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Design Of A Block Chain Based Model For Secure And Effective Pharmaceutical Supply Chain

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The manufacture and allocation of forged drugs is an urgent and increasingly critical worldwide issue, especially in pandemics. The imperfect Supply and Block Chain system in the pharmaceutical industry is one of the reasons for drug counterfeiting. Drugs ownership changes from manufacturers to wholesaler, distributor, and then pharmacist before it reaches the customer thus making it difficult to keep track of it. In this paper, we have to Design a Block chain based Model for Secure and Effective Pharmaceutical Supply Chain. Finally, the study mainly focuses on increasing the safety of pharmaceutical products and reducing the manual operation of the supply chain with the most efficient architecture. This initiative will use block chain technology to address issues and inefficiencies in the pharmaceutical supply chain. The traditional pharmaceutical supply chain is vulnerable to problems such as counterfeiting, data inconsistencies, and a lack of transparency. The proposed solution uses a decentralized and transparent block chain technology to improve the entire traceability, security, and efficiency of the supply chain.

Keywords: Block chain, Supply chain, Architecture model, Pharmaceutical products.

1. INTRODUCTION

The supply chain passes all the way through the various checkpoints associated with assembling and spreading of the products. These days, a supply chain can incorporate hundreds of stages and numerous geological areas. This makes it hard to follow a fool-proof configuration in a supply chain as there are data misfortunes and obstruction in each progression. Furthermore, if the supply chain of the pharmaceuticals' sector is taken into consideration, the security of the process flow becomes extremely significant. There's a prospect that a counterfeit medication would be loaded up with something more harmful just like floor wax or boric corrosive. Sometimes, it is exposed to be rodent poison. These can make hypersensitive disorders which might cause genuine injury to death. To get better the supply chain's traceability and security, Blockchain technology has been producing motivating research zones due to its resourceful attributes that give productive answers for the current loopholes identified. In simple terms, Block chain can be defined as a conveyed in order base, which is shared among and concurred upon by a distributed organization, also known as a peer-to-peer network. When a component is annexed to the block chain, it can't be distorted, making a block chain into a enduring record of past movement, thus helping to

improve overall performance and security. To conclude, the features that makes Block chain an ideal solution are a) Immutability, b) Transparency, c) Verification of information, d) Secured by cryptography. Block chain technology mainly offers two types of services: a) Ethereum, b) Hyperledger. These give a base to fathom the responsibility issue. At whatever point products will trade hands, the transaction will be recorded and put away on block chain for credibility and confirmation. Currently, the belief will be founded on bring together organizations. Crude materials provided to them by the provider will be tried in the laboratory and succeeding testing, as well as the developed cycle, will begin. The pharmaceutical sector has a complex and extensive supply chain that involves many parties, including producers, distributors, wholesalers, and pharmacies. However, this system is widespread with problems, including as counterfeit pharmaceuticals, inadequate tracking, and a lack of accountability. To solve these difficulties this project proposes the deployment of a Block chain-Based Pharmaceutical Supply Chain Management System which would use block chain technology's troublesome potential. Block chain is a decentralized and disseminated ledger that provides an immutable record of transactions, assuring transparency, security, and traceability. By adding block chain into the pharmaceutical supply chain, the initiative hopes to transform the industry's operating dynamics, increasing efficiency and reinforcing stakeholder confidence.

2. Literature Review

Block chain technology was developed specifically for making crypto currency (i.e. bitcoins) and other financial services. After some years of that discovery, many more block chain implementations were proposed in various fields and block chain become more effective after the introduction of smart contracts. Despite Block chain’s enormous ease, proposals have been proposed to cope with its medication and healthcare apps. Benchouf and Ravaud have clarified how block chain is used to improve the additive effect of the standard of clinical research. We told about the overall use of block chain in healthcare and medicine but there is no reason for the use of blockchain in the drug supply chain. Med Share is another research paper that has a reason to use block chain technology in health care to share medical data from one individual to another in a secure environment.

Jianfeng Shi iet Al.[1] proposed a Blockchain and IoT based pharma supply chain to ensure the authenticity of data sources, IoT idevices, sensors, locators, and QR codes. For this, distributed Ledger was implemented for sharing and storage of data thus maintaining the transparency of data and increasing the safety of products.

Yen-Chih Liao, Bin Chong, Jen-Hung Tseng, and Shih-Wei Liao, put forward a method named Gcoin Block chain as the base of the drug data flow. It is a combination of a decentralized autonomous organization regulation model and open government which ensures transparent drug transaction of data. It is also proven to be a system that can handle millions of transactions per day unlike Ethereum or hyper ledger block chain.

Haya Hasana, Esra AlHadhramia, Alia Al Dhaheri, Khaled Salaha, and Raja Jayaraman, proposed a block chain-based solution which utilized the functionalities of smart contracts in Ethereum block chain. It manages the transactions between the sender and receiver.IoT sensors are used ito monitor and track previously defined shipping conditions such as humidity, temperature, pressure, geographic location, broken seal, light exposure, etc.

Sunny, J., Undralla, N., Madhusudanan Pillai, V explained the significance of transparency and traceability in any supply chain management system. They also gave in overview of traceability solutions using blockchain in the food,pharmaceutical, consumer electronics, and automobile supply chains.The Proof of Concept was provided by the implementation of solidity smart contracts in Microsoft Azure Block chain Workbench.
Gregor Blossey, annick Eisenhardt, Gerd Hahn, proposed to use Block chain technology to secure the supply chain. As many as 53 block chain applications were analyzed in the field of management of supply chain. Predominant use cases cover provenance following of resources just as robotization of supply chain tasks while parts of supply chain account are just upheld once in a while in block chain applications. Applications of block chain exclusively center around catching the advantages of executing a novel broadly useful innovation. These issues are identified with the administration model of information possession and ordinarily low information quality in supply chain settings. This research paper mostly centered around the issues of assembling and coordination inside SCM.

3. PROPOSED METHODOLOGY

Block chain technology provided the base for the peer-to-peer digital currency and led to the bit coin platform. But the applications of block chain technology are far more than crypto-currencies, and it can provide an excellent solution for tracing drugs in the pharmachain. So, let's understand the working of the block chain network and how it can solve the problem of drug-counterfeiting Block chain is nothing but an unchangeable distributed database shared by a group of nodes over a p2p network. Each activity on this network is called a transaction. A group of such transactions forms a block. A block is associated with a timestamp, hash value, and hash of the prior block. This chaining of blocks together makes the ledger tamper-proof and immutable. The blocks are appended to the network after verification by the Proof-of-Work consensus or any other custom consensus algorithm, which provides answerability and integrity to the block chain network. The ability to store the transactions based on their sequence makes block chain an ideal candidate for solving traceability problems in the supply chain management system.

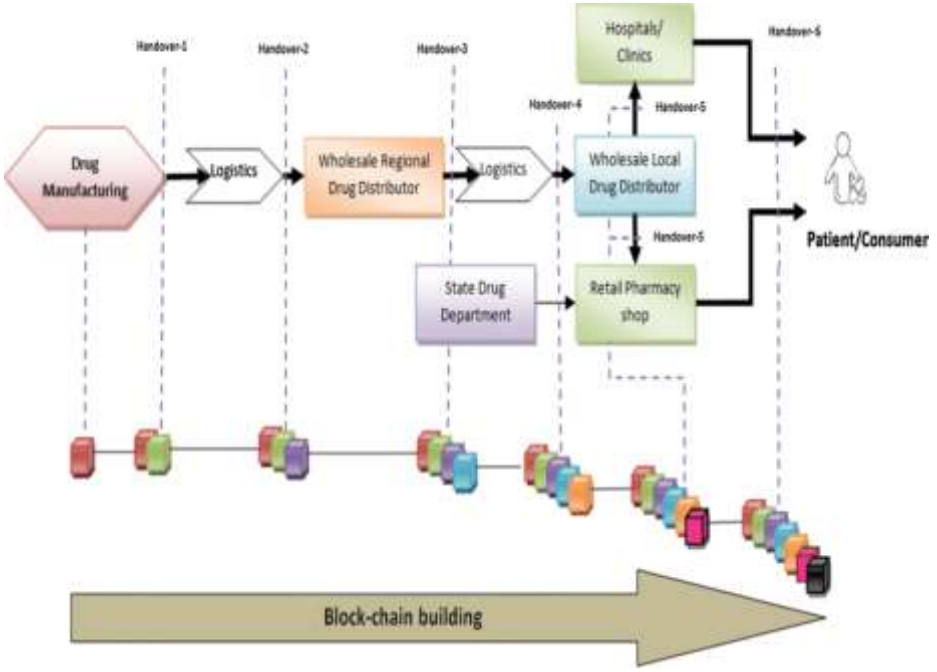


Fig 1. System architecture of Block Chain

3.1 BLOCK CHAIN RECOGNITION

Initially, the producer will create a QR code enclose the manufacturer's name, manufacturing date, expiry date, and transaction number. The transaction umber will help in recognize the medicine on the block chain. Then the distributor will scan the QR code and check for validity. When the consignment leaves the distributor's storage, the distributor should add his signature details in the medicine's record. The wholesalers, retailers, and pharmacies will carry out the same tasks at their end. By recording the transactions at each stage of the supply chain, tracking and traceability can be made possible in the drug supply chain.

3.2 PROOF OF WORK

Each square has a hash, timestamp, and the hash of the past square. Past hash keeps from adjusting blocks in the middle. Along these lines, the organization is altered, straightforward, and permanent. Block chain in short is a disseminated permanent record that keeps up the uprightness of the organization by accomplishing agreement through calculations like Proof of Work or Evidence of Authority or own custom agreement calculations.

3.3 TYPES OF BLOCK CHAIN

Furthermore, there are two kinds of block chain – Public and Private which have some drawbacks. These all give a base to address the accountability issue. Presently, at whatever point products will trade hands, it will be recorded and put absent on block chain for authenticity and substantiation. Presently, our base trust will be founded on assembling organizations. Crude materials provided ito them by the provider will be tried in the lab and

subsequent testing mechanized interaction will start in on. The principal cycle of these assembling organizations like Sun Pharma, Abbott, Pfizer, Cipla, and so on is to create a remarkable QR code name that will contain the name of the producer, expiry date, and exchange number or square number on the medicine pack itself. At the point when the medication is produced, they will be put away and their QR code will be filtered, and it will go about as the confirmation of the medication from their side. Presently when this medication will leave the production line, the merchant should filter the medication to realize that it is coming from the assembling industrial facility plant and not from other off-putting places. They will at that point add his scrupulous subtleties and further send it to various wholesalers, retailers, and so forth with this procedure we will accomplish FTP (Production line ito Pharmacy), and all the switch over's will be recorded on the block chain additionally, the client can basically check this by filtering the QR code at the nearby pharmacy store or in medical clinics. All the stages will be recorded on the block chain and it will tackle the issue for fake recommendations.

4. SECURED METHODS AND MATERIALS USED IN BLOCK CHAIN iTECHNOLOGY

There is no doubt that Block chain technology is transforming the pharmaceutical business in the world, where security, traceability, and intelligibility are keys.

A Block chain-Based Pharmaceutical Supply Chain Management System provides a original answer to the industry's complicated difficulties by using block chain's decentralized and safe and sound nature.

4.1BLOCK CHAIN SET OF CONNECTION

A distributed ledger is implemented make use of a block chain platform of choice e.g Ethereum or Hyperledger). The network has nodes representing several stakeholders, including producers, distributors, wholesalers, and pharmacies.

4.2 SMART PROCESSING

Self-executing agreements that are programmed with business rules to automate tasks like order processing, observance checks, and remember management. Smart contracts are implemented on the block chain network. User Interface: Gives stakeholders a user-friendly way to engage with the system. This interface enables real-time monitoring, traceability, and access to pertinent data.

4.3 TRACEBILITY AND DERIVATION

Improving traceability and transparency is a key goal. Stakeholders get complete insight into the derivation of pharmaceutical items, from manufacture to sale, by securely recording each transaction on the block chain and integrating real-time tracking systems using unique IDs and QR codes.

4.4 CRYPTOGRAPHY TECHNIQUES

Cryptographic techniques such as hashing and encryption are used to protect data stored on blockchains. Access control techniques are designed to prevent illegal access, and extensive testing guarantees resistance to cyber attacks.

4.5 INTELLIGENT SYSTEM

A strong recall management system is vital for addressing quality concerns. Recall triggers are connected into smart contracts to automatically identify impacted batches. Communication channels are built to rapidly alert stakeholders and customers, allowing for the secure removal of recalled items from the supply chain.

4.6 USER FRIENDLY

The project will entail designing and implementing a block chain network specifically for the pharmaceutical supply chain. Smart contracts will be created to automate essential procedures, and a user-friendly interface will make it easier to engage with the system. Integration with current supply chain technology and protocols will be examined to provide a smooth implementation.

5. PHARMACEUTICAL PRODUCT ATTRIBUTES

Product ID: A unique identification assigned to each pharmaceutical product.
Product Name: The name of the medicinal item.
Batch ID: Identifies a specific production batch of the product.
Manufacturing Date: The date when the batch was manufactured.
Expiry Date: The date until which the product is considered safe for use.
Composition: List of active ingredients in the product. Manufacturer: The company or entity that produced the batch.

6. SUPPLY CHAIN TRANSACTION ATTRIBUTES

Transaction ID: A unique identifier for each supply chain transaction.
From: The sender or source of the product in the transaction. To: The recipient or destination of the product in the transaction.
Timestamp: The date and time when the transaction occurred. Quantity: The quantity of products involved in the transaction.
Transporter: The entity responsible for transporting the products.
Location: The physical location or address associated with the transaction.

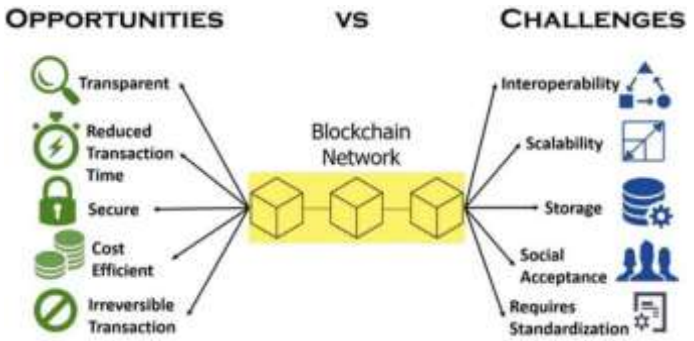


Figure 2 Advantages and challenges related to the application of block chain.

7. SYSTEM IMPLEMENTATION

The Security algorithm used in the execution of the supply chain is given below:
Algorithm for Admin Login: Step 1: Start Admin login
Step 2: Call MetaMask web services ito request account address
Step 3: Validate login –
If(account_address === admin_account){ Login as admin ;
Return admin dashboard;
Step 4: Stop
}else {}

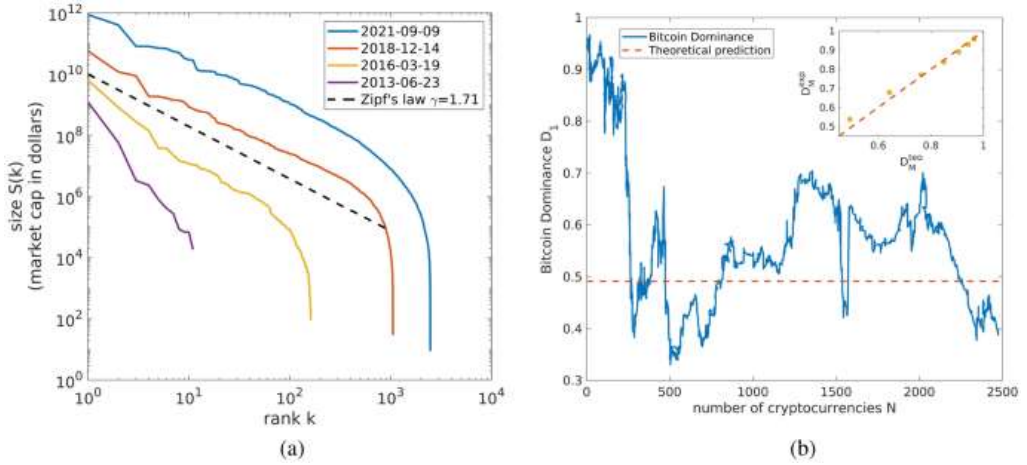
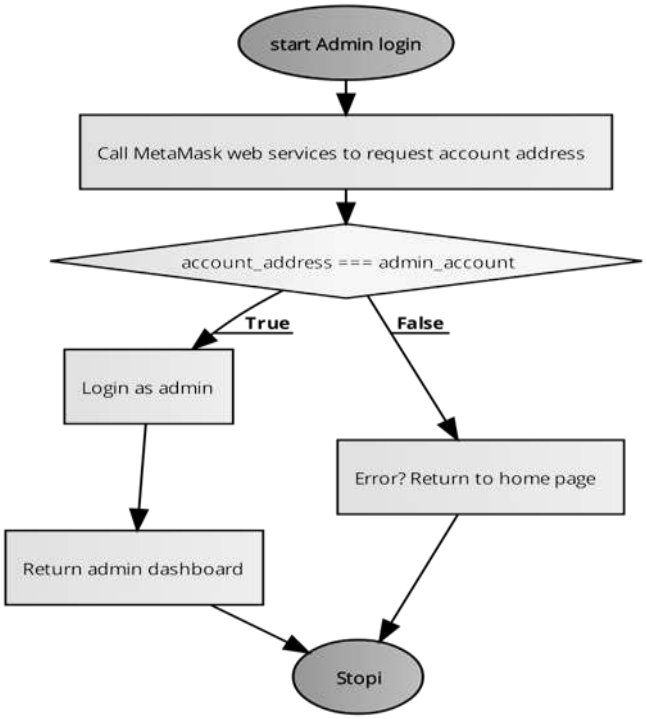


Fig. 3. The above represents the process of Block Chain Cryptocurrency

Fig. 4. The above flowchart represents the process for secure admin



8. Future Scope and Conclusion

In conclusion, the Block chain-Based Pharmaceutical Supply Chain Management System is a reliable solution for solving the complex difficulties of the pharmaceutical supply chain. Blockchain technology enables unparalleled transparency, security, and traceability across the whole product lifecycle. This project has effectively used blockchain's decentralized and irreversible nature to create confidence among stakeholders, maintaining the integrity of vital data such as batch submissions, product tracking, and recall management. The extensive literature analysis has proved the need for such novel solutions in the pharmaceutical industry, highlighting the influence on supply chain efficiency, regulatory compliance, and overall patient safety. The limits of current systems, notably in terms of data integrity, traceability, and security, have emphasized the urgent need for a paradigm shift toward decentralized alternatives. The future scope of blockchain-based pharmacy supply chains is vast and promising. As block chain technology continues to evolve, it has the potential to bring even greater transparency, efficiency, and security to the pharmaceutical industry. One possible area of potential development is the use of smart contracts and automated processes to streamline supply chain operations. Smart contracts can be used to automatically trigger payments, verify product authenticity, and ensure compliance with regulatory requirements. Another area of potential development is using image processing technology in facial recognition which can be integrated into the process of issuing identity documents, typically in conjunction with other

biometric technologies like fingerprint recognition. AI- powered Chat bots can be implemented to track medication orders and verify the details of retailers and sellers. In addition, blockchain technology could be used to create a decentralized network of pharmacies and suppliers, allowing for greater collaboration and information sharing. This could lead to more efficient distribution channels and better patient outcomes. Overall, the future of blockchain-based pharmacy supply chains looks bright, with the potential to bring significant benefits to patients, healthcare providers, and the pharmaceutical industry as a whole.

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