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Drug Traceability In Supplies Of Healthcare Products Using Block Chain

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Abstract The goal of a drug traceability system is to track or trace where a drug has been and where it has gone along the drug supply chain, which is critical for public drug security and pharmaceutical company business. Traditional centralized server-client technical solutions have failed to meet expectations in terms of data integrity, privacy, system resilience, and adaptability. For drug traceability, we've proposed a totally new blockchain system. This solution is more secure and scalable than other options currently available. Furthermore, the suggested system can prune its storage effectively, resulting in a robust and usable blockchain storage solution.

Keywords: —Blockchain, drug counterfeiting, traceability, healthcare, supply chain, trust, security

1. INTRODUCTION

Drug traceability is critical for the health and well-being of patients, businesses, and the government. Patients and other parties involved in the drug supply chain could easily track the location of their medication if it had a dependable traceability mechanism. In fact, governments all around the world are increasingly making drug tracking a vital requirement. Prescription medications must be identified and tracked electronically and interoperably as part of the U.S. Drug Supply Chain Security Act (DSCSA), enacted on November 27, 2013, to ensure their safety in the country's supply chain. About eight years ago in China, the above-mentioned stakeholders were compelled to input the drug information of individual pharmaceutical goods into the official authorized IT system wheneverpharmaceuticals entered or exited their warehouses. An effective drug traceability system should be able to maintain track of or trace drug transactions as they move through various supply chain participants. It should provide stakeholders and patients with trustworthy information about the flow, particularly regarding the origin of medicine production for anticounterfeiting purposes. In some cases, it could be utilized as a means of tying the hands of the relevant parties in the control of drug security. There must also be a high level of privacy for traceability data, especially that pertaining to statistical information on drugs that have passed through the stakeholder's hands (such as productivity, sales volume, and so on). For the first time, a blockchain system for drug traceability and regulation is presented in this study. As time goes on, it rebuilds the entire service architecture, ensuring the authenticity and privacy of traceability data, while at the same time, achieving a finally stable blockchain storage. There have also been presented algorithms that mirror the practical workflow of the medication supply chain

II LITERATURE SURVEY

1.Ronaldo Brito da Silva, Claudia Aparecida de Mattos. ―Critical Success Factors of a Drug Traceability Systemfor Creating Value in a Pharmaceutical Supply Chain‖ International Journal of Environmental Research and Public Health (IJERPH) 2019. In this paper, we have analyzed how drug traceability actually works in real time. We also got to know about the stakeholders present in the pharmaceutical supply chain and how they perform their tasks.The present analysis identified the critical success factors for the implementation of a drug traceability system based on the views of several professionals who are directly involved with the implementation of drug traceability projects.

2.Yang Cheng, Han Shaoqin. ―Research on Blockchain Technology in Cryptographic Exploration‖ International Conference on Big Data & Artificial Intelligence & Software Engineering (ICBASE) 2020. In this paper, we have studied about blockchain technology. While going through this paper we've got know more about various terms like smart contracts, consensus, cryptography

and many more. In this paper, combining Blockchain Technology using bitwise XOR, bitwise rotation operation and one-way encryption hashing a lightweight security authentication mechanism for RFID system passwords for smart factories is realize 3.Ahmad Musamih, Khaled Salah, Raha Jayaraman, Junaid Arshad, Mazin Debe, Yousof Al-Hammadi and Samer Ellahham. ―A Blockchain Based Approach for Drug Traceability in Healthcare Supply Chain‖ (IEEE Access) 2021 In this paper, we have looked how drug traceability can be done using Blockchain Technology. We've also seen some traditional efforts taken in drug traceability such as Smart-Track, Near Field Communication, Data Matrix-Tracking System also In this article, we have investigated the challenge of drug traceability within pharmaceutical supply chains highlighting its significance especially to protect against

counterfeit drugs. We have developed and evaluated a blockchain-based solution for the pharmaceutical supply chain to track and trace drugs in a decentralized manner. 4.Monalisa Sahoo, Sunil SamantaSinghar, Biswojit Nayak, Bhabendu Kumar Mohanta. ―A Blockchain Based Framework Securing ECDSA to Curb Drug Counterfeiting‖ (IEEE) 2019. In this paper various issues have discussed related to drug supply chain management and how Blockchain can prevent the issues in a transparent and secure manner with extensive use of elliptic curve digital signature algorithm(ECDSA). Here ,it has also been described that how the Blockchain can be used to add traceability and visibility to the drug supply chain to overcome the issues of drug counterfeiting.A model of decentralized Blockchain architecture has been presented with shared ledger system, which will not only prevent drug counterfeiting but also will make the drug supply more robust, transparent and trustworthy. 5.Ching-Ling Chen, Yong-Yuan Deng, Chun-Ta li, Shunzhi Zhu, Yi-Jui Chiu, Pei – Zhi Chen. ‖IoT-Based Traceable Drug Anti-Counterfeiting Management System‖ (IEEE Access) 2020. This paper explains the disadvantages of existing traceability system which is currently in the market along with that authors explained how we can improve efficiency of drug traceability and drug management. In this research, authors propose an IoT-based traceable drug anti-counterfeiting management system, a comprehensive plan from drug research and development, certification, production to sales. The drug manufacturer starts by contacting the raw material supplier to develop a new drug and then is approved by the drug administration until the drug distributor conducts terminal sales. All information about the drug circulation process is uploaded on the blockchain and the data is signed by each role, thus it cannot be tampered with privately by interested people

III. PROPOSED WORK

In today's world, the healthcare industry relies on extensive supply chains that cross organizational and geographic boundaries. Impurities such as erroneous information, a lack of transparency, and restricted data provenance can be introduced by the intrinsic complexity of such systems. Counterfeit medications are one of the consequences of such constraints in existing supply chains, which not only has a negative impact on human health but also costs the healthcare business a lot of money. A dependable end-to-end track and trace system for pharmaceutical supply chains has thus been emphasized in prior study. An end-to-end pharmaceutical supply chain tracking system is vital to assure product safety and eradicate counterfeits. Most modern track and trace systems in healthcare supply chains are centralized, posing privacy, transparency, and authenticity issue

DISADVANTAGE:

- The system is less secured since blockchain techniques which are maintains trust between data are not implemented.
- Trust is not implemented in which a multidisciplinary and multifaceted concept that has been defined in various disciplines, such as sociology, economics, psychology, computation, information and computer science, to model different types of relationships.

We are developing a Drug Traceability System based on Blockchain Technology that will be used to track drugs throughout the healthcare supply chain. There are numerous stakeholders in the healthcare supply chain, including manufacturers, suppliers, distributors, pharmacies, hospitals, and so on. While supplying the drug from the manufacturer to the customer or patient, there is a possibility that one of the stakeholders will mislabel or counterfeit the drug. To avoid this, we propose our solution. Another aspect to consider when examining flaws in the healthcare supplychain is the possibility that one of the stakeholders stocks the drugs for an extended period of time. Waiting for demand to rise before selling the drugs. This drug stockpiling has an impact on the treatment of patients in an emergency. To avoid this, we are gathering information on how many drugs each stakeholder has and when he is supposed to supply the other stakeholder. To achieve all of the above, we will use the blockchain technology which is a distributed ledger used to store transactions between the parties in the form of blocks.

The challenge of achieving traceability to mitigate against counterfeit drugs is well-established and several efforts have been made to address this within pharmaceutical industry. However, a careful review of literature presents several gaps and opportunities for a comprehensive application of blockchain technology for drug traceability. In this context, the primary contributions of this paper can be summarized as follows:

- Propose a blockchain-based solution for the pharmaceutical supply chain that provides security, traceability, immutability, and accessibility of data provenance for pharmaceutical drugs.
- Design a smart contract capable of handling various transactions among pharmaceutical supply chain stakeholders.
- Present, implement and test the smart contract that defines the working principles of our proposed solution.
- Conduct security and cost analysis to evaluate the performance of the proposed blockchain-based solution.

ADVANTAGE:

- The system proposes a blockchain-based solution for the pharmaceutical supply chain that provides security, traceability, immutability, and accessibility of data provenance for pharmaceutical drugs.
- The system designs a smart contract capable of handling various transactions among pharmaceutical supply chain stakeholders.
- The system presents, implement and test the smart contract that defines the working principles of our proposed solution.
- The system conducts security and cost analysis to evaluate the performance of the proposed blockchain-based solution.

Algorithm 1: Creating a Lot in Smart Contract

Input: lotName, lotPrice, numBoxes, boxPrice, IPFShash, Caller, OwnerID
Output: An event declaring that the Lot has been manufactured
An event declaring that the image of the Lot has been uploaded
Data:
lotName: is the name of the Lot
lotPrice: is the specified price of the Lot
numBoxes: is the total number of boxes within a Lot
boxPrice: is the price of each box within a Lot
IPFShash: is the IPFS hash of the Lot image
ownerID: is the Ethereum address of the owner of the Lot
initialization;
if *Caller == ownerID* **then**
  Update *lotName*
  Update *lotPrice*
  Update *numBoxes*
  Update *boxPrice*
  Add *IPFShash*
  Emit an event declaring that the Lot has been manufactured
  Emit an event declaring that the Lot image has been uploaded to the IPFS server
else
  Revert contract state and show an error.

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Algorithm 2: Granting Lot Sale

Output: An event declaring that the Lot is for sale
initialization;
if *Caller* == *ownerID* **then**
  Emit an event stating that the Lot is up for sale
else
  Revert contract state and show an error.

Algorithm 3: Buying Lot

Input: ownerID, Buyer, Seller, Transferred Amount, lotPrice
Output: An event declaring that the Lot has been sold
Data: *ownerID*: The Ethereum address of the current Lot owner
Buyer: The Ethereum Address of the buyer
Seller: The Ethereum Address of the Seller
Transferred Amount: The amount transferred to the function
lotPrice: The price of the Lot
initialization;
if $Buyer \neq Seller \wedge TransferredAmount =$ *lotPrice* **then**
  Transfer the price of the Lot to the seller
  Update ownerID by replacing the seller Ethereum address to the buyer Ethereum Address
  Emit an event declaring that the Lot has been sold
else
  Revert contract state and show an error.

Modules

Stakeholders include regulatory agencies such as FDA, manufacturers, distributors, pharmacies, and patients. These stakeholders act as participants in the smart contract and are assigned specific functions based on their role in the supply chain. They are also given access to the on-chain resources such as history and log information to track transactions in supply chain. Further, they are authorized to access information stored on the IPFS such as the drug Lot images, and information leaflets.

Decentralized Storage System (IPFS)

Provides A low-cost off-chain storage to store supply chain transactions data to nsure reliability, accessibility, and integrity of the stored data. The integrity of data is maintained by generating a unique hash for every uploaded file on its server, and the different hashes for the different uploaded files are then stored on the blockchain and accessed through the smart contract, and any change that occurs to any of the uploaded file is reflected in the associated hash.

Ethereum Smart Contract is used to handle the deployment of the supply chain

The smart contract is central and essential for tracking the history of transactions and manages the hashes from the decentralized storage server which allows the participants to access the supply chain information. Moreover, the functions of the different stakeholders in the supply chain are defined within the smart contract and access to these functions is given to the authorized participants by using modifiers. A modifier is basically a way to decorate a function by adding additional features to it or to apply some restrictions. The smart contract also handles the transactions, such as selling drug Lots or boxes.

On-chain Resources are used to store the logs :

Events that are created by the smart contract allowing track and trace. Moreover, a registration and identity system is used as an on-chain resource to associate the Ethereum address of the different participants to a human readable text which is stored in a decentralized way

IV METHODOLOGY

The Ingredient Supplier provides all basic aspects required to manufacture the specific drug. Before starting the Production, Manufacturer need to take authenticated certificate from (Food Drug Association)FDA. After the approval, manufacturer starts production of drugs. Manufacturer transfer Drug lot to Primary Distributer and packager. The packager develops new packaging and transfer repackaged drugs to Secondary Distributer. The both primary and secondary distributer distribute drug lot to hospitals and directly to the pharmacy shops. In the patient block, we can include customers of pharmacy shops and patients of hospitals.

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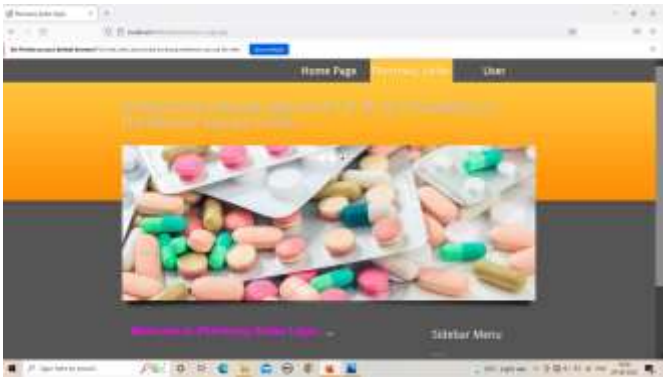
Screen 1: Home Page for Block Chain Based Drug Traceability

Screen 5: Report Showing Drug Block Chain for a keyword Entered

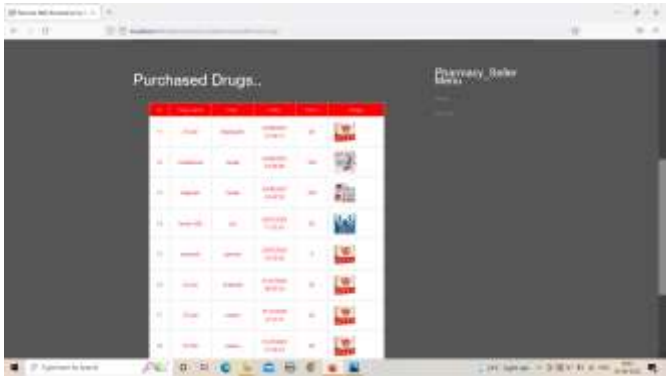

Screen 2: Home Links Showing Pharacy Seller and User Login Activities


Screen 6: Bar Graph Showing all Drug ranked Search Information


Screen 3: Menu Activities of Pharmacy Seller


Screen 7: Pharmacy Seller Adding New Drugs and their Avaialibity


Screen 4: User Login for Drug Traceablility



Screen 8 : Report Showing Purchased Drugs

V. CONCLUSION

We looked into the problem of drug traceability in pharmaceutical supply chains and found that it is especially important in the fight against the sale of fake medications. Using blockchain technology, we have created and tested a system for tracking and tracing pharmaceuticals in a distributed fashion. Because of the cryptographic foundations of blockchain technology, we suggest a method that makes use of smart contracts on Ethereum blockchain to automatically record occurrences and make those records available to all stakeholders.

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