

Blockchain-Based Health Insurance Claim Verification System

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Abstract: Health insurance helps people cover medical expenses by allowing them to claim the cost of treatment from an insurance provider. To claim health insurance, patients must submit medical records, bills, and policy details to the insurance company for verification. However, the traditional claim process is mostly manual and faces several problems such as delays in claim approval, fake or duplicate claims, data tampering, and lack of transparency between patients, hospitals, and insurers. To overcome these issues, Blockchain-Based Health Insurance Claim Verification System is proposed. The system uses blockchain technology to securely manage claim information and ensure data integrity. Medical records are stored using off-chain storage like IPFS, while their hashes are stored on the blockchain to prevent unauthorized modification. Smart contracts are used to automatically verify policy conditions and claim eligibility. By using blockchain and healthcare technologies together, the proposed system reduces fraud, minimizes manual effort, improves transparency, and enables faster and more reliable health insurance claim processing.

Keywords: Blockchain, Health Insurance, Claim Verification, Smart Contracts, IPFS, Data Integrity, Fraud Prevention

I. INTRODUCTION

Health insurance helps reduce medical expenses by enabling policyholders to claim treatment costs through coordination among patients, hospitals, and insurers. However, existing claim verification systems are centralized and manual, leading to delays, lack of transparency, high administrative costs, and increased chances of fraud such as fake reports and duplicate claims. Additionally, centralized data storage is vulnerable to security breaches and data tampering. To address these issues, this paper proposes a blockchain-based health insurance claim verification system. Blockchain ensures a decentralized, transparent, and tamper-proof ledger, while smart contracts automate claim validation based on predefined rules, reducing manual intervention and processing time. Sensitive medical data are stored off-chain using IPFS, with cryptographic hashes stored on the blockchain to maintain data integrity and privacy. The proposed system enhances security, transparency, and efficiency in claim processing. Key contributions include a secure architectural framework, automated claim validation using smart contracts, and integration of blockchain with off-chain storage. The paper further discusses related work, problem statement, system design, architecture, and future research directions.

II. LITERATURE SURVEY

In the field of healthcare insurance claim processing and fraud detection, several research works have utilized blockchain and artificial intelligence technologies to improve security, transparency, and efficiency.

[1] Raja Jayaraman et al., IEEE, 2022 – “Blockchain-Based Processing of Health Insurance Claims for Prescription Drugs” focuses on using a private Ethereum blockchain with smart contracts for secure claim processing. It uses IPFS



for storing medical data, ensuring tamper-proof and decentralized storage. The system improves transparency, traceability, and reduces fraud in insurance claims.

[2] **Sudeep Tanwar and Usha Patel, IEEE, 2022** – “*Blockchain and AI Empowered Healthcare Insurance Fraud Detection*” applies blockchain and artificial intelligence for detecting fraudulent insurance claims. Blockchain ensures secure and transparent data handling, while AI identifies suspicious patterns. The system enhances reliability and reduces financial losses.

[3] **Hakim Ghazzai, IEEE, 2020** – “*A Secure AI-Driven Architecture for Automated Insurance Systems*” introduces a blockchain-based automated insurance system integrated with machine learning. It uses the XGBoost algorithm to detect fraud and risky claims. The approach reduces manual work and improves efficiency and accuracy.

[4] **Manaf Zghaibeh, IEEE, 2020** – “*A Blockchain-Based Health System with Smart Contract Capabilities*” presents a blockchain-based healthcare system for secure medical data management. Smart contracts are used to automate processes like appointments and record handling. The system ensures data integrity, security, and efficient data sharing.

[5] **Nader Mohamed, IEEE Access, 2019** – “*Blockchain Technology Applications in Healthcare Supply Chains*” discusses the use of blockchain for secure verification of prescription insurance claims. It prevents fake prescriptions and ensures transparency through decentralized records. Smart contracts enable automated claim validation and approval.

III. METHODOLOGY

3.1 Claim Initiation

After receiving medical treatment, the patient initiates an insurance claim by submitting the required policy details through the system. The claim request is forwarded to the hospital for medical record verification.

3.2 Medical Data Submission:

The hospital generates medical records and billing information related to the treatment. These records are uploaded to off-chain storage using the InterPlanetary File System (IPFS). A cryptographic hash of the stored data is generated to ensure data integrity.

3.3 Blockchain Record Creation:

The generated hash, along with claim metadata such as patient ID, policy number, and timestamp, is recorded on the blockchain. This creates a tamper-proof record of the claim submission.

3.4 Smart Contract Verification:

Smart contracts deployed on the blockchain automatically validate the claim by verifying policy conditions, coverage details, and claim eligibility. The verification process is executed without manual intervention based on predefined rules.

3.5 Claim Approval or Rejection:

Based on the smart contract evaluation, the claim is either approved or rejected. The final decision is permanently recorded on the blockchain, ensuring transparency and traceability for all authorized stakeholders.

IV. SYSTEM ARCHITECTURE

The proposed blockchain-based health insurance claim verification system is designed to ensure secure, transparent, and efficient interaction among patients, hospitals, and insurance providers. The architecture consists of multiple modules that work together to process claim data and improve trust and efficiency in the verification process.



4.1 Patient Module

This module allows policyholders to initiate insurance claims after receiving medical treatment. Patients submit claim requests along with policy details through a secure interface.

4.2 Hospital Module

The hospital module generates medical records and billing details related to the treatment. These records are uploaded to off-chain storage using IPFS, and a cryptographic hash is generated for verification.

4.3 Off-chain Storage Module (IPFS)

Sensitive medical data are stored in IPFS to ensure privacy and reduce blockchain storage load. The generated hash values are used to verify data integrity without exposing actual records.

4.4 Blockchain Module

This module maintains a decentralized and immutable ledger of all claim transactions. Only authorized participants can access the network, ensuring secure and transparent data sharing.

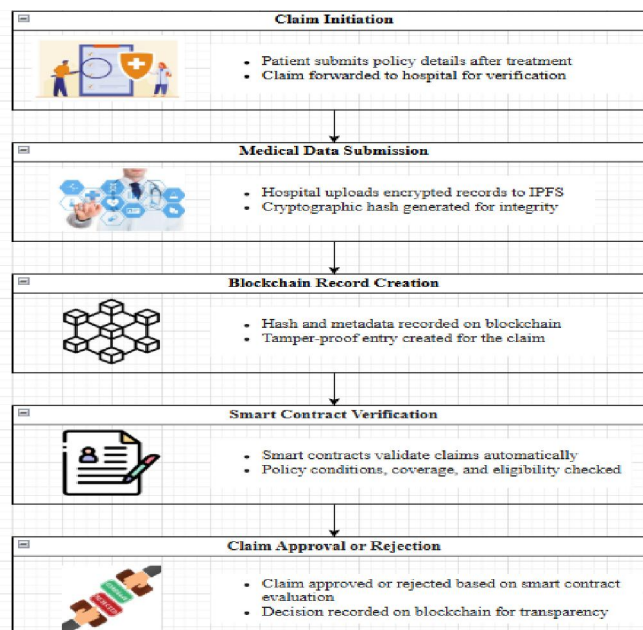
4.5 Smart Contract Module

Smart contracts automate the claim verification process by validating submitted data against predefined policy conditions. Based on the validation, claims are approved or rejected automatically.

4.6 Insurance Provider Module

Insurance companies interact with the blockchain to verify claims and policy details. The final decision is recorded on the blockchain, ensuring transparency and traceability.

4.7 FLOWCHART



5.1 OUTPUT

V. RESULTS AND DISCUSSION

Claim Details

780000

Upload Bill

Choose file hpb2.webp

Upload Medical Report

Choose file medical_report_10.pdf

Submit Claim

Fig 5.1 Claim Detection

Policy Details

POLICY009

Critical

Policy bazar

Patient Details

USHA

78

Diabetes mellitus

Hospital Details

JIPMER

67

Fig. 5.2 Patient and Hospital Details

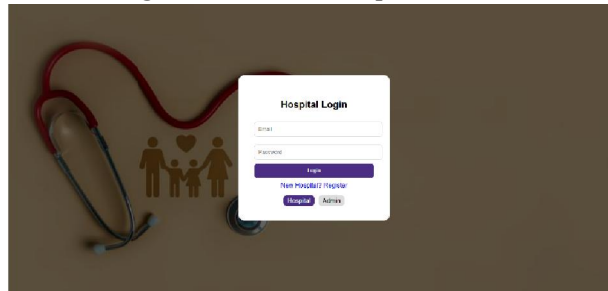


Fig. 5.3 Hospital Login

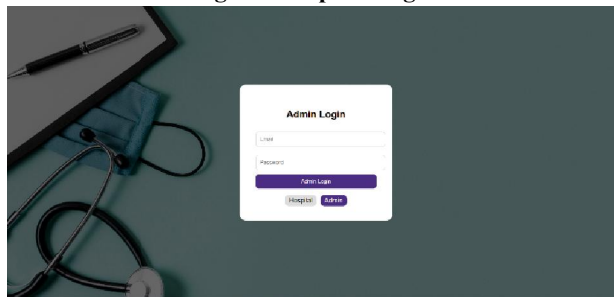


Fig. 5.4 Admin Login



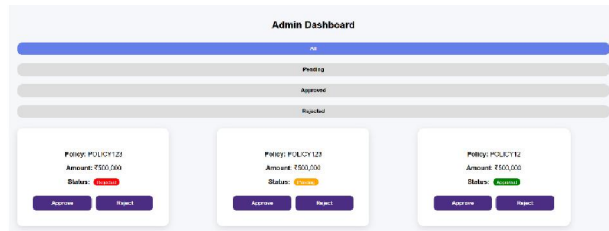


Fig. 5.5 View all types of Claims

5.2 PERFORMANCE ANALYSIS

The proposed blockchain-based health insurance claim verification system demonstrates improved efficiency, security, and transparency compared to traditional manual processes. The use of smart contracts enables automatic claim validation, significantly reducing processing time and minimizing human errors. The integration of blockchain ensures data immutability and prevents unauthorized modifications, thereby reducing fraud such as duplicate claims and fake medical records. Off-chain storage using IPFS improves system scalability by handling large volumes of medical data while maintaining data integrity through cryptographic hashes. The system also enhances trust among stakeholders by providing transparent and traceable claim records. Overall, the proposed solution supports faster, secure, and scalable claim processing, making it suitable for real-time healthcare insurance applications.

5.3 DISCUSSION

The results indicate that the integration of blockchain technology and smart contracts significantly improves the efficiency and reliability of the health insurance claim verification process. The automated validation mechanism reduces manual effort and minimizes errors, leading to faster claim processing. The use of blockchain ensures transparency and immutability of records, which plays a crucial role in preventing fraudulent activities such as duplicate or tampered claims. Additionally, the integration of IPFS for off-chain storage effectively handles sensitive medical data while preserving privacy and ensuring data integrity. Overall, the system provides a secure, transparent, and scalable solution for health insurance claim verification, enhancing trust among stakeholders and improving the overall efficiency of the healthcare insurance ecosystem.

5.4 CHALLENGES AND IMPROVEMENTS

Some challenges include scalability issues in blockchain networks, higher transaction latency, and computational overhead associated with smart contract execution. Managing large volumes of sensitive medical data while ensuring privacy and compliance with regulations is also a critical concern. Additionally, integration with existing healthcare systems and ensuring interoperability among different stakeholders can be complex. Future improvements can include the use of more scalable blockchain frameworks, optimization of smart contract execution to reduce costs and latency, and enhanced privacy mechanisms such as zero-knowledge proofs. Integration with real-time healthcare systems and advanced data analytics can further improve system performance, usability, and adoption.

VI. CONCLUSION

This paper presents a blockchain-based system for secure and efficient health insurance claim verification. The proposed approach leverages blockchain technology to create a decentralized and tamper-proof system, overcoming the limitations of traditional manual and centralized claim processes. Smart contracts are utilized to automate claim validation, ensuring faster processing and reducing errors and fraudulent activities. The system also integrates IPFS for secure off-chain storage of sensitive medical records while maintaining data integrity through cryptographic hashing. This enables better privacy, transparency, and traceability among all stakeholders, including patients, hospitals, and insurance providers. The results demonstrate improved efficiency, security, and scalability in claim processing. Overall,



the proposed system provides a reliable and technology-driven solution for enhancing trust and effectiveness in the health insurance ecosystem. Furthermore, the system can be extended to support real-time claim processing and integration with existing healthcare infrastructures. The adoption of advanced security techniques can further strengthen data privacy and user trust. Future research can focus on improving scalability and expanding the system for broader healthcare applications.

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