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Supply Chain Using Blockchain (Healthcare Industry)

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Abstract: ***The main objective of the project is to eliminate the centralized mechanism in some part of the supply chain and to make the system more transparent and accessible to the end user as well as supplier. Also helps to increase traceability of the product. A blockchain supply chain can help participants to record price, date, location, quality, certification, and other relevant information to more effectively manage the supply chain. It can also help to reduce losses from counterfeit and grey market.***

Keywords: blockchain technology; healthcare; medical workflows; smart contracts; data exchange; secure; distributed ledger technology; transparency

1. Introduction

The efficiency of traditional supply chain of goods at local level may be having some flaws like the price variation for the same product in the same market at different locations. The authenticity of the product is also an issue of concern in the local supply chain of goods.

Also the users are not aware of the fact that the product they are looking for is available or not in the market and they have to look for different shops if their desired product is present there or not. Using blockchain in the supply chain can help participants to record price, date, location, quality, certification, and other relevant information to more effectively manage the supply chain.

A blockchain supply chain can help participant's record price, date, location, quality, certification, and other relevant information to more effectively manage the supply chain. The availability of this information within blockchain can increase traceability of material supply chain, lower losses from counterfeit and gray market, improve visibility and compliance over outsourced contract manufacturing, and potentially enhance an organization's position as a leader in responsible manufacturing.

2. Problem Statement

To develop an application based solution to control and manage supply chain process using block chain.

Using Technology and working Principle

In our day-to-day life we often come across some situation where we are looking for a certain medicine in medical stores but we don't get it in any of the medical store. Even the medical shop owners can't tell us exactly where we will find it. This project aims to efficiently handle the supply system of medicines with ease on the level of distributor to retailer and customers. So that this problem can be solved by using this project. Also the distributors whom will be connected to this chain will be able to see where the needs of a particular medicine stock.

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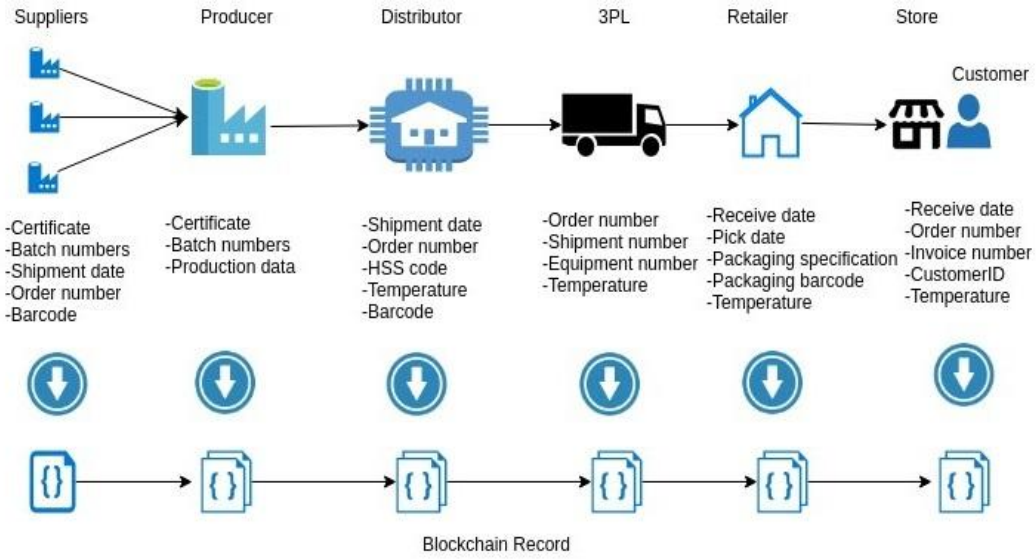

Figure: Supply Chain Path recorded by Blockchain

In distribution system there are six major parts are occurred, which are Suppliers, Producer, Distributor, Retailer, Local Store and Customers. This all are connected to a single path and when we follow this distribution path then each block of information is added in a blockchain by block-by-block.

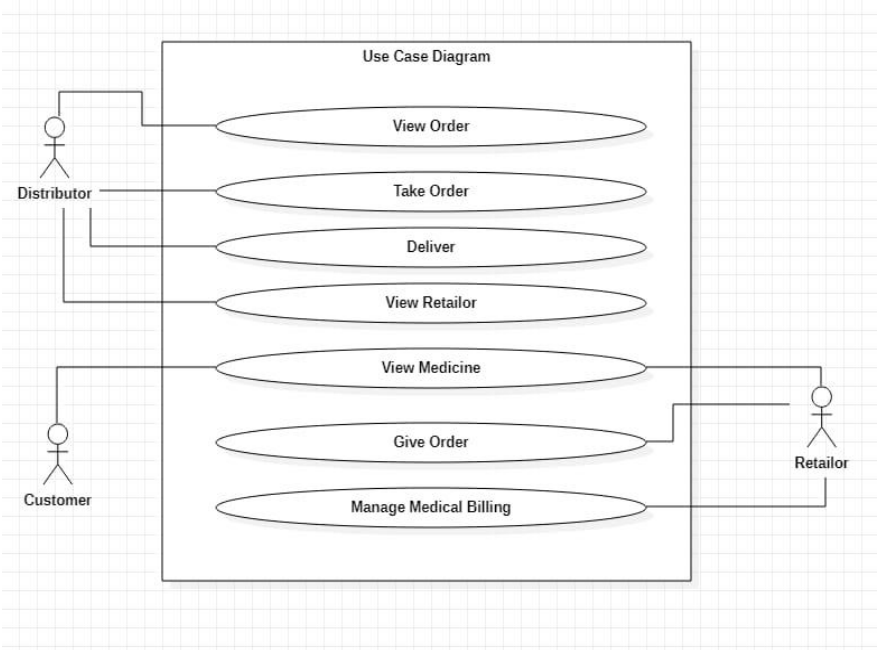

Figure: Use Case Diagram of Supply Chain using Blockchain

It is a trustless decentralized token-based energy trading system, which provides agents with anonymous communication channel and ability to trade Management ownership in the using distributed smart Supply Chain Technology. In this section we discuss the core components of the Decentralized Blockchain technology.

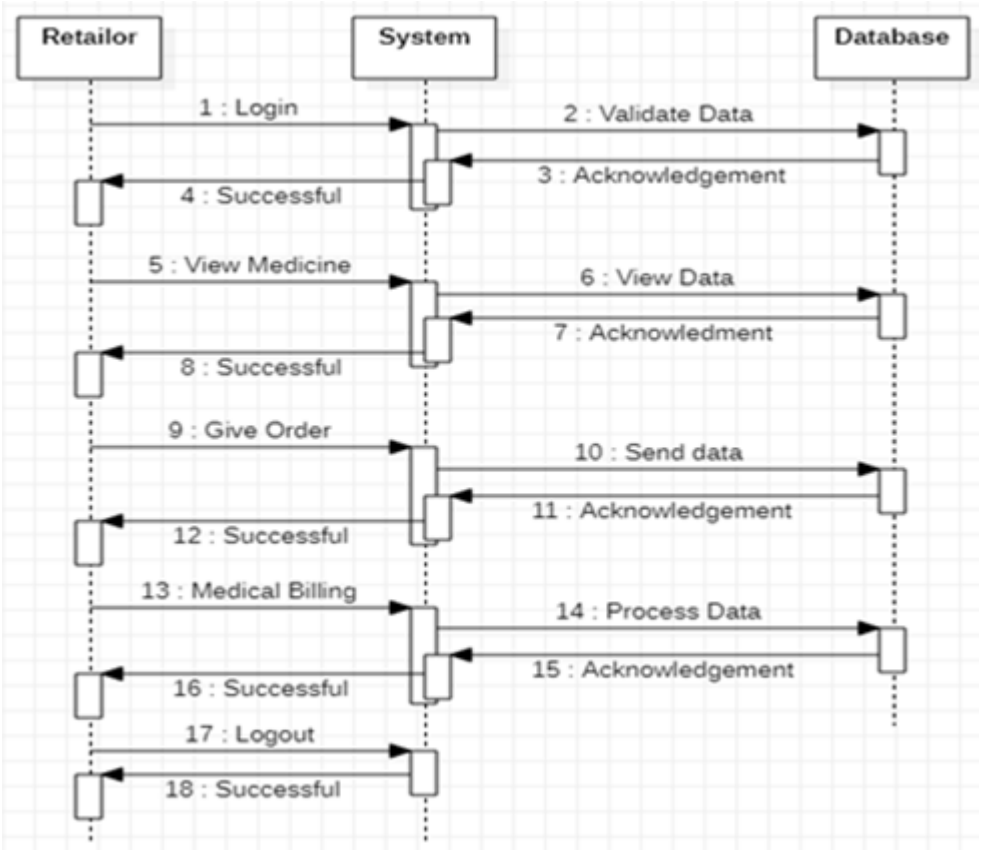

Figure: Sequence Diagram of Supply Chain using Blockchain

Blockchain can enable more transparent and accurate end-to-end tracking in the supply chain: Organizations can digitize physical assets and create a decentralized immutable record of all transactions, making it possible to track assets

from production to delivery or use by end user. This increased supply chain transparency provides more visibility to both businesses and consumers.

Blockchain can drive increased supply chain transparency to help reduce fraud for high value goods such as diamonds and pharmaceutical drugs. Blockchain could help companies understand how ingredients and finished goods are passed through each subcontractor and reduce profit losses from counterfeit and gray market trading, as well as increase confidence in end-market users by reducing or eliminating the impact of counterfeit products.

Furthermore, businesses can maintain more control over outsourced contract manufacturing. Blockchain provides all parties within a respective supply chain with access to the same information, potentially reducing communication or transfer data errors. Less time can be spent validating data and more can be spent on delivering goods and services—either improving quality, reducing cost, or both.

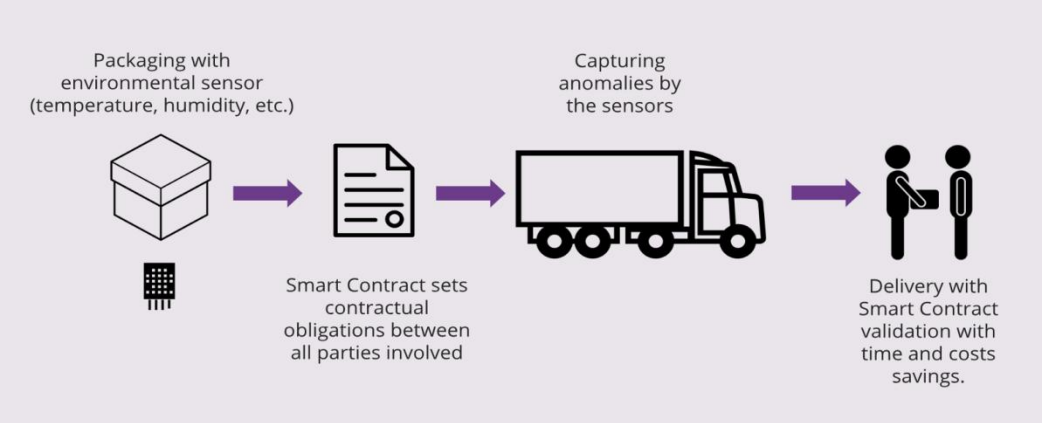

Figure: Example of Supply Chain Using Blockchain

Typically, SCM attempts to centrally control or link the production, shipment, and distribution of a product. As a result there is no transparency everyone in the supply chain needs to trust each other. Which in turn can cost significant time delays? Any person in the supply chain can easily modify the information as per his / her needs. which results in poor supply chain process.

3. A Review on Blockchain Healthcare Applications

Legacy systems typically only share healthcare resources internally in the medical and healthcare field and are not fully compatible with external systems. Nonetheless, evidence indicates numerous benefits from integrating these networks for interconnected and better healthcare, calling for interconnection between different organizations for health informatics researchers [35]. One of the most critical issues is multi-organizational data exchange, which demands that medical data obtained by a healthcare provider be easily available to other organizations, such as a physician or research institute. In many healthcare implementations, blockchain technology redefines data processing and governance. This is to its adaptability and unprecedented segmentation, secure and sharing of medical data and services. In the healthcare industry, blockchain technology is at the forefront of many current developments. With advances in electronic data related to health, cloud data storage and patient data protection regulations, new opportunities are opening up for the management of health data, as well as convenience for patients to access and share their health data [36]. Ensuring data security, storing, transactions, and managing their smooth integration is tremendously valuable to any data-driven organization, particularly in health care where blockchain technology has the potential to solve these critical issues in a robust and effective manner. In this section, blockchain-based applications including data sharing, data management, data storage and EHR, discussed in details. Emerging blockchain-based healthcare innovations, including data sources, blockchain technology, healthcare applications, and stakeholders, are conceptually divided into several layers. Gordon and Catalini [37] published a review on healthcare blockchain where they concluded their discussion on how blockchain technology can enable patient-centric control of healthcare data sharing over institution centric control. In their study they examined how blockchain technology transforms the healthcare sector by enabling digital access rights, patient identification across the network, handling a large volume of healthcare data and data immutability. Daisuke et al. [38] worked on medical records using the Hyperledger fabric blockchain platform where they were sending medical data to the hyper ledger blockchain network. They have collected those medical records using smartphones. In their work, they were trying to make sure that healthcare data is registered to the Blockchain.

There are many advantages to the distributed ledger system as discussed by Nofer et al. [55] including security to the personal data, sensitive information handling, eliminating third parties, identity management. Unlike centralized networks, the network's functionality continues even if individual nodes break down. It increases faith as the trustworthiness of the intermediary or other network members is not judged by individuals. It's enough if people build confidence in the system itself. Data security is also facilitated by the lack of intermediaries. As there is a possibility of security breaches in the current practice of third parties gathering personal data. Third parties may become redundant by using the blockchain, effectively increasing the protection of the user. A report by MIT Media Lab [56] presented about security and privacy aspects of

data and personal information handling underlining all of the blockchain technology implementations. It is the value of the secure processing of data–in the sense that it cannot be manipulated. Another dimension of data security is data protection and privacy. For example, Enigma is a decentralized, privacy-guaranteed computing platform and an advancement on blockchain technology. The goal of Enigma is to enable developers to build an end-to-end decentralized application that is' privacy by design' without a trusted third party. Enigma is an expansion of blockchain technology since processing and data storage are not achieved within the blockchain, instead the blockchain is an "operating system" for secure multiparty computations performed by network-participating storage and computation nodes. Information is split between different nodes, and different nodes are working together to measure functions without leaking information to the other nodes. In summary, "no single party has access to data in its entirety; rather, each party has a piece of it that is meaningless (i.e., apparently arbitrary). Blockchain holds the promise to create the new data deal, a greater degree of individual ownership, control and content distribution of personal data, within a system that allows community to benefit from the aggregation of data. The traffic congestion information inside Google Maps is a clear example of the benefits of data aggregation: by adding location, travel speed and other essential personal information, drivers benefit from the common data pool to achieve shorter traffic time and avoid traffic jams. To do this, however, Google needs to combine driver personal location information.

Potential Benefits of Blockchain in the Healthcare Industry:

Blockchain technology provides numerous benefits to medical researchers, health care providers, and individuals. It would serve research as well as personalized medicine to create a single storage location for all health data, track personalized data in real-time and set data access permissions at a granular level. Health researchers need comprehensive data sets to advance understanding of disease, accelerate biomedical discovery, track the development of drugs quickly, and design individual treatment plans based on genetics, lifecycle, and environment. By including patients of different ethnic and socio-economic backgrounds and from different geographic areas, the shared data system of Blockchain would provide a wide range of data set. It provides perfect information for longitudinal studies because blockchain collects health data over the lifetime of a person. A health care blockchain will extend the collection of health data to include data from groups of people currently under-served by the medical community or not typically involved in science. The shared data environment of blockchain makes it easier for "hard-to-reach" audiences to be interested and for the general public to produce results more reflective.

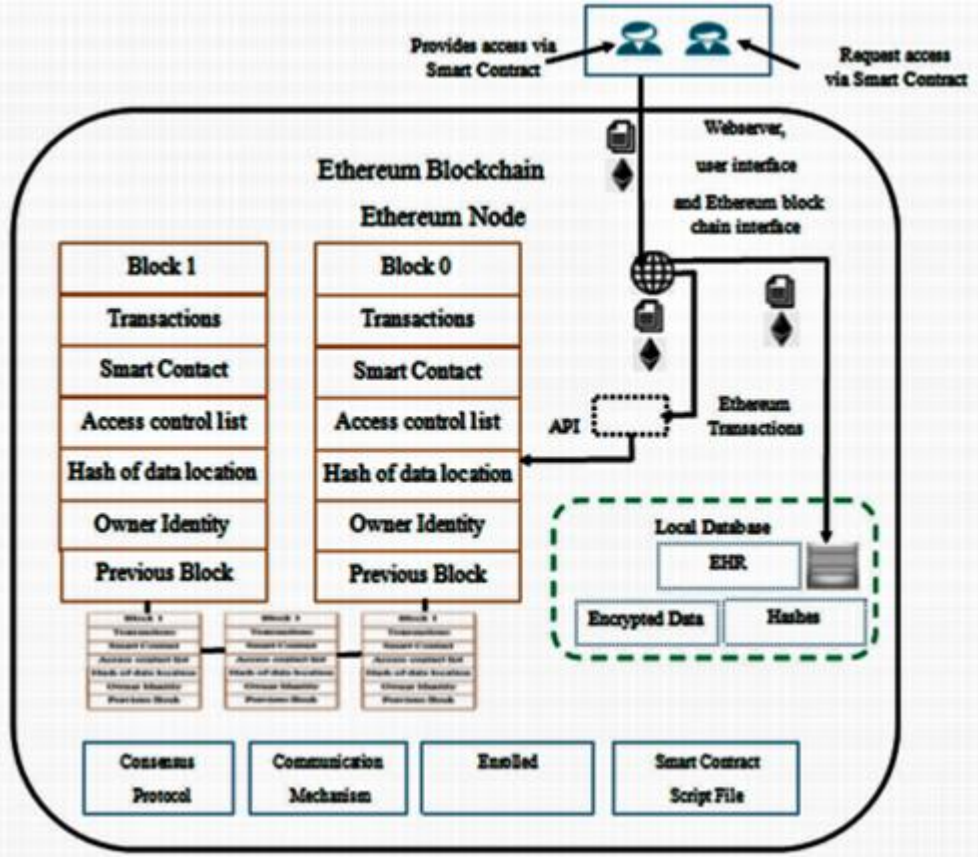

Figure: System workflow with smart contract controlled access

4. Background Concepts on Blockchain Technology

Blockchain is a distributed ledger technology that is managed by different peers on a peer-to-peer network. This technology operates without any central administrator or centralized data storage management. Data is widely spread

across several nodes and the quality of data is maintained by replication and encryption. On 31st October 2008, the concept of block chain came into existence via a white paper, written by Nakamoto. He came up with the idea of **B**itcoin transactions on a platform where the online payments could be sent directly from one peer to another peer without going through a financial institution. His main idea was to develop a trustless system that solves the double-spending problem using a peer-to-peer distributed ledger technology through a computational proof of the chronological order of transactions. The term, block chain refers to a chain of blocks where each block stores a group of information about its past, present and future. Each block plays a key role in connecting with the previous block, and with the following block, as soon as it comes into the system to be a part of the chain. The main role of each block is to record, validate and distribute the transactions among other blocks. This means that a block in the chain cannot be removed or altered as this would change every subsequent block. The block chain network is, therefore, a decentralized information system that contains information about all past transactions and operates on a pre-selected protocol which defines the direction of performing and validating the transactions, as well as the functioning of the entire network and its members. Moreover, this network is usually referred to as a distributed registry, as data is stored on each node operating in each of the individual networks. A transaction group in blockchain networks is combined into blocks of transactions connected in the chain using the hash of the previous block's record. Therefore, as a property of immutability, the basic security feature of blockchain networks is enforced. The further the block is along the chain (the older it is), the more the data included in it is protected from changes. If an attacker tries to change any of the keys, the local register will immediately cease to be valid because the hash values inside the next blocks headers will be completely different depending on the hash function mechanism.

5. Conclusion

We focus particularly on a Distributed Database (DDB) is a collection of data which is logically interrelated and distributed over various sites of a computer network. Large amount of information available in distributed databases needs to be exploited by organizations in order to be competitive in the market. In order to exploit this information concurrently, an efficient consistency controlled system is required. Distributed database has some unique characteristics which make the design of consistency controlled system both challenging and interesting.

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