A Blockchain based Approach for Drug Traceability in Healthcare Supply Chain

Abstract:

Healthcare supply chains are complex structures spanning across multiple organizational and geographical boundaries, providing critical backbone to services vital for everyday life. The inherent complexity of such systems can introduce impurities including inaccurate information, lack of transparency and limited data provenance. Counterfeit drugs are one consequence of such limitations within existing supply chains which not only has serious adverse impact on human health but also causes severe economic loss to the healthcare industry. Consequently, existing studies have emphasized the need for a robust, end-to-end track and trace system for pharmaceutical supply chains.

Therein, an end-to-end product tracking system across the pharmaceutical supply chain is paramount to ensuring product safety and eliminating counterfeits. Most existing track and trace systems are centralized leading to data privacy, transparency and authenticity issues in healthcare supply chains. In this article, we present an Ethereum blockchain-based approach leveraging smart contracts and decentralized off-chain storage for efficient product traceability in the healthcare supply chain. The smart contract guarantees data provenance, eliminates the need for intermediaries and provides a secure, immutable history of transactions to all stakeholders. 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.

Existing System:

According to the Health Research Funding Organization, up to 30% of the drugs sold in developing countries are counterfeit. Further, a recent study by World Health Organization (WHO) indicated counterfeit drugs as one of the major causes of deaths in developing countries, and in most cases the victims are children. In addition to the adverse impact on human lives, counterfeit drugs also cause significant economic loss to the pharmaceutical industry. In this respect, the annual economic loss to the US pharmaceutical industry due to counterfeit medicine is estimated around $200 billion. There was no such existing system which could eradicate and counterfeit the Healthcare supply chain.

Proposed System:

Healthcare supply chain is a complex network of several independent entities that include raw material suppliers, manufacturer, distributor, pharmacies, hospitals and patients. Tracking supplies through this network is non-trivial due to several factors including lack of information, centralized control and competing behaviour among stakeholders.

Such complexity not only results in in-efficiencies such as those highlighted through COVID-19 pandemic but can also aggravate the challenge of mitigating against counterfeit drugs as these can easily permeate the healthcare supply chain. Counterfeit drugs are products deliberately and fraudulently produced and/or mislabelled with respect to identity and/or source to make it appear to be a genuine product. Such drugs can include medications that contain no active pharmaceutical ingredient (API), an incorrect amount of API, an inferior-quality API, a wrong API, contaminants, or repackaged expired products.

Some counterfeit medications may even be incorrectly formulated and produced in substandard conditions. In this project to eradicate the addressed problems, we were building a decentralized and distributed application were taking multiple stakeholders as authorised entities and storing all the data in the Distributed Ledger for transparency and trust. Stakeholders can counterfeit and track the medicines.

Software Tools:

1. Ganache
2. Truffle Suite
3. Nodejs
4. NPM
5. Solidity
6. Web3.js
7. Metamask

Hardware Tools:

1. Laptop
2. Operating System: Windows 11
3. RAM: 8GB RAM
4. ROM: 2GB
5. Fast Internet Connectivity

Applications:

1. You can create any custom-based Supply Chain using this architecture.
2. Helps the government and hospitals to track and counterfeit the medicines.