW

[1] Sai (2023) studied the integration of Blockchain and Artificial Intelligence in healthcare systems. The research explained how blockchain technology improves the security, privacy, and transparency of medical records by using decentralized storage and encryption techniques. The study also highlighted the role of AI in disease prediction, symptom analysis, and intelligent healthcare support systems.

[2] Alrebdi (2022) proposed a blockchain-based Electronic Medical Record (EMR) system named SVBE for secure healthcare data management. The system focused on searchable and verifiable storage of patient records while maintaining privacy and data integrity. The research demonstrated that blockchain technology can effectively protect healthcare data from unauthorized access, data tampering, and cyber threats while ensuring reliable sharing of medical records among healthcare providers.

[3] Costa (2022) developed a blockchain-enabled Personal Health Record (PHR) architecture that allows patients to securely manage and control access to their medical information. The study emphasized decentralized healthcare systems for improving data accessibility, privacy, and interoperability between hospitals and healthcare organizations. The paper also discussed how blockchain can reduce dependency on centralized healthcare databases.

[4] Kshetri (2023) introduced the healthAIChain model, which combines Artificial Intelligence and Blockchain technology to improve security and reliability in healthcare systems. The research explained that blockchain ensures transparency and secure data storage, while AI provides intelligent healthcare analysis and predictive support. The study highlighted the importance of protecting patient information in AI-driven healthcare applications.

[5] Zekiye and Özkasap (2023) reviewed decentralized healthcare systems using Federated Learning and Blockchain technology. The research focused on secure medical data sharing without directly exposing sensitive patient information. The paper explained how federated learning enables AI model training using distributed healthcare data while blockchain maintains trust, privacy, and transparency in the system.

[6] Hamid (2023) discussed the importance of blockchain technology in Health Information Management systems. The study explained how blockchain provides immutability, integrity, and secure access control for Electronic Health Records (EHR). The research highlighted that blockchain-based healthcare systems improve trust between patients and healthcare providers by ensuring secure and tamper-proof medical data management.

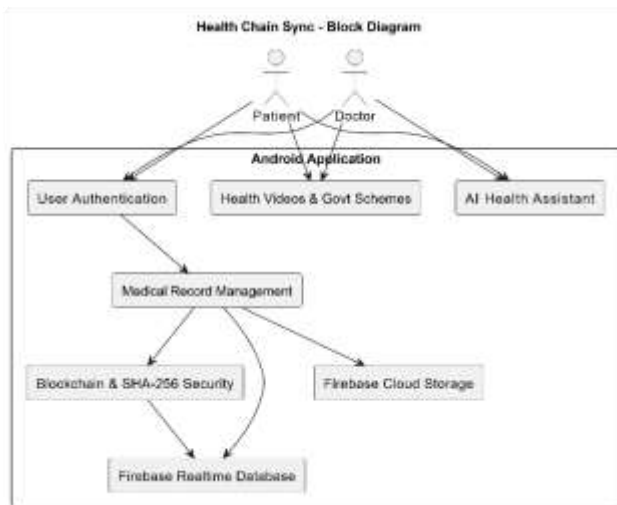
[7] Sharma (2023) proposed a blockchain-based healthcare data sharing system for secure communication between patients and healthcare providers. The study focused on improving data privacy, authentication, and secure access control in cloud-based healthcare environments. The research concluded that blockchain technology can significantly reduce the risk of healthcare data breaches and unauthorized modifications.

[8] Kumar (2024) developed an AI-enabled healthcare monitoring system integrated with cloud computing and blockchain security. The paper explained how Artificial Intelligence can assist in symptom prediction and medical report analysis, while blockchain ensures secure and transparent storage of patient records. The study highlighted the importance of combining AI and blockchain for intelligent healthcare services.

[9] Chen (2023) presented a decentralized healthcare framework using blockchain and Internet of Things (IoT) devices for remote patient monitoring. The research focused on secure real-time healthcare data collection and transmission. The study demonstrated that blockchain improves trust, integrity, and reliability in IoT-based healthcare applications.

[10] Rahman (2024) proposed a secure electronic health record management system using SHA-256 hashing and blockchain technology. The research emphasized tamper-proof storage of healthcare documents and secure sharing of patient information among hospitals and doctors. The paper concluded that SHA-256 hashing enhances data integrity and prevents unauthorized changes in medical records.

3. BLOCK DIAGRAM



4. METHODOLOGY

The development of Health Chain Sync follows a secure and structured methodology for healthcare data management using Blockchain, SHA-256 hashing, cloud storage, and Artificial Intelligence technologies. The system is designed as a dual-role Android application for doctors and patients, developed using Java/XML with Firebase integration.

1. Requirement Analysis

The first phase involves analyzing the requirements of both doctors and patients. The system is designed to provide secure medical record storage, easy document access, patient-doctor communication, and AI-based healthcare assistance.

2. System Design

The application architecture is divided into different modules including:

- User Authentication Module
- Medical Record Upload and Storage Module
- Blockchain Security Module
- AI Health Assistant Module
- Health Awareness and Scheme Information Module

Firebase Realtime Database and Firebase Cloud Storage are used for cloud-based data management, while Blockchain and SHA-256 hashing are used to secure healthcare records.

3. User Authentication

Doctors and patients register and log in securely using Firebase Authentication. Role-based access control is implemented to ensure authorized access to healthcare data.

4. Medical Record Management

Patients and doctors can upload medical reports, prescriptions, and healthcare documents. The uploaded files are stored securely in Firebase Cloud Storage.

5. Blockchain and SHA-256 Security

Each uploaded document is converted into a SHA-256 hash value. The generated hash is stored as a block in the blockchain ledger, ensuring data integrity and preventing unauthorized modification of medical records.

6. AI-Powered Health Assistant

The application integrates an AI-based chatbot using Natural Language Processing (NLP) and generative AI techniques. The assistant helps users understand symptoms, interpret medical reports, and access trusted healthcare information.

7. Health Awareness Integration

Educational health videos and government healthcare scheme information are provided through WebView integration to improve healthcare awareness and accessibility.

8. Testing and Deployment

The application is tested for functionality, security, usability, and performance. After successful testing, the system is deployed as an Android application for end users.

5. Mathematical Model

The mathematical model of Health Chain Sync is based on secure healthcare data storage using Blockchain and SHA-256 hashing.

Let:

- $U = \{u_1, u_2, u_3, \dots, u_n\}$ be the set of users (doctors and patients)
- $D = \{d_1, d_2, d_3, \dots, d_n\}$ be the set of medical documents
- $H(d)$ represent the SHA-256 hash function
- $B = \{b_1, b_2, b_3, \dots, b_n\}$ be the blockchain ledger

Hash Generation

Each uploaded medical document is converted into a unique hash value:

$$H(d) = SHA256(d)$$

where:

- d = medical document
- $H(d)$ = generated hash value

Blockchain Linking

Each block in the blockchain contains:

- Current document hash
- Previous block hash
- Timestamp

Mathematically:

$$B_n = (H(d_n), H(B_{n-1}), T_n)$$

where:

- B_n = current block
- $H(d_n)$ = hash of current document
- $H(B_{n-1})$ = previous block hash
- T_n = timestamp

AI Health Assistant Function

The AI assistant processes user queries using NLP:

$$R = f(Q)$$

where:

- Q = user query
- f = NLP and AI processing function
- R = generated response

This model ensures secure, tamper-proof, and intelligent healthcare data management.

Table -1: Result Analysis of Health Chain Sync System

Sr. No	Feature	Technology Used	Result Obtained
1	User Authentication	Firebase Authentication	Secure login and role-based access for doctors and patients was successfully implemented.
2	Medical Record Upload	Firebase Cloud Storage	Healthcare documents were uploaded and stored securely in cloud storage.
3	Blockchain Security	Blockchain + SHA-256	Generated unique hash values for each document and ensured tamper-proof record management.
4	Data Integrity Verification	SHA-256 Hashing	Any modification in uploaded records changed the hash value, helping detect unauthorized changes.
5	Cloud Database Management	Firebase Realtime Database	Real-time storage and retrieval of healthcare data was achieved successfully.
6	AI Health Assistant	NLP and Generative AI	Users were able to understand symptoms and medical reports through AI-generated responses.

7	Health Awareness Module	WebView Integration	Educational health videos and government healthcare scheme information were accessed successfully.
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The developed Health Chain Sync application successfully demonstrated secure and intelligent healthcare data management using Blockchain, SHA-256 hashing, Firebase cloud services, and Artificial Intelligence technologies. The integration of blockchain technology ensured that uploaded healthcare records remained tamper-proof and transparent by storing unique SHA-256 hash values for each medical document. This significantly improved data integrity and security compared to traditional healthcare management systems.

Firebase Realtime Database and Cloud Storage provided efficient real-time data synchronization and secure cloud-based document storage. The role-based authentication system allowed authorized access for doctors and patients, ensuring privacy and controlled data sharing.

The AI-powered health assistant enhanced user interaction by helping users understand symptoms, medical reports, and healthcare-related queries through Natural Language Processing and generative AI techniques. This feature improved healthcare accessibility and user engagement.

Table 1 - Performance Analysis of Health Chain Sync System Modules



3. CONCLUSIONS

Health Chain Sync successfully demonstrates a secure and intelligent digital healthcare management system for both doctors and patients. The application effectively

integrates Blockchain technology, SHA-256 hashing, Firebase cloud services, and Artificial Intelligence to ensure secure, transparent, and tamper-proof medical record management. The blockchain-based storage mechanism improves data integrity and prevents unauthorized modification of healthcare records, while Firebase enables efficient real-time data storage and accessibility.

The integration of an AI-powered health assistant using Natural Language Processing and generative AI enhances user experience by helping users understand symptoms, interpret medical reports, and access trusted healthcare information. Additionally, the inclusion of educational health videos and government healthcare scheme information improves healthcare awareness and accessibility for users.

Overall, Health Chain Sync provides a reliable, user-friendly, and secure healthcare ecosystem

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