Drug Supply Chain Management Using Blockchain

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Abstract

Recently, blockchain has received a lot of attention, and it has given rise to numerous applications. A distributed database of records, or public ledger, of all completed transactions or digital events that are dispersed among users, is known as a blockchain. Most of the system's participants double-check each transaction on the public ledger. Once the information has been entered, it cannot be removed. Every transaction is documented in the blockchain, making it certain and verifiable. The most well-known application of blockchain technology is the decentralized peer-to-peer digital currency Bitcoin. The main concept is that in the digital online world, the blockchain provides a way to achieve distributed consensus. Involved parties can be sure that a digital event constructed by creating an unquestionable record in a public ledger. Making the switch from a centralized to a scalable, open and democratic digital economy is now doable. A peer-to-peer network is established using Ethereum, a decentralized blockchain technology, to safely execute and validate smart contract code. Without the aid of a reliable central authority, parties can conduct business with one another via smart contracts. Participants have full ownership and access to transaction data thanks to the immutable, verifiable, and securely distributed transaction records that are made available through the network. The drug supply chain is managed by this effort using the Ethereum blockchain. Drug supply chains are intricate networks that span numerous regional boundaries and act as the foundation for necessities required in daily living. Our main objective is to reduce the supply of illegal drugs. This solution reduces losses from fake pharmaceuticals, improves traceability of the medication supply chain to guarantee corporate standards are met, and gets rid of the time-consuming paperwork needed to handle all transactions. Additionally, it makes it simpler for the customer to examine the product's integrity.

Keywords:Blockchain, Ethereum, Supply chain, Survey, Web Application

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I. INTRODUCTION

New hope for the solution to a variety of problems has been generated by the advancement and use of blockchain technology. Blockchain technology provides advantages such as decentralization and distributed storage, as well as anti-tampering, more reliable, and secure storage. Additionally, the objectives of pharmaceutical supply chain management are particularly well matched to these benefits. A data format called blockchain joins data blocks in chronological order in a chain. Data is permanently saved as blocks in the blockchain system. Each block is built consecutively and joined to construct a blockchain using a chain structure. Each block consists of two parts: the block body and the block header. The version number, timestamp, hash value of the preceding block, and important information required in the consensus method are the main components of a block header. Each module's data that goes to the block header is hashed to form the preceding block's hash value, which acts as a link between the blocks. All transaction data from the time the blockchain was created until this block's development is stored in the block body.

The blockchain is a distributed, decentralized database. In contrast to traditional distributed databases, where data is typically maintained by a single central server, the blockchain network is maintained by all nodes. Each node will create a backup. If a single node's data is changed or withdrawn, the data that has been recorded on the blockchain is unaffected. A blockchain supply chain can help participants manage the supply chain more effectively by keeping track of information like price, date, location, quality, certification, and other relevant details. A company's reputation as a responsible manufacturing leader may be enhanced by the availability of this information within the blockchain, which can also help with material supply chain traceability, decrease losses due to grey market and counterfeit goods, increase visibility and compliance with regard to outsourced

contract manufacturing, and more. Blockchain technologies in the supply chain have the potential to significantly increase corporate value by increasing supply chain transparency, reducing risk, and enhancing overall supply chain management.

1.1 Structure of Blockchain

A blockchain, which is depicted in Figure 1, is a decentralized, distributed, and frequently public digital ledger made up of records called blocks that is used to record transactions across numerous computers in a way that prevents any involved block from being changed retroactively without also affecting all succeeding blocks. As a result, participants may independently review and audit transactions for little money. Independent operation of a blockchain database is carried out via a peer-to-peer network and a distributed time stamping server. Widespread cooperation, which is stimulated by group self-interest, validates them. Utilizing a blockchain eliminates a digital asset's ability to reproduce indefinitely. It addresses the long-running double spending problem by confirming that each unit of value was only transferred once.A blockchain has been used to define a value-exchange mechanism. A blockchain can protect title rights by offering a record that requires an offer and an acceptance when it is properly configured to describe the trade agreement.
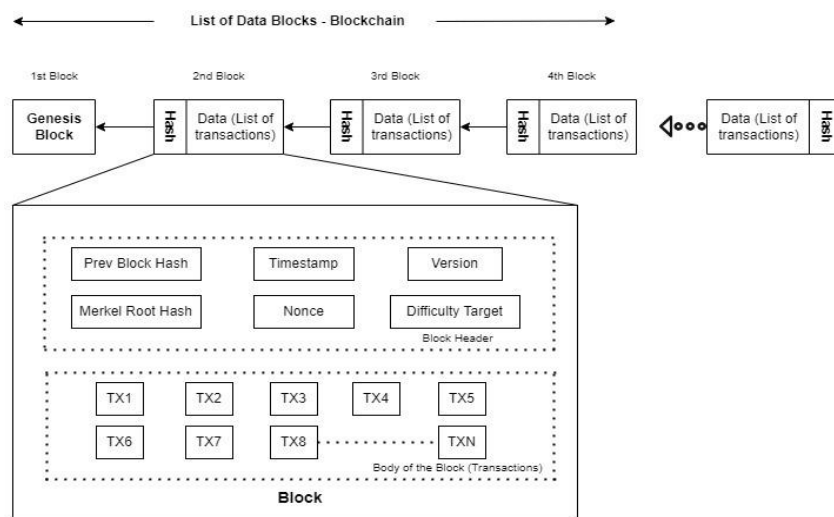

Figure 1: Structure of the Blockchain

1.1.1 Blocks

Batches of valid transactions are hashed and encoded into a Merkle tree in blocks. Each block includes the cryptographic hash of the previous block in the blockchain, as illustrated in fig 1.2, which connects the two. The connected blocks come together to create a chain. This recursive procedure verifies the integrity of each subsequent block, all the way back to the genesis block, which is the first block.

Several blocks can occasionally be generated at the same time, resulting in a temporary fork. Aside from a secure hash-based history, any blockchain involves a specialized algorithm for scoring various copies of the past so that the one with the highest score may be chosen over the others.Blocks that weren't picked to be part of the chain are known as orphan blocks.The database's supporting peers sometimes have distinct versions of the history. They only keep the database version with highest score that they will have reference to.When a peer receives a higher-scoring version (typically the old version with a single additional block added), they expand or overwrite their own database and resend the change to their peers. Blockchains are often intended to add new block scores to existing block scores, with incentives to prolong instead of substitute old blocks.

As even more blocks are added on top of an entry, the likelihood of it being surpassed diminishes rapidly, finally becoming exceedingly low.
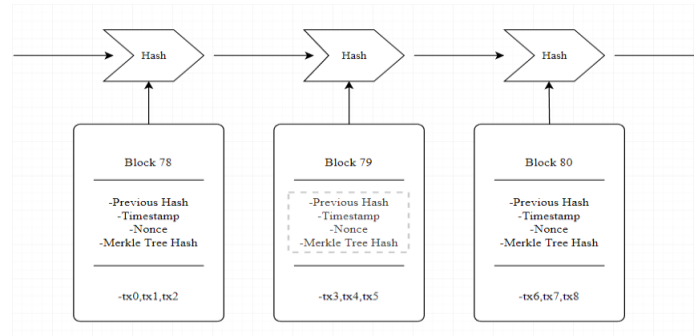
Figure 2: Blocks in Blockchain

1.1.2 Block Time

The block time is the average amount of time it takes the network to produce one more block on the blockchain. Every five seconds or fewer, certain blockchains create a new block. By the time the block is finished, the contained data is verified. Because this is essentially when the transaction occurs in bitcoin, a shorter block time equals faster transactions. The block time for Ethereum is projected to be between 14 and 15 seconds, whereas the normal block time for bitcoin is 10 minutes.

II. EXISTING SYSTEM

In the existing system, there exists a method where consumer can just check to which company the product belongs to, by just scanning the QR code. Drug supply chain performance management is critical to addressing rising customer demand for goods that are safe, of high quality, manufactured sustainably, and have provenance. Drug supply chain performance management aims to ensure the safety, quality, authenticity of product for consumers and organizations. With increase in the demand of drugs, the supplies of counterfeit drugs are also increasing concurrently. So, there is an urgent need to reduce it.

2.1 Disadvantages of existing system
- Shipment visibility: Tracking and shipment visibility has become crucial, lacking the same can present challenges and endanger demanding delivery operations like same- day and one-hour delivery. Poor freight visibility can be detrimental to supply chain and logistics operations. The consequences might include decreased revenue, inefficient delivery operations, poor customer experience, and increased transportation hazards.
- Mutable and Invalid source: Due to centralized management of all the details of supply chain by the manufacturing and supply company. There is a high chance of data getting manipulated with the interest of the company for their own sake, which can be false leading to the customer.
- Loss of reputation due to fake products in market: As mentioned above, because of centralized nature there can be falsified authentication and access, hackers or middlemen can change the data which will hamper the reputation of the company.
- Slow Process and Error prone paperwork: The old way of separating manufacturing from marketing and shipping from accounting doesn't work well when you're operating a global supply chain in the 21st century. Firms that are siloed cannot collaborate on supply chain management as effectively as organizations that are networked. The old way also includes paperwork which consume a lot of time.

III. PROPOSED SYSTEM

In traditional drug supply chain there are several middlemen's involved to overlook the process of the supply which reduces the trust and performance of the system, so to overcome that QR codes were introduced which adds a layer of security to fight against fake products, where manufacturer adds QR code and stores products details in the company's database, here user can scan the QR code and get the end-products details, but even here there is a catch where database can be easily modified by company itself or can be hacked, so to add another layer we propose a system that adds the product details directly into distributed ledger of blockchain in every step of supply from supply of raw materials to customer, here customer can scan the code and verify from where the product has arrived and in which warehouse it was stored.

### 3.1 Advantages of proposed system
- Decentralization: Decentralization is one of the most intriguing characteristics of blockchain technology. Instead of being stored in a single location, the blockchain system is totally decentralized, which means that an overarching authority cannot push its own agenda and dominate the network.

- Trust: Members of the supply chain may trust the data they see on the blockchain since it is decentralized and irreversible. In contrast, a traditional supply chain data storage structure often mandates that each link in the chain maintain their own records, which leads to disagreements when the records do not line up.
- Efficiency: Because the life cycle of a product is tracked at every step, it is simple to quickly pinpoint where in the supply chain a nonconformance (such as a product defect or missing product quantity) has occurred. This is because all data is recorded at every step in the supply chain, and every member of the supply chain has access to the data.
- Transparency: Because all data on the blockchain is automatically time-stamped and preserved, even certain data that often wouldn't be kept in a conventional supply chain system, blockchain fosters transparency. All participants in the supply chain may benefit from end-to-end tracking made possible by blockchain technology, which also fosters transparency. Conflicts may be settled more quickly than with conventional supply chain methods.

IV. LITERATURE SURVEY

[1] "A Novel Framework for Pharmaceutical Supply Chain Management using Distributed Ledger and Smart Contracts"

The researchers have highlighted how technology has played a key role in supply-chain management, highlighting the various flaws in traditional supply-chain management, such as the involvement of multiple intermediaries, trust, and performance issues, as well as the possible solutions that can be achieved using blockchain, which helps to gain customer trust through its unbreakable hash-based integrity system. For supply chain management to work, data must flow in both directions to and from suppliers, manufacturers, distributors, retailers, and end users in order to meet market demands. It comprises the demand for commodities on the market as well as the supply of goods at various stages of supply chain management. Traditional pharmaceutical supply chain management, as depicted in fig. 3, entails raw material suppliers supplying raw materials to manufacturers for drug production, packaging, and distribution to distributors. The producer is also in charge of medicine inventory. The first level of drug distribution is referred to as this. As a second stage of medication distribution, distributors supply the drug to hospitals, retailers, and pharmacies based on the needs gathered from patients.
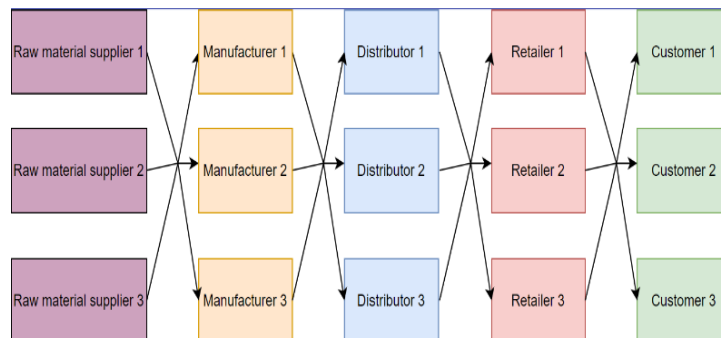
Figure 3: Pharmaceutical supply chain process

[2] "Sea Food Supply Chain Management Using Blockchain"

The researchers examined the use of blockchain in the sea food supply chain to eliminate the supply chain's shortcomings. They used pricey NFC tags to collect all information, from processing to expiration date. The challenge in this industry, however, is the delay in delivering products between partners, as well as other concerns. We'll use raw material items as an example in this technique. We will utilize the two components in our idea while transporting things from producer to customer. First, we shorten the time it takes for items to arrive. That is, smart tags can be used to collect product information and delivery details from wholesalers, retailers, and consumers. Second, we take a step forward in terms of trustworthiness at the client level. That is, the wholesaler/retailer/consumer receives the product from the producer and uses the smart tag to learn more about the product (example: Company Name, Manufacturing Date, etc.). The paper's main contribution is that it steered detailed study on marine food supply chain management and built Smart tags for the supply chain utilizing Blockchain.

[3] " Anti-fake technology of commodity using QR Code"

Researchers have emphasized how QR codes are employed in commodities to carry authentication information in order to prevent buyers from purchasing counterfeit goods. They have also presented a strategy

for QR code generation, scanning, and verification. The customer may easily validate the QR code, and the process is completely automated. A QR code encryption approach for anti-faking of commodities is also proposed. This research provided a practical method for encrypting QR codes, using RSA and DES to encrypt the plaintext. Customers just scan the QR code with the help of a mobile app and an enterprise database, and the app sends data to the database, which then returns feedback. Customers can then obtain a variety of accurate product information. This article evaluates the impact of encrypt/decrypt efficiency while utilizing different encrypting methods, in addition to merely increasing the complexity of decrypting.

V. CONCLUSION

We presented a new application of blockchain technology in healthcare in this project. We discussed the problems with the way the pharmaceutical industry now manages its supply chain and how blockchain technology can be used to combat medication supply fraud by adding transparency and visibility to it. It is described how the blockchain's identity method functions and how sharing medical data is made possible by safeguarding information about the products' sources. We emphasize the many methods, blockchain varieties, and third-party solutions that can be applied to construct a blockchain-based pharmaceutical supply chain. We concluded by describing how the suggested system functions and providing an illustration of how various participants will find it simple to utilize.

This outlines a blockchain approach to improve the present supply chain, management model, and supply chain commodities. Blockchain technology also aids in connecting people from diverse regions in supply chain commodities. Therefore, the supply chain has to create a distributed ledger. The transactions and transportation information in the aforementioned drug supply chain are all recorded in the distributed ledger. It is certain that no one will attempt an attack. Additionally, we suggested a QR code system from the manufacturer to connect with the user. The benefit of this is that anyone may learn about the product's integrity, from the maker to the consumer, and how to use it properly.

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