



A Blockchain-based Approach for Medical record system with Drug Traceability in Healthcare Supply Chain.

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ABSTRACT: Counterfeit drugs are a very big challenge for the pharmaceutical industry worldwide. The blockchain typically described as a decentralized system in which transactional or ancient statistics are recorded, stored, and maintained throughout a peer-to-peer community of personal computers referred to as nodes. 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. Blockchain technology has gained tremendous attention, with an escalating hobby in a plethora of several applications like safe and relaxed healthcare records management. Similarly, blockchain is reforming the traditional healthcare practices to an extra reliable means, in phrases of powerful prognosis and treatment through safe and cosy facts sharing using SHA Hash Generation Algorithm. Within the future, blockchain will be an era that can probably assist in personalized, authentic, and at ease healthcare by means of merging the entire actual-time scientific information of a patient's fitness and offering it in an up to date cosy healthcare setup. In this paper, we evaluation each the present and modern day trends inside the subject of healthcare with the aid of imposing blockchain as a model. We also talk the packages of blockchain, at the side of the demanding situations confronted and destiny views. The proposed system executed blockchain implementation in distributed computing surroundings and it gives the automated restoration of invalid chain by using Consensus and Mining Algorithm. The blockchain has the full potential to handle and track the supply chain process very efficiently. In this paper, we have proposed and implemented a novel blockchain and data mining-based drug supply chain management and secure healthcare system. Our proposed system consists of two main

modules: blockchain-based drug supply chain management and data mining-based secure healthcare system for consumers or patients. The smart contract guarantees data provenance, eliminates the need for intermediaries and provides a secure, immutable history of transactions to all stakeholders. 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.

Keywords: *Blockchain Technology, Decentralization / Decentralized System, Distributed Computing, Peer-to-Peer Network, Healthcare, Healthcare Supply Chain, etc.*

I. INTRODUCTION

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.

According to the Health Research Funding Organization, up to 30% of the drugs sold in developing countries are not given to valid patient and 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.

Blockchain technology has introduced a new model of application development primarily based on the successful implementation of the data structure within the Bitcoin application. The fundamental concept of the blockchain data structure is similar to a linked list i.e. it is shared among all the nodes of the network where each node keeps its local copy of all the blocks (associated with the longest chain) starting from its genesis block. Recently, many real-world applications have been developed in diverse domains, such as the Internet of Things, e-Government and e-document management. These applications leverage benefits of blockchain technology due to its self-cryptographic validation structure among transactions (through hashes), and public availability of distributed ledger of transaction-records in a peer-to-peer network. Creating a chain of blocks connected by cryptographic constructs (hashes) makes it very difficult to tamper the records, as it would cost the rework from the genesis to the latest transaction in blocks.

The supply chain in a blockchain is the chain that involves all the major stakeholders through which the information has to pass until it reaches its end user. The supply chain in the case of drug manufacturing can begin right from the raw material supplier who is supposed to provide the raw material for manufacturing the drug and ends at the end

consumer of that drug. Various researchers can specify their supply chains depending on the material and the number of stakeholders involved in the supply of that material.

In this survey, we discuss various blockchain-based technologies that are aiding in preventing drug Traceability in Healthcare Supply Chain. The overview of the technology is presented in section II. Section III presents the literature survey of the referred researches followed by the analysis of literature in section IV. Further, in section V, we present research gaps in the referred studies with a comparative analysis, and finally, the conclusions and the future areas for research are discussed in the last section.

II. LITERATURE SURVEY

- According to **Johansen, 2017** [2] Due to the novelty of concepts and the underlying technologies, the system provides a new overview on recent developments and related literature in this book and strives to explore the related concepts in the literature. Through the exploration of the concepts, the system dives into blockchain utilization as a technological platform for an upcoming ecosystem of applications and software and looks at the theoretical features of the technology as a foundation for this paper. Thus, systems enhance the understanding of the technology in other contexts throughout the literature and explore the current contributions to the literature. This study has implications for both researchers and practitioners. For researcher's systems seek to open research lines on enablement of the BT as a platform-centric technology for ecosystems to flourish as those of OI. For practitioners, systems illustrate that it is crucial to keep developing on the technology, as research indicates that systems have still not reached the tipping point of the technology.
- According to **Lember, 2017** [4]. The several technologies associated with the smart city, such as electronic sensors or urban control rooms and city labs. As well as emerging technologies, such as blockchain, that enables peer-to-peer service delivery is becoming more central to the ways citizens engage with public-service delivery under the schemes of dedicated user/citizen-innovation, technology, and living labs to accelerate technological innovations in the public sector. All these approaches aim at putting user experience at the center of the public sector innovation processes, however, these experimental units and methods are still far from becoming an organic part of the public sector and its change.
- According to **Pazaitis et al., 2017** [5] explores the potential of blockchain technology in enabling a new system of value that will better support the dynamics of social sharing. System study begins with a discussion of the evolution of value perceptions in the history of economic thought. Starting with a view on value as a mechanism that defines meaningful action within a certain context, the system associates the price system with the establishment of capitalism and the industrial economy. The system then discusses its relevance to the information economy, exhibited as the techno-economic context of the sharing economy, and identifies new modalities of value creation that had better reflect the social relations of sharing.

Through the illustrative case of back end, new systems of value are anticipated, comprised of three layers: (a) production of value; (b) record of value; and (c) actualization of value. In this framework, the system discusses the solutions featured by Back feed and demonstrates a conceptual economic model of blockchain-based decentralized cooperation.

- According to **Davidson et al. 2016** [1] as said, BT is a new institutional technology of governance that competes with other economic institutions of capitalism, namely firms, markets, networks, and even governments. Present this view of BT through a case study of Back feed, an Ethereum-based platform for creating new types of commons-based collaborative economies. This case was developed for evaluating contributions to projects on a network. Back feed introduces a social protocol on top of blockchain-based infrastructures to coordinate individuals through the creation and distribution of economic tokens and reputation scores. Its purpose after all allow for the emergence of meritocratic systems and emergent alternative economies that can variously augment or substitute for extant modes of economic governance (i.e. provided by hierarchies or markets). At its core, Backfeed is an engine for decentralized cooperation between distributed agents. It implements a Social Operating System for decentralized organizations, enabling massive open-source collaboration without any form of centralized coordination.
- According to **Glaser Bezenberger, 2015** [3] following the theoretical introduction, this system aims to further elaborate on the theoretical grounding to give a summary of prior research and highlight potential areas for future research. Additionally, the system seeks to establish a common understanding of the theory within the field of OI regarding BT. Within the OI research area, BT has still considered a novel innovation and has yet to become a part of mainstream OI research. This is moreover supported by the general landscape, whose primary focus has been on the blockchain as a cryptographic economic system, e.g. Bitcoin.

III. ANALYSIS OF LITERATURE

The literature referred to in this paper discusses the methodologies to prevent the counterfeiting of drugs. The paper cited is all based on blockchain technology and its implementation to prevent drug counterfeit. Most of the papers discuss the mechanisms to authenticate the drugs and their supply chain management. The paper is based on detecting drugs traceability in their supply chain. Many papers also introduce their kinds of blockchain for the supply management and authenticity of the drugs. The main areas covered in the literature are:

- Integration of Blockchain technology for verifying the authenticity of the drugs
- Verifying the drugs with unique codes such as Quick Response codes
- Supply management of the drugs from the manufacturer to the end-user.
- Decentralized drug supply chain with traceability of the supply process
- Implementing Blockchain in the pharmaceutical environments

- Tracking and monitoring system on the blockchain network.

The papers cited also have some limitations like most of the implementations are costly and in many of the papers, the practical implementations of the discussed systems are not presented. Some of the papers are also not based on the decentralized architectures and testing and validation of the discussed approaches are not displayed.

IV. PROPOSED WORK

The security challenges are still among the major obstacles when considering cloud adoption services. The main reason is that the database hosted and processed in the cloud server, which is beyond the control of the data owners. For the numerical query, these schemes do not provide sufficient privacy protection against practical challenges. In this system, we propose different data instance architectures for a secure database that protects several questions related to the numeric range. We implement a three-layer/instance storage framework based on data computing.

The technology of Blockchain attracts high attention first due to the possibility of decentralizing highly risky operations, which traditionally carried out in predetermined data centers. The most popular example of use is the replacement of the function of conducting transactions within the system of bank transfers to a decentralized network of cryptographic handlers. The essence of this method of processing financial transactions is the encryption of transaction sets combined into blocks with the inclusion in the code of the unique identifier code of the previous block.

- Large data storage at the required of decentralized data storage as well as an information system
- The different attack issues in centralized database architectures.
- There is no automatic attack recovery in central data architectures
- The decentralized architecture provides the automatic data recovery from different attacks.

After the analysis of this system, we move to develop the decentralized system architecture, and distributed computing provides parallel processing in a distributed environment.

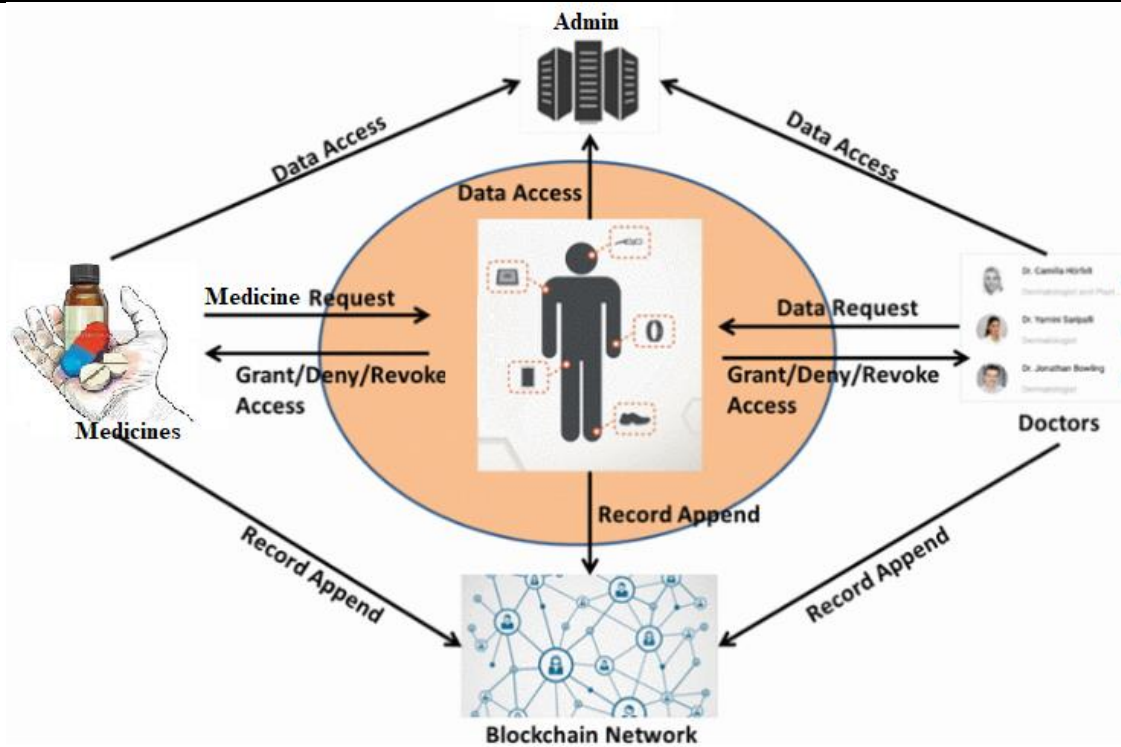


Fig.1: System Architecture

V. OBJECTIVES

In this proposed model we are going to implement following things:

- To design approach for health insurance company where system store all historical data into block chain manner.
- To create a fog computing environment hierarchy for paralel data processing for end users applications.
- To design impelement own SHA family block for whole blockchain.
- Each transaction has stored on dependant blockchain in cloud environment.
- To design and implement a new mining technique for generate new block for each transaction.
- To imepement a varification algorithm which can validate each peer on every access request.
- To imepement emergency medicine tracking system and give to valid patients.

VI. ALGORITHM

A. Blockchain:

Blockchain is an online ledger that provides decentralized and transparent data sharing. With distributed recordings, all transaction data (stored in nodes) are compressed and added to different blocks. Data of various types are distributed in distinct blocks, enabling verifications to be made without the use of intermediaries. All the nodes then form a blockchain with timestamps. The data stored in each block can be verified simultaneously and become inalterable once entered. The whole process is open to the public, transparent, and secure.

B. Custom Blockchain:

Custom Blockchain is a decentralized distributed database. The working processes of the system developed in this study are as follows:

Custom Blockchain provides low-cost off-chain storage to store supply chain transactions data to ensure 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, 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.

C. Smart Contract:

Smart contracts are lines of code that are stored on a blockchain and automatically execute when predetermined terms and conditions are met. At the most basic level, they are programs that run as they have been set up to run by the people who developed them for authentications. A smart contract is an agreement between two modules in the form of computer code. They run on the blockchain, so they are stored on a public database and cannot be changed. The transactions that happen in a smart contract processed by the blockchain, which means they can be sent automatically without a third party.

D. SHA Hash Generation:

The SHA-256 algorithm is a hashing algorithm that performs on data in one-way and Ron Rivest develops it. It is an evolution of previous algorithms such as SHA 0, SHA 1, SHA 256, SHA 384. Hashing is also known as compression or message summary function, which takes the entire variable length and changes it into a binary sequence of fixed length.

VII. RESEARCH GAPS

After having a survey of the literature discussed above, some gaps are noticed which need to be considered in further researches. We can generalize those major and common problems that hindered the authors to get proper results as:

- A. In most of the papers, the data is stored on Blockchain, which is a costly process.
- B. Complete decentralization and transparency of the system are missing in many referred literature works.
- C. There is no practical implementation of the proposed process in some cited papers.
- D. Many of the systems proposed are only limited to specific countries.

VIII. CONCLUSION

In this paper, we propose a review of recent researches on blockchain-based approaches, which can help in preventing drug tractability system in healthcare supply chain. Many of the recent researches propose a decentralized supply system with secure and immutable tracking capabilities using blockchain technology. To determine the authenticity of the drug throughout its supply chain Permissioned Hyper ledger blockchain is used along with Quick Response Code for users as well as patient convenience and security purposes. Through the literature referred, we conclude that most of the research done so far is not on a specific drug, as many drugs require different handling procedures and environments in their supply chain. So, a new approach is required to handle drugs like COVID-19 vaccines.

Future researches can be done to address the issues found like:

- A new supply chain framework for drugs that require extra handling measures
- An anti-counterfeit framework using blockchain technology for COVID-19 vaccines
- Incorporating IPFS along with blockchain for providing decentralized storage to COVID-19 secure supply chain
- A simulation or an actual implementation of the COVID-19 vaccine anti-counterfeiting framework can be proposed.

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