

A Project Report

On

**“Medicine Tracking System using Blockchain”**

Batch Details

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5. **INTRODUCTION**

The fight against fake medications, which present major health hazards and financial losses, is extremely difficult for the pharmaceutical business. Millions of lives are at risk because approximately 10% of medications in low- and middle-income nations are faulty or counterfeit, according to the World Health Organization (WHO). Effectively identifying and getting rid of counterfeit medications is challenging in traditional supply chain systems because they frequently lack traceability and transparency. Furthermore, centralized databases, which are susceptible to manipulation and cyberattacks, form the foundation of contemporary tracking techniques.

Manufacturers, distributors, pharmacies, and customers are all part of the intricate pharmaceutical supply chain. To protect the public's health and preserve faith in healthcare systems, it is essential to verify the legitimacy of medications. However, these problems cannot be adequately addressed by current regulatory procedures and anti-counterfeiting technologies. By offering a safe and unchangeable record of medical transactions, a decentralized strategy utilizing blockchain technology presents a possible answer.

With the use of blockchain technology, a transparent and impenetrable ledger can be created, guaranteeing that all parties involved can monitor and confirm the legitimacy of medications at every turn. This technique can drastically cut down on the spread of fake medications by combining blockchain technology with authentication via QR codes. Blockchain improves data integrity, lowers operating expenses, and does away with the need for middlemen, in contrast to conventional tracking techniques. In order to avoid counterfeit medications, safeguard consumer health, and enhance regulatory compliance, this study suggests a blockchain-based medication tracking system that makes use of smart contracts and decentralized ledgers. Manufacturers, distributors, retailers, and consumers may all instantly confirm the legitimacy of medications because to the system's guarantee that every supply chain transaction is documented on the blockchain.The proposed solution seeks to transform pharmaceutical supply chain management by offering a safe, open, and economical way to stop fake medications.   
The technology also reduces the risk of data manipulation and unauthorized changes by utilizing blockchain's decentralized structure. Security and efficiency are further improved by combining smart contract functionality with artificial intelligence. The application of blockchain technology to medication tracking will be examined in this essay, with an emphasis on the advantages, difficulties, and potential ramifications for the healthcare sector.

1. **LITERATURE REVIEW**

**Studies on Blockchain in Supply Chain Management**

Supply chain management could undergo a transformation because to blockchain technology, which improves security, traceability, and transparency. Blockchain, a decentralized and unchangeable digital ledger, makes it possible for stakeholders to securely share data while guaranteeing that transactions are documented chronologically and cannot be changed. This tackles important supply chain issues like inefficiency, fraud, and lack of visibility.  
  
Blockchain successfully addresses problems in the pharmaceutical industry, including real-time tracking, regulatory compliance, and the prevention of counterfeit drugs. According to estimates from the World Health Organization (WHO), 10% of medications in low- and middle-income nations are fake. By guaranteeing end-to-end traceability and securely documenting every step of manufacture, distribution, and dispensing, blockchain lowers this risk.  
  
Stakeholders can keep track on the location and condition of products, including medications that are susceptible to temperature changes, during transit thanks to real-time tracking.

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| **Sl. No.** | **Title of the Paper** | **Author** | **Year** | **Technology/Concept Used** | **Results/Findings** | **Limitations/Challenges** |
| 1 | Blockchain Technology in Pharmaceutical Supply Chain Management | Smith et al. | 2023 | Blockchain in supply chains | Enhances transparency and reduces fraud | Scalability and integration challenges |
| 2 | Blockchain Applications in the Pharmaceutical Industry | Johnson & Lee | 2023 | Blockchain applications | Reduces counterfeiting risk | Regulatory compliance issues |
| 3 | Digitalization Enhancement in Pharmaceutical Supply Network | Chen et al. | 2023 | Blockchain in pharmaceutical logistics | Improves data visibility | Adoption barriers |
| 4 | Protected QR Code-Based Anti-Counterfeit System | Patel et al. | 2024 | QR code security | Enhances anti-counterfeit measures | QR code encryption vulnerabilities |
| 5 | Authenticating Medications with QR-Codes | Nguyen et al. | 2023 | QR code with digital signatures | Strengthens authentication | Digital signature infrastructure dependency |
| 6 | Multi-MedChain: Multi-Blockchain System | Kumar & Singh | 2024 | Multi-party blockchain & smart contracts | Improves scalability & access control | Computational overhead |
| 7 | Security of Blockchain-Based Systems | Williams et al. | 2021 | Decentralized ledger security | Strong resistance to data breaches | Performance concerns |
| 8 | Smart Contracts for Secure Pharmaceutical Supply Chains | Garcia et al. | 2022 | Smart contracts | Automates verification processes | Legal and regulatory barriers |
| 9 | Blockchain-Based Drug Authentication System | Thompson & Wright | 2023 | Blockchain & IoT | Improves real-time tracking | High implementation cost |
| 10 | Distributed Ledger Technologies in Healthcare | Adams et al. | 2024 | Blockchain in healthcare | Enhances data security & interoperability | Privacy concerns |
| 11 | Secure and Transparent Drug Supply Chain Using Blockchain | Brown & White | 2024 | Blockchain ledger & encryption | Improves traceability | High initial investment |

TABLE 1.1 Literature Survey

Research by Johnson & Lee (2023) and Smith et al. (2023) highlights how blockchain might improve supply chain transparency and reduce fraud. Although issues like scalability and regulatory compliance still exist, their research shows how well decentralized ledgers work to ensure traceability.

The application of blockchain technology in combination with QR code-based authentication is investigated by Nguyen et al. (2023) and Patel et al. (2024). They show that QR codes can be a reasonably priced way to improve security, but weaknesses in digital signatures and encryption need to be fixed.   
A multi-blockchain architecture that increases access control and scalability but has a higher processing overhead is suggested by Kumar & Singh (2024). Similar to this, Garcia et al. (2022) examine how smart contracts might automate verification procedures, although legal issues continue to be a major barrier.

1. **OBJECTIVES**

* Develop a decentralized, transparent, and tamper-proof medicine tracking system.
* Enable manufacturers, distributors, retailers, and consumers to verify medicine authenticity.
* Reduce counterfeit drugs in the market through blockchain’s immutability.
* Provide real-time tracking and monitoring for regulators and stakeholders.
* Implement a user-friendly QR code-based verification system.

1. **EXPERIMENTAL DETAILS/ METHODOLOGIES**

**4.1 Medicine Registration (Blockchain Entry)**

* Manufacturers log in and register medicine details (batch number, expiry date, unique ID).
* Information is stored in MongoDB and recorded on the blockchain via a smart contract.
* A QR code containing the transaction ID and details is generated and printed on packaging.

**4.2 Digital Transfer of Ownership**

* Each supply chain stakeholder logs in to transfer medicine ownership digitally.
* Transactions are recorded on the blockchain, ensuring traceability.
* The system updates the dashboard in real-time for transparency.

**4.3 Consumer QR Code Verification**

* Consumers scan the QR code via a web or mobile app.
* The system retrieves and displays the medicine’s history, verifying authenticity.
* Any mismatch triggers a counterfeit alert.

**4.4 Real-time Dashboard**

* A React.js-based dashboard provides insights into stock movement and authenticity verification.
* Manufacturers, distributors, and regulators can monitor medicine batches.
* Admin controls allow authorized monitoring of the supply chain history.

1. **DESIGN PROCEDURE**
2. **TIMELINE OF THE PROJECT/ PROJECT EXECUTION PLAN**

**A screen shot of a chart

AI-generated content may be incorrect.**

1. **OUTCOMES**

* **Increased Security and Trust in Pharmaceutical Supply Chains:**  
  Blockchain increases confidence between producers, distributors, retailers, and customers by guaranteeing safe, unchangeable records of each transaction.
* **Reduction in Counterfeit Medicine Circulation:**  
  Blockchain keeps fake medications out of the supply chain by offering end-to-end traceability, guaranteeing that only authentic goods are delivered to customers.
* **Enhanced Regulatory Compliance through Smart Contracts:**  
  By automating compliance checks, smart contracts make sure that, without human intervention, all supply chain operations follow legal requirements.
* **Real-Time Tracking and Verification Capabilities:**  
  Blockchain makes it possible to trace medications in real time across the supply chain, giving stakeholders quick access to information about the location, state, and ownership of the product.
* **Improved Stakeholder Confidence in Medicine Authenticity:**  
  Consumers, healthcare professionals, and regulators are more confident when they can confirm a product's origin and route through an open system.

1. **CONCLUSION**

A blockchain-based medication tracking system is suggested in this study to fight fake medications in the pharmaceutical supply chain. The solution guarantees the security, traceability, and transparency of medications at every level by utilizing smart contracts, decentralized ledgers, and QR code authentication. The literature review emphasizes how well blockchain technology works in supply chain management and how it may be used to solve important issues facing the pharmaceutical sector.

Blockchain is a promising option because, despite certain constraints like processing costs and legal hurdles, the benefits exceed the disadvantages. The proposed approach seeks to simplify regulatory compliance, boost stakeholder confidence, and improve patient safety. To guarantee the broad use of blockchain-based tracking systems, future research should concentrate on scalability optimization, incorporating AI for improved security, and encouraging regulatory cooperation. Resolving these issues will be essential to guaranteeing the technology's successful long-term use in the pharmaceutical industry.

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