Vaccine Supply Chain Management through Blockchain Technology

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February 25, 2024

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Introduction

- The pharmaceutical industry faces vaccine supply chain concerns.
- Challenges involve transparency issues and fraud in vaccine records.
- To address these issues, develop a decentralized vaccine supply chain data management system using blockchain.
- Blockchain's decentralized, immutable nature enhances transparency, traceability, and security.

Current state of art

- Centralized and unclear
- Manual Tracking
- Vulnerable to Tampering
- Counterfeit Risks

Motivation

- Enhanced Transparency
- Improved Traceability
- Data Integrity Assurance
- Decentralized Trust
- Security Against Counterfeiting

Objectives

- Decentralize the System
- Guarantee Data Integrity
- Optimize Traceability
- Mitigate Counterfeiting

Literature Review

Table 1: Literature Review (Part 1)

Sl No.	Title	Author	Objective	Features
1	Protecting Vaccine Safety: An Improved, Blockchain-Based, Storage-Efficient Scheme (2022)	L. Cui et al	- Tackle vaccine circulation reliability challenges. - Introduce a secure blockchain for enhanced vaccine safety and traceability in circulation.	- Uses cloud for efficient off-chain storage. - Utilizes consortium blockchain for secure recording of vaccine circulation data.
2	Towards a Blockchain Assisted Patient Owned System for Electronic Health Records (2021)	T. Fatokun et al	- Introduce a patient-centric EHR system using blockchain - Enhance EHR system interoperability for secure data exchange.	- Secure, consistent health records controlled by patients. - Patient-Centric EHR Web Portal

Literature Review

Table 2: Literature Review (Part 2)

Sl No.	Title	Author	Objective	Features
3	A Novel Medical Blockchain Model for Drug Supply Chain Integrity Management in a Smart Hospital (2019)	F. Jamil et al	• Creating a secure drug supply chain with Hyperledger Fabric blockchain. • Handling counterfeit drugs in developing country pharmaceuticals.	• Secure Drug Supply Chain Record System. • Access Control and Permissions.
4	FAIR: A Blockchain-based Vaccine Distribution Scheme for Pandemics (2021)	A. R. Nair et al	• Address healthcare supply chain challenges. • Ensure Secure and Fair Distribution System.	• Focus on trust and forecasting • Distinct working layers

Proposed Methodology

- **API Design**
  - ■ Registering new vaccines
  - ■ Tracking vaccine batches
  - ■ Verifying vaccine authenticity
  - ■ Retrieving vaccine information

- **Data Models**
  - ■ Define data structures for vaccine batches, including attributes like batch number, manufacturer, production date, etc.
  - ■ Define structures for transactions and blocks in the Hyperledger blockchain.

- **Middleware Development**
  - ■ Implement a middleware layer in Golang to expose API endpoints.
  - ■ Utilize libraries like Gorilla Mux for routing and handling HTTP requests.

Proposed Methodology

- **Hyperledger Integration**
  - Integrate Golang middleware with Hyperledger Fabric or Composer.
  - Implement smart contracts for managing vaccine transactions and authenticity verification.

- **Authentication and Authorization**
  - Implement authentication mechanisms (e.g., JWT tokens) to secure API endpoints.
  - Define roles and permissions for accessing different functionalities.

- **Testing**
  - Develop unit tests for API endpoints and middleware functions.
  - Conduct integration tests to ensure interoperability with Hyperledger.

Implementation Status and Plan

Table 3: Implementation Status and Plan

Task	Status	Remarks
Research and Analysis	Completed	
API design	Completed	
Golang and Solidity setup	In progress	Planning to complete by February 25th 2024
Middleware Implementation	In progress	Planning to complete by March 7th 2024
Hyperledger Integration	Yet to start	Planning to complete by March 15th 2024
Authentication Setup	Yet to start	Planning to complete by April 10th 2024

Reference

1 M. Rehman, I. T. Javed, K. N. Qureshi, T. Margaria, and G. Jeon, "A Cyber Secure Medical Management System by Using Blockchain," IEEE Transactions on Computational Social Systems, vol. 10, no. 4, pp. 2123-2136, Aug. 2023.

2 L. Cui, Z. Xiao, F. Chen, H. Dai, and J. Li, "Protecting vaccine safety: An improved, blockchain-based, storage-efficient scheme," IEEE Trans. Cybern., early access, Apr. 13, 2022, doi: 10.1109/TCYB.2022.3163743.

3 F. Jamil, L. Hang, K. Kim, and D. Kim, "A novel medical blockchain model for drug supply chain integrity management in a smart hospital," Electronics, vol. 8, p. 505, Apr. 2019.

4 T. Fatokun, A. Nag, and S. Sharma, "Towards a blockchain assisted patient owned system for electronic health records," Electronics, vol. 10, no. 5, p. 580, Mar. 2021.

Thank you!