

Supply Chain For Pharma Network Using Blockchain and QR Code Technology

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Abstract-

Blockchain technology has wider scope in the financial tech fields, pharmacies and food industries. Blockchain technology is decentralized distributed ledger that provides the transparency, immutability and reliability in the network. In this project, we are integrating the Blockchain technology with pharma supply chain process for reliable supply chain process. It records all the information in the form of smart contract from manufacturer to the customer. In the field of finance, blockchain technology was recently developed to offer a secure, consensus-based, and irreversible environment. In certain contexts, trust and transparency are essential, and blockchain arrives to save the day. Pharmaceutical information must be transmitted. data to multiple parties with accuracy. Like prescription medications, Blockchain technology makes it possible to see and track supply chains, providing producers with comprehensive information to consumers. Nowadays, big manufacturers collect and handle data, and pharmacies misuse their centrally located systems. A lot Current strategies and techniques make pharmaceutical data to be maintained and grouped between the tending provider and other parties involved. In the traditional supply chain process stakeholders cannot trust each other because there is no any trustworthy document verified by them but, in Blockchain the data can be stored by mining a block by number of miners so there is the transparency between the stakeholder.

Keywords: Blockchain Technology, Pharma supply chain, Smart contract, Transparency, Visibility.



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I. INTRODUCTION

Blockchain technology is a decentralized and distributed ledger system that securely records and verifies transactions across a network of computers. It relies on cryptographic principles to ensure data integrity and immutability, making it resistant to tampering and fraud. With its transparent and trust less nature, blockchain eliminates the need for intermediaries, fostering efficiency and enhancing security in various industries, including finance, supply chain, and healthcare.

To address the urgent issues facing the pharmaceutical sector, we suggest creating a cutting-edge supply chain management system built on blockchain technology. With its creative approach, the pharmaceutical industry has long been beset by serious problems like black marketing, fake medications, and a lack of transparency. The system makes use of the immutability, decentralization, and transparency that are inherent to blockchain technology to guarantee an unbroken and impenetrable record of a medicine's journey from the manufacturer to the final consumer.[3]

The project's integration of smart contracts reduces the possibility of counterfeit medications and improves the integrity of the pharmaceutical supply chain by automating verification procedures. By facilitating real-

time tracking and fostering transparency among

stakeholders, the implementation of this state-of-the-art system offers a comprehensive and resilient response to the many challenges that the pharmaceutical industry faces.[2]

II. OBJECTIVES

Enhanced Traceability: Enable real-time tracking of pharmaceutical products from manufacturing to distribution to ensure the authenticity and integrity of the drugs. Each transaction recorded on the blockchain provides an immutable audit trail, allowing stakeholders to trace the entire journey of a product.

Reduced Counterfeiting: Mitigate the risk of counterfeit drugs entering the supply chain by verifying the authenticity of pharmaceutical products through blockchain records. Each product can be assigned a unique digital identity stored on the blockchain, making it difficult for counterfeiters to replicate.

Faster Recall Process: Improve the efficiency of product recalls by quickly identifying affected batches and tracing their distribution history on the blockchain. This reduces the time and resources required to manage recalls, thereby minimizing the impact on public health.

Improved Transparency: Increase transparency across the supply chain by providing stakeholders with access to a shared, immutable ledger. This transparency helps in identifying inefficiencies, reducing delays, and ensuring compliance with regulatory standards.

III. LITERATURE SURVEY

- Volume 11, Issue 5 May 2023 — ISSN: 2320-2882 Dr. Aarti Dandavate, Krupa Savsani, Tejas Pisal, Rutuja Pandule, Hema Nagandla: Cryptopharmacy Blockchain Based Pharmacy Supply Chain, In this paper consensus algorithm, proof of authority, SHA algorithm, PKI algorithm is used. All product transferring records are permanently registered in an immutable ledger by the system through the use of smart contracts and product registration and transfer. This makes it possible to track products and allows customers to contribute to maintaining information flows. Because of the system's decentralized features, there is less chance of data manipulation.[1]

- ICIITB 2022, ACSR 104, pp. 22–35, 2023 Hesham Magd, Mohammad Sultan Ahmad Ansari and Saurav Negi: Impact of Blockchain Technology on Operations and Supply Chain Management Performance, This paper focuses on investigating the connections between supply chain management, operations, and blockchain technology, as well as the effects of blockchain on supply chain management, logistics, and operations performance. [2]

- DOI:10.1109/ICECCME55909.2022.998787 Kaushal Shah, Shivrajsinh Rana, Neel Solanki: Blockchain-based Pharmaceutical Drug Supply Chain Management System, In this paper, a overview of the blockchain technology is given and examines and evaluates the most noteworthy and current studies that have used blockchain technology in pharma supply chain network. Here, they use solidity, concurrent algorithms, smart contracts, and supply chain transparency to create a software solution for security and transparency.[3]

- ISSN 2573-8240, August 12, 2022 Corrine Sim, Haisheng Zhang and Marianne Louise Chang: Improving End - to - End Traceability and Pharma Supply Chain Resilience Using Blockchain, In this paper, Hyperledger Fabric features automatically executable smart contracts, which are business logic algorithms that are mutually agreed upon by all network participants and are intended for use in enterprise applications across various industries. Every party will endorse every transaction in accordance with an elaborate endorsement policy that has been preestablished. It looks at the benefits of end-to-end traceability for businesses and the changes it makes, like strengthening supply chains and thwarting counterfeit goods.[4]

- Vol-08, DOI: 10.35291/2454-9150.2022.0115, APR 2022 Prof.R Nageswar Rao, Surekha Adiki: A Conceptual Framework for Sustainable Supply Chain Practices for the Pharmaceutical Industry, In order to better understand how pharmaceutical companies develop supply chain models for system-level transformation toward sustainability, this paper will offer a conceptual model. Research methodologies were applied in the construction of this framework for content analysis.[5]
- 10.1109/ACCESS. 2021.3139829,VOLUME 10, 2022 Ilhaam A. Omar, Raja Jayaraman, Mazin S. Debe , Haya R. Hasan ,Khaled Salah And Mohammad Omar: Supply Chain Inventory Sharing Using Ethereum Blockchain and Smart Contracts, In this paper, they present a blockchain-based inventory sharing strategy that links suppliers and retailers through private Ethereum networks and smart contracts. In order to improve trust between participating entities, we present a generalized mechanism for secure information sharing that includes extensive algorithms to capture supply chain stakeholder interactions.[6]
- DOI:10.36909/jer.ACMM.16307 Atul Kumar Singh, V.R. Prasath Kumar: Smart Contracts and Supply Chain Management Using Blockchain, The aim of this paper is to examine the potential of blockchain technology in relation to smart contract and supply chain management applications in the building industry. Cost overruns are typically ascribed to the slow progress of Rxcontractual obstacles or the inefficiency of procurement procedures for equipment and materials.[7]
- DOI :10.1109/EMR.2019.2898178 Qingyun Zhu, Mahtab Kouhizadeh: Blockchain Technology, Supply Chain Information, and Strategic Product Deletion Management, The proposed system will lessen the risk of a product being discontinued, optimize supply chain operations, and improve stakeholder trust and transparency generally. The main goal is to create a reliable system that gives all parties involved real-time visibility into the production, distribution, and final product deletion phases of the supply chain. [8]

IV. METHODOLOGY

- **Tool:**
Smart contract- Smart contracts are self-executing contracts with the terms of the agreement directly written into code. In a blockchain- based pharmaceutical supply chain management system, smart contracts automate and enforce agreements between different parties without the need for intermediaries. They facilitate transparent and secure transactions by ensuring compliance with predefined rules and conditions. Smart contracts play a crucial role in enhancing trust, efficiency, and accountability within the pharmaceutical supply chain, ultimately improving traceability, reducing counterfeit drugs, and streamlining processes.
- **Use-Case Diagram:**



Fig.1 Use Case Diagram

• Supply Chain Entities:

1] **Manufacturer:** The manufacturer produces pharmaceutical products and packages them for distribution. Their role involves recording product information, such as batch numbers, manufacturing dates, and quality control parameters, onto the blockchain ledger. Manufacturers also authenticate their products by embedding unique identifiers, such as QR Codes, into the packaging, which can be verified by other stakeholders.

2] **Distributor/Wholesaler:** Distributors or wholesalers are responsible for the storage, transportation, and distribution of pharmaceutical products to retailers or pharmacies. They record product movements, transfers, and deliveries onto the blockchain ledger, ensuring transparency and traceability throughout the distribution process. Distributors may also verify product authenticity and compliance with regulatory standards before accepting and distributing products further down the supply chain.

3] **Retailer:** Retailers dispense pharmaceutical products to end-users or customers. Their role involves verifying the authenticity and quality of pharmaceutical products received from distributors or wholesalers. Retailers record product sales, dispensations, and inventory management transactions onto the blockchain ledger, providing real-time visibility into product availability and movement.

4] **Customer/End-user:** Customers or end-users are the final consumers of pharmaceutical products. Their role involves verifying the authenticity and quality of products purchased from retailers or pharmacies. Customers may access product information, such as manufacturing details and expiration dates, by scanning QR codes embedded in the product packaging. Customers may also provide feedback or report issues related to product quality or effectiveness, which can be recorded and addressed within the block chain-based system.

• Algorithm: SHA Algorithm:

The Secure Hash Algorithm (SHA) serves as a foundational component in ensuring the security and integrity of data within a blockchain-based pharmaceutical supply chain management system. It is utilized to generate cryptographic hash functions that uniquely represent data stored on the blockchain ledger, thereby ensuring data integrity. SHA is integral in validating transactions, as it computes hash values of transaction data, which are then included in blocks to authenticate and secure transactions. Additionally, it facilitates the creation of digital signatures, enabling authentication of participants and preventing unauthorized access to transaction data. Consensus mechanisms, such as proof-of-work leverage SHA for cryptographic puzzles, ensuring the security and stability of the blockchain network. Overall, SHA plays a crucial role in enhancing the transparency, efficiency, and trustworthiness of the pharmaceutical supply

chain by safeguarding data integrity and facilitating secure transactions.

V. SYSTEM ARCHITECTURE

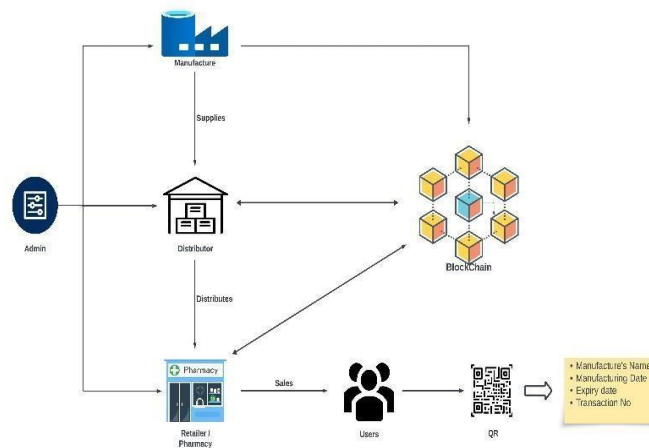


Fig.2 System Architecture Diagram

The manufacturer will first generate a QR code with the following information: the transaction number, manufacturing date, expiration date, and manufacturer. On the blockchain, the transaction number will be useful for locating the medication. After that, the distributor will scan the QR code to confirm its authenticity. The distributor is required to sign the medicine's record as soon as the shipment leaves his storage. At their end, pharmacies, retailers, and wholesalers will complete the same tasks. Tracking and traceability in the drug supply chain can be achieved by documenting the transactions at every point of the chain.

Every square has a timestamp, the previous square's hash, and a hash of its own. Previous hash prevents middle-of-the-block adjustments. In this sense, the organization is modified, uncomplicated, and long-lasting. In a nutshell, a blockchain is a distributed permanent record that maintains the integrity of the business by achieving agreement through formulas like Proof of Work, Evidence of Authority, or one's own custom agreement formulas.

VI. MODELLING AND ANALYSIS

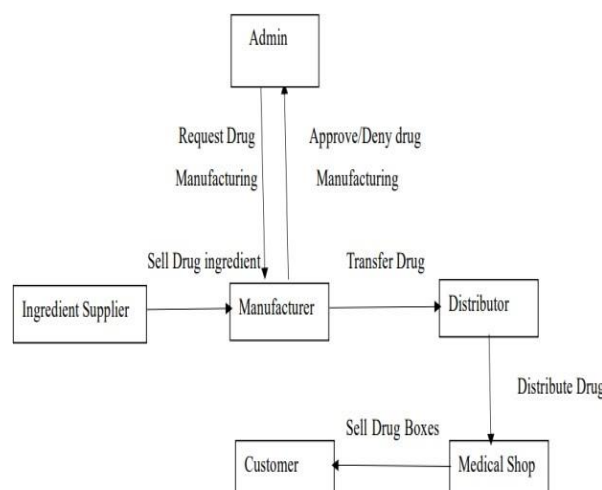


Fig.3 Process Diagram

Modeling and analysis in a blockchain-based pharmaceutical network involve the development of mathematical or computational models to simulate and evaluate various aspects of the system. It involves the process modeling, Data modeling, optimization, simulation modeling, Risk analysis, Performance analysis and security analysis.

In a blockchain-based pharmaceutical network, the data flow model represents the movement and exchange

of data among different stakeholders and entities involved in the supply chain. It illustrates how information, such as product details, transactions, and regulatory compliance data, flows through the network, facilitated by blockchain technology. The data flow model visualizes the lifecycle of pharmaceutical products from manufacturing to distribution to end-users, highlighting key interactions and touchpoints where data is recorded, verified, and accessed. By depicting the flow of data within the blockchain network, stakeholders can gain insights into the transparency, traceability, and integrity of the pharmaceutical supply chain, ultimately enhancing trust and efficiency in the ecosystem.

This model facilitates real-time visibility into the movement of pharmaceutical products, enabling stakeholders to track their provenance, verify authenticity, and ensure compliance with regulatory standards.

VII. ADVANTAGES

- It help in reducing the time for managing the supply chain
- It prevents security threat and data breaches • Brokers can be removed from the supply chain
- Increases collaboration between manufacturer, Distributer and regulator

VIII. APPLICATION

- Batch Verification: The system allows suppliers to upload verified batch documents on the blockchain. This application ensures the authenticity and integrity of the medicine batches throughout the supply chain.
- Medicine Validation: Consumers can use the system to validate the authenticity of medicine strips by scanning QR codes. This application enables consumers to verify the legitimacy of the medicine they purchase, thereby reducing the risk of counterfeit drugs.
- Counterfeit Detection and Reporting: The system empowers consumers to report suspected counterfeit drugs, enhancing the overall safety of the pharmaceutical industry. By integrating real-time verification and reporting mechanisms, the system encourages users to actively participate in detecting and preventing counterfeit products.
- Document Management: The system provides a secure and transparent platform for manufacturers to upload and share batch documents. Distributors, retailers, and consumers can access these documents to ensure they have accurate and complete information about the medicines they handle or purchase.

IX. SCOPE

It includes ensuring product traceability, preventing counterfeit drugs, ensuring regulatory compliance, optimizing inventory management, improving supply chain efficiency, maintaining quality assurance, managing product recalls, ensuring transaction security, fostering stakeholder collaboration, and integrating with other emerging technologies. By leveraging blockchain technology, stakeholders can enhance transparency, traceability, security, and efficiency throughout the pharmaceutical supply chain ecosystem, ultimately improving patient safety and public health outcomes.

X. RESULT

In this paper, we have developed a QR-Based Pharmaceutical Supply chain management System that relies on Blockchain technology. The Customer or the one who wishes to seek information about the pharmaceutical product can easily scan the QR code in our web interface and he will get entire details regarding to the pharmaceutical product or medicine from the Manufacturer I'd to the entire pharmaceutical supply chain. The information entered by the user will not be exposed to the 3rd party as our project is specifically meant for data security and integrity.



Fig 4 Prints QR Code on Package

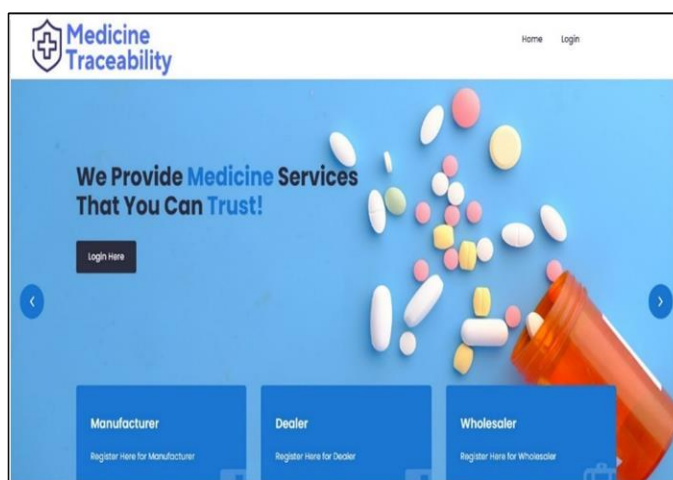


Fig 5 Dashboard User Interface

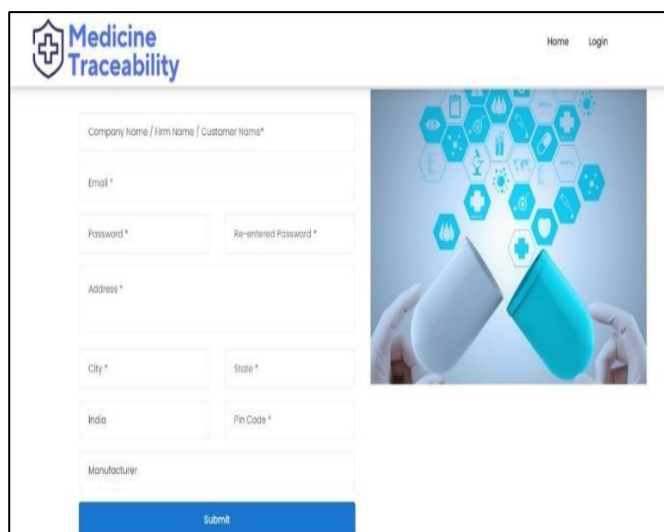


Fig 6 Medicine Registration

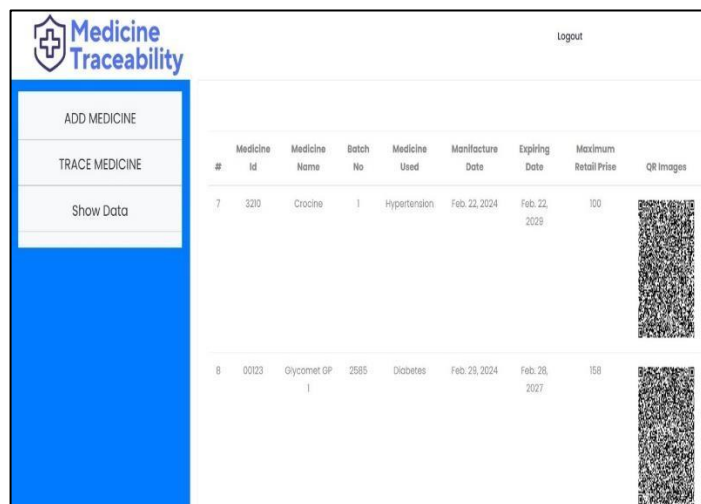


Fig 7 Login Form

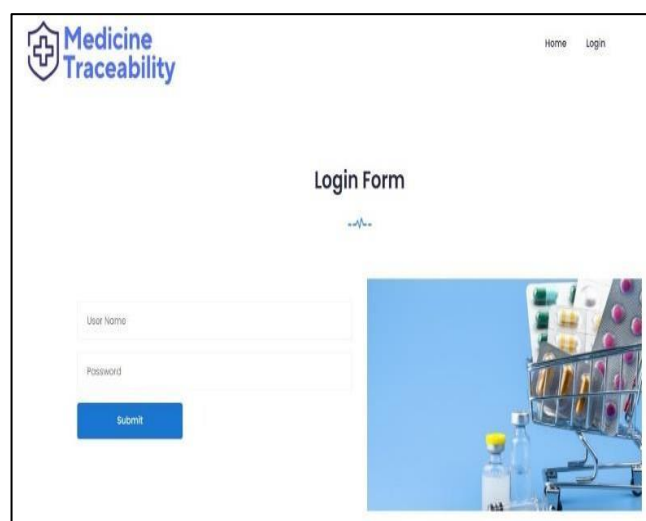


Fig 8 Medicine Information

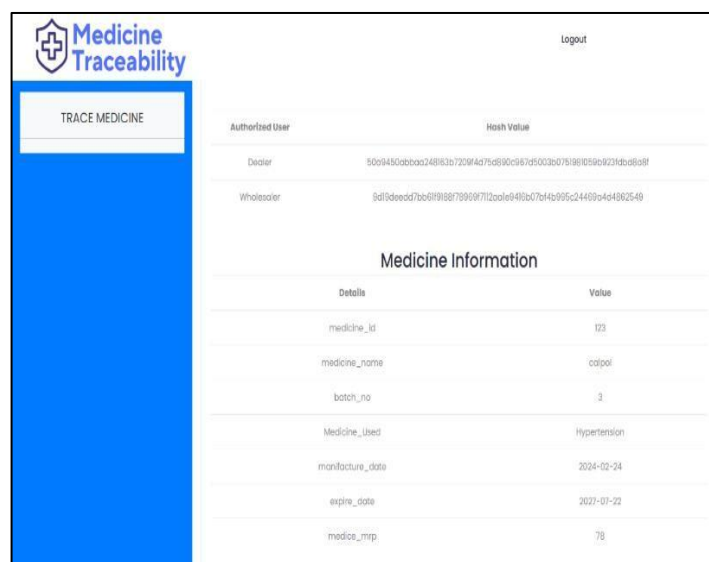


Fig 9 Shows Medicine Data

Fig 10 Overall supply chain process Tracking

XI. CONCLUSION

The traditional pharmaceutical supply chain suffers from inadequate traceability systems, contributing to the proliferation of counterfeit drugs and challenges in tracking them. This project emphasizes the necessity of implementing a blockchain-enabled supply chain system in the pharmaceutical industry. By leveraging blockchain technology, transparency is enhanced through comprehensive tracing and tracking, effectively mitigating the circulation of counterfeit drugs and ensuring safe delivery to consumers. Each product is assigned a unique ID, utilized to generate a Quick Response (QR) code, offering a practical and cost-effective method for authentication.

Additionally, consumer feedback is collected and analyzed to assess and rate the performance of supply chain actors. Ultimately, the integration of blockchain technology in the pharmaceutical supply chain offers a robust solution to combat counterfeit drugs, bolstering consumer safety and confidence while improving overall supply chain efficiency and transparency.

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