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A Blockchain-Based Approach for Drug Traceability in Healthcare Supply Chain

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ABSTRACT

The creation and distribution of fake medications is a pressing and serious global problem, particularly during pandemics. One of the causes of drug counterfeiting is the pharmaceutical industry's unreliable supply chain system. It is challenging to maintain track of medications because their ownership changes before they are delivered to the client from the producer to the wholesaler, distributor, and finally the pharmacist. In this project, we compared the supply chain management systems built on blockchain that have already been suggested and existing. Data sharing, storing, openness, and traceability are all guaranteed by the system put in place using hyper ledger fabric. However, the Ethereum design made use of smart contract features to control communications between sender and receiver. The study's primary goals are to improve the safety of pharmaceutical products and automate as much of the supply chain's manual work as possible.

Keywords: Blockchain Technology, Drug Traceability, Healthcare, supply chain, Data sharing, storing, openness, and traceability

I. INTRODUCTION

The health care system now offers much better-quality services because to evolving technology. introduced intelligent transport and services and convinced the government to approve the orderly flow of medical supply chains. But technology advancement for effective infrastructure installation is coming. Using blockchain technology in the supply chain management system has many advantages, including systematic and strategic management that creates value for higher customer satisfaction. Ethereum blockchain was introduced for improved management of the medical supply chain. Blockchain technology in supply chain management improves productivity, openness, security, and offers immutable data with sophisticated encryption methods.
Product traceability is improved when blockchain is used instead of databases without interfering with data. In the past, supply chain management systems have utilized Prioritizing slower moving cargo and keeping an eye on bottlenecks and delivery networks requires a storage database. For tracking and maintaining the service or product to minimize conflict, administrators can update real-time data. Most crucially, it keeps mutable data, which can be changed at any moment. The healthcare supply chain must have products that are traceable and

can be effectively controlled. In order to centrally coordinate or link the production, delivery, and distribution of a product, supply chain management is used.

A. Motivation:

Healthcare applications and uses for blockchain are numerous. The management of the medication supply chain, safe data transfer of patient medical records, and assistance in genetic code discovery are all made possible by distributed ledger technology. A blockchain network is helpful in the healthcare industry for preserving and exchanging patient data.

In the medical industry, a blockchain application can precisely identify severe errors, including deadly ones. Blockchain is a critical component in handling fraud in clinical trials for improved healthcare outcomes.

B. Problem Statements

Because of the advancement of technology, the health care system today provides services of a considerably higher caliber. introduced intelligent transport and services and convinced the government to approve the orderly flow of medical supply chains.

C. Objectives:

- To research and evaluate how blockchain works in a distributed database system.
- To create a specialized blockchain-based supply chain management system for pharmaceuticals.
- To develop innovative methods for mining, smart contracts, and hash generation for the proposed blockchain.
- To test the system using different consensus algorithms in a peer-to-peer (P2P) setting.
- To create and use a new mining method that produces a new block for each transaction.
- To implement a peer-validation algorithm that can examine each access request.

II. RELATED WORK

Puja Banerjee et.al. The use of blockchain technology in healthcare is covered in this article, with a focus on mHealth, supply chain management, telehealth, and electronic health records (EHRs). The comparative examination of several published studies on healthcare and its limits is also covered in this work.

Yaoming Yue et.al. This study examines and develops a blockchain-based technique for managing the whole life cycle of a supply chain for medical equipment. Based on the idea of supply chain management over the full life cycle, a medical equipment supply chain supervision system and blockchain-based model for monitoring medical equipment supply chains have been developed. A medical equipment management information system that addresses the whole production, supply, tendering, procurement, storage, application, export, usage, destruction, and traceability of medical equipment was created by combining full life cycle theory with blockchain technology.

Raja Wasim Ahmad et.al. The current system design and all of the specifics pertaining to its implementation. Cost analysis is used to analyze the performance of the suggested solution and demonstrate its affordability. We describe our solution from the perspective of generalization and application before presenting the security analysis to confirm the dependability of the smart contracts. Additionally, we present open challenges that

represent the limitations of our solution and can serve as future research areas. We publish the source code for our smart contracts on GitHub.

Farzad Firouzi Jahantigh et.al. -The delivery of medications from a wholesaler to clinics is the primary focus of the evaluation of supply chain management in healthcare systems. There are now problems with clinic service levels that must be fixed. The paper's usefulness comes from its thorough examination of a healthcare supply chain in a developing country and its identification of the variables in inventory.

III. LITERATURE SURVEY

Sr No	Paper	Author	Description
1	Application of Blockchain Technology in Healthcare: An Analysis	Puja Banerjee; Saurabh Bilgaiyan; Adarsh Tikmani	This paper discusses the application of blockchain technology in healthcare, especially Electronic Health Records (EHRs), Supply Chain Management, Telehealth, and Mobile-based Healthcare (mHealth). This work also discusses the comparative analysis of different published papers on healthcare and its limitations
2	Research on Medical Equipment Supply Chain Management Method Based on Blockchain Technology	Yaoming Yue; Xueliang Fu	This research analyses and designs a full life cycle supply chain management method for medical equipment based on blockchain technology. A medical equipment supplies chain supervision model based on blockchain technology was constructed, and a medical equipment supply chain supervision system based on blockchain technology is made.
3	Blockchain-Based Forward Supply Chain and Waste Management for COVID-19 Medical Equipment and Supplies	Raja Wasim Ahmad; Khaled Salah; Raja Jayaraman. Yaqoob; Mohammed Omar;	This present system design along with its full implementation details. This evaluates the performance of the proposed solution using cost analysis to show its affordability. We outline the limitations of our solution in form of open challenges that can act as future research directions. We make our smart contracts code publicly available on GitHub.
4	A Blockchain-Based Approach for Drug Traceability in Healthcare Supply Chain	Ahmad Musamih; Khaled Salah; Raja Jayaraman; Junaid Arshad; Mazin Debe; Yousof Al-Hammadi; Samer Ellahh	We present the system architecture and detailed algorithms that govern the working principles of our proposed solution. We perform testing and validation, and present cost and security analysis of the system to evaluate its effectiveness to enhance traceability within pharmaceutical supply chains.

IV. SYSTEM ARCHITECTURE

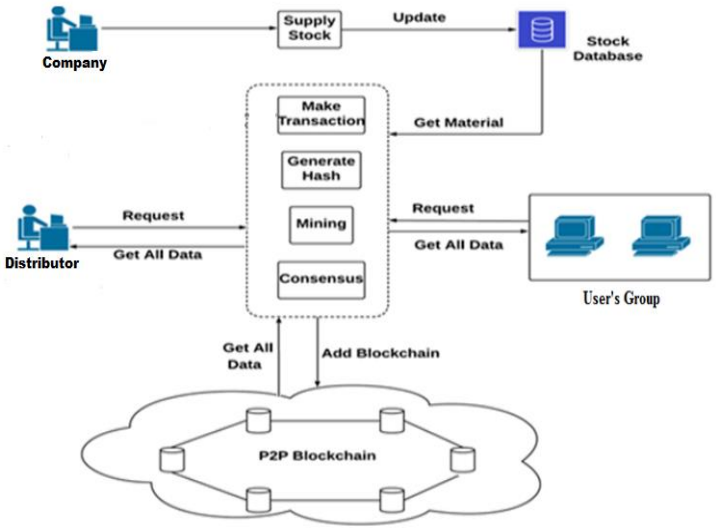

Figure 1: System Architecture

We are creating a blockchain-based drug traceability system to monitor medications across the healthcare supply chain. There are many different parties involved in the healthcare supply chain, including producers, suppliers, distributors, pharmacies, and hospitals. One of the parties may mislabel or fake a drug when it is delivered from the manufacturer to the client or patient. This is something we suggest avoiding. The potential that one of the parties has long-term storage of the drug is another factor to take into account while analysing the flaws in the healthcare supply chain. Before we start selling our medications, we are waiting for the demand to pick up. The treatment of patients in an emergency is impacted by the stockpile of this medication. Gather data on the quantity of medications that each stakeholder owns and the timing of their distribution to other stakeholders to prevent this. All of this is accomplished via blockchain technology. The blocks of transactions between parties are kept in this distributed ledger.

V. OTHER SPECIFICATIONS

A. Advantages

- Supply chain management ensures that medications and items are available when they are needed, minimizing inventory waste, enhancing patient care, and minimizing drug and human error across all departments.
- Better supplier collaboration.
- Improved quality assurance.
- Optimization of shipping.

- Lower costs for overhead and inventories.
- Better risk reduction.
- A more robust cash flow.
- A more adaptable company.
- Better data analytics and visibility.

B. Disadvantages

- Expensive supplier preferences products, a lack of access to health IT execution for supply chain procedures, and a lack of adequate cost accountability are some of the finest healthcare supply chain control challenges.
- Complexity: There are several players involved in complex global supply networks. Costs could go up, and there might be delays.
- Regulatory risks: Global supply chains must abide by a variety of rules and legislation in several nations. Costly fines and penalties may be imposed as a result of this, which can be difficult to handle.
- Lack of visibility: Because there are so many different parties involved in the global supply chain, it can be challenging to keep track of and monitor the flow of goods and services. Delays and ineffectiveness may result.
- Language and cultural hurdles: International stakeholders are involved in global supply chains, which can cause linguistic and cultural difficulties. Due to this, it may be challenging to communicate clearly, which may lead to errors and inefficiency.
- Security issues, including cyberattacks, data breaches, and theft, can affect global supply chains. To secure the security of their international supply chains, businesses must be ready to make the necessary investments in technology and procedures.
- Expensive shipping: Because goods must be carried over great distances when working with global supply chains, shipping prices might be considerable.

C. Applications

- Demand planning is the process of anticipating future demand for finished goods in order to ensure on-time delivery to clients. It senses demand through modelling and forecasting so that additional supply chain elements can be activated to bring in materials. Plex Demand Caster Supply Chain Planning enables businesses to detect and forecast demand more precisely than manual planning methods, resulting in a more effective supply chain.
- Supply planning is the method used to get raw resources to satisfy demand projections. Purchases, storage, inventory management, and other order characteristics including ideal order points, min/max considerations, and lead times are all included. By linking these processes through software automation, it is possible to have more control, pay less, and be more likely to fulfil orders on time.
- Production planning: This program makes certain that equipment, personnel, and supplies are available to fulfil orders in a timely manner in order to satisfy delivery dates. Planning for capacity, using labor

centers, and WIP parameters are a few examples. For predicting capacity further in the future, sophisticated software might enable both capacity planning and rough-cut capacity planning.

- Vendor management: Traditionally, verbal agreements, faxed orders, and emails were the main forms of supply chain management. Contract audits and vendor performance review are now part of vendor management. Companies can improve quality and delivery methods and shift vendors into a partnership role by employing software to track and monitor material end-to-end, using solutions like "vendor managed inventory."

VI. RESULT AND DISCUSSION

In this study, we examined the problem of drug traceability in pharmaceutical supply chains and emphasized its significance, especially in preventing the use of bogus medications. A blockchain-based pharmaceutical supply chain solution that enables decentralised medicine tracking and tracing has been developed and tested. In particular, our recommended approach makes use of smart contracts within the Ethereum block chain to achieve automated event recording that is available to all involved stakeholders. This makes it possible to record supply chain events in a way that cannot be altered. We have demonstrated that our proposed approach is cost-effective in terms of the amount of gas required to execute the various processes that are triggered within the smart contract.

VII. CONCLUSION

The pharmaceutical sector supply chain lacks a comprehensive traceability mechanism, which contributes to the rise of counterfeit pharmaceuticals and the difficulty in locating them. This project concentrated on the need for a supply chain system in the pharmaceutical sector that is equipped with blockchain technology. By ensuring tracking and tracing, our blockchain application promotes transparency by preventing fake pharmaceuticals from entering the supply chain and ultimately reaching consumers. Each product received a unique ID that was used to generate a Quick Response (QR) code. It was determined that using QR codes was a useful and economical strategy. Additionally, consumer feedback was taken into account and used for additional analysis and grading of supply chain participants.

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