A Blockchain Approach for Eliminating Counterfeit Drugs in Pharma Supply Chain

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ABSTRACT

The following paper gives a general review of the trending Blockchain technology and the platforms that be able to deploy to build an infallible system in eradicating spurious drugs in pharmaceutical enterprises. Several report analysis indicates that introduction of substandard drugs into the supply chain by unknown sources is one of the significant problems encountered by the drug companies. Applying blockchain throughout the supply chain operations, multiple issues can be resolved as blockchain is reliable, secure and immutable in nature. Overall, this paper aims to explain how blockchain transactions can fix the existing issues faced by the stakeholders

***Keywords:** Anti-Counterfeit, Blockchain, Pharmaceutical Supply Chain, Smart Contract*

1. INTRODUCTION

1.1 Blockchain

It is a distributed and non-editable database storing blocks of transactions tied together through cryptographic methods across a peer-to-peer network. The underlying architecture allows the shareholders (nodes) connected over the network to share the entries (ledger). Whenever a transaction occurs, all the nodes receive a copy of the transaction since the data gets synchronized across the entire network through peer-to-peer replication. Its distributed nature rules out the need of a central authority as the transactions are visible and validated by the participating nodes of the network.

Figure 1 : Blockchain architecture

1.2 Smart Contract

It is a code promoting the settlement among participants intended to be stored over the blockchain. It is run along with the transaction making transactions tamper proof and trustworthy. The purpose of these smart contracts aims at higher security than traditional contracts. Each smart contract has a contract related address as well as hash which is utilized for caching and recovering contracts in a fool-proof way.

1.3 Supply Chain

It comprises of various check-points associated with the production and shipment of assets. Nowadays, a supply chain involves a lot of steps and in many terrestrial places. It results in hard to track events and review issues in each stage.
When a participant in a supply-chain introduces substandard goods, the inquiry becomes tedious and usually, neither individual is responsible. Hence both needs a trusted entities to approve a entity a specific quality of the products and the service into consideration.

2. LITERATURE SURVEY

Nakamoto.S [1], the paper proposes a new form of digital cash eliminating the need for a assured third party. The system is tamper-proof reducing the frauds existing in the current system. The transactions are validated through the proof-of-work.

After the acceptance by the other nodes, the transactions are attached with the timestamp and added as a block to the existing blockchain. The proposed idea is against the centralized banks but does not achieve the level of privacy provided in the existing systems. M. Crosby et al. [2], the paper discusses the applications of blockchain technology in financial as well as non-financial fields. Non-financial applications like music, IoT, blockchain based counterfeit solutions. It also explores the risks involved in its adoption in real world applications like resistance to change by people, scaling, government regulations etc. In V. Hua et al. [3], the paper suggests how this technology result in an improvement in the assurance factor in supply-chains.

In a supply chain, customers need a certain level of quality of service. Trust is needed for record and also security, authenticity is a must. Therefore, when implementing there are several limitations and need to trust middlemen. So, blockchain is designed for it to overcome this problem. Kentaroh Toyoda et al. [4], the paper implements an experimental system using the Ethereum platform to prevent counterfeit drug supply from cloning of RFID tags. The paper aims at identifying substandard products introduced within the supply chain. With this system still, if the tags are replicated, modification of product ownership is not possible. Thomas Bocek et al. [5], the paper puts forward an integrated system with blockchain and IOT for the supply chain pharmaceutical. It discusses the startup Modium.io which executes such a system. In addition to this, it explains some of the start-ups working on blockchain technology. The system comprises of the front and back end and sensor devices. An Ethereum platform and temperature sensors assure that temperature provided for a system is right. For continuous interactions, the servers are connected to blockchain network, smart contract as well for clients. API allows to create new records in a system. It checks that whether it is immutable by any person within the system. This article infers a blockchain can be integrated with other domain.

In Gendal Brown et al. [6], the paper explains the design and the main ideas of their model: A machine-readable contract code needs an agreement between two or more parties represented by state objects. The transaction is responsible between state objects and their protocol results in no need for centralized authority. This article gives a comparison of a different blockchain platform. The author suggests Croda was built to manage and record business agreements organizations. Soundarya K. et al [7], the paper discusses about the different blockchain platforms that can be used to implement systems which eliminate counterfeit drugs being introduced in supply chains. It also talks about the challenges to be dealt with when using the blockchain technology.

3. PROPOSED SYSTEM

A purpose of this project is building trustable and a robust platform to bypass the counterfeit situations in the supply chain of pharmaceutical industries.

3.1 Overview

The aim of the project is to develop a model/prototype for Blockchain to implement a supply chain for pharmaceutical industries to prevent bogus products in the system. With the immutability and transparency obtained by Blockchain, misconducts occurring within the supply chain can be avoided. The different actors are cryptographically appended into a Blockchain network and can add as well as extract details (or records) from the Blockchain. Hence, the patients can be aware of all the related information like the product source, various stages in the supply chain and the holders involved from the data stored in the Blockchain.

Every participant can enter data at every checkpoint which is reflected across the common network. Due to the visibility factor, each shareholder contains data that have been replicated so no manipulation of data is not possible at any given point.

3.2 Architecture Diagram

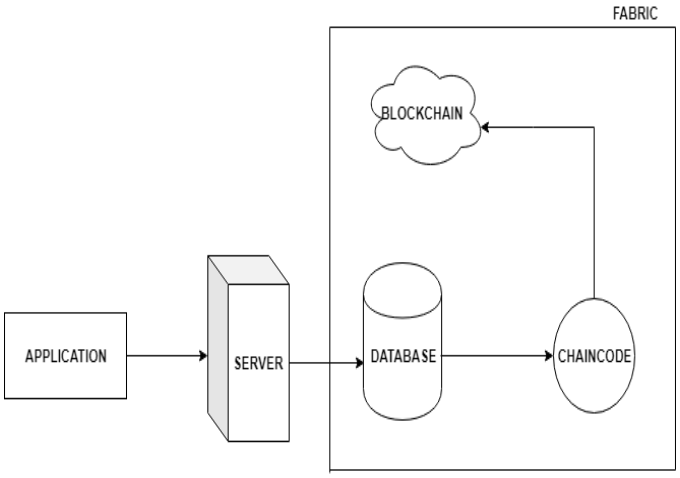

Figure 2 : Architecture diagram of the proposed system

Architecture diagrams are used to depict the relationship between different components of a system. It is essential to understand the complete concept of the system. The Figure2 shows the architectural diagram of the proposed system. In the proposed system each participant at each checkpoint uses the API to add the related legitimate data to a checkpoint. The entered data stored in a database through a server.
It smartly manages the retrieval of data stored in the database. The smart contract is created in IDE and further assembled and blockchain is deployed into it.

4. IMPLEMENTATION

4.1 Components

The following components are required for the proposed system:

- Blockchain Platform is needed to make and execute smart contract between participants(nodes) connected through it. There is numerous accessible to an open-source platform of such as MultiChain, BigChain DB Ethereum, etc.
- Cloud provides a platform for running virtual machines and servers and act as different nodes for the blockchain. Some of cloud service providers are AWS,Azure.
- Smart-contract is needed to store and validate the details provided in each node of the supply chain. Transaction is done only if policy is agreed.
- Database is needed to store the information entered by the clients on the application and also to store information related to the used smart contracts.
- Server is needed to establish interaction among blockchain network, the participants, and smart contracts.
- Application is needed to provide an interface to enter details by participants and also to view the entered information.

4.2 Blockchain Platforms

4.2.1 Ethereum

This platform is decentralized which allows building decentralized applications also know as DApps. It also helps to run smart contracts over a built blockchain. The smart contracts overcome the possibility of fraud or third-party interference. It is a public blockchain and can be used in financial as well as non-financial applications. It is adaptable and flexible unlike the Bitcoin protocol. The cryptocurrency used for transactions is named Ether. It supports various programming languages.

4.2.2 Hyperledger Fabric

It is a standardized, open, enterprise-grade distributed ledger framework by IBM alongside with The Linux Foundation. Hyperledger Fabric allows for components such as membership services and consensus protocols. The application logic of the system comprises of a chain code (similar to smart contract). Its applications include Banking, Finance, Internet of Things, Supply chain etc., Hyperledger Fabric can be used as a public as well as a private blockchain and it supports Python, Go languages.

4.2.3 MultiChain

It helps to rapidly build blockchain applications that can be used for financial transactions. It is an example for a permissioned blockchain. It supports Windows, Linux and Mac servers provides a simple API and a CLI to preserve and set up the chain. Users have the ability to customize the platform accordingly. It supports Python, JavaScript, Ruby, C#, and PHP languages.

4.2.4 Quorum

It is created by J.P. Morgan which is a version of Ethereum, basically an enterprise-focused version of. It is also an example of a permissioned network. Applications which requires higher throughput and greater speed for processing of the transaction uses this type of platform. It provides higher performance and privacy when compared to Ethereum. It has extra features like transaction privacy and new consensus mechanisms like Raft-based Consensus and Istanbul BFT. C++, Go and Python are the languages supported by Quorum.

4.2.5 Corda

By using this application we can build interoperable networks for permissioned applications. It includes a feature like managing and recording an agreement between two or more participants as per the existing legal guidelines and conventions without a central authority. It provides strict privacy between the participants within the blockchain network. Java is the language supported by Corda.

5. CONCLUSION

The following approach aims at solving the existing issues in the pharmaceutical supply chain using blockchain. Its immutability and reliability factor helps in eliminating the introduction of counterfeit and substandard drugs into the supply chain. Since all the transactions are visible to each and every actor in the supply chain, there is no need of a central authority to supervise the operations.

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