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Optimized Data Storage Method for Sharding-Based Blockchain

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ABSTRACT

This presents a comprehensive platform for managing the pharmaceutical supply chain that consists of several modules intended to optimise different steps in the ordering, shipping, and selling of medications. The objective of the suggested approach is to improve quality, accountability, and efficiency across the whole pharmaceutical supply chain. The Distributor Module offers a centralised platform for submitting buy contracts and handling orders, hence streamlining the procurement process of pharmaceuticals and raw materials. The goal of this module is to guarantee prompt delivery of necessary prescriptions and minimise delays. The DLT-1 and DLT-2 Modules use distributed ledger technology (DLT) to provide quality control and transparency through crucial contracts. Pharmaceutical product tracking using DLT enables stakeholders to confirm authenticity and reduces the possibility of shoddy or counterfeit medications reaching the market. With the help of the Retailer Module, retailers may buy medications from wholesalers with ease and manage their inventory effectively. This module aids businesses in streamlining operations and successfully satisfying consumer demand by offering solutions for order fulfilment and inventory management. Improving raw material procurement transparency is the main goal of the Supplier Module since it is crucial to the production of pharmaceuticals. Through the optimisation of procurement transparency and the facilitation of raw material sales, this module serves to guarantee the dependability and quality of pharmaceutical products.

Keywords: Pharmaceutical supply chain management, Block chain Technology, Traceability

1. INTRODUCTION

Efficiency, transparency, and quality control are critical components of the complex supply chain environment that the pharmaceutical sector operates in. This proposal presents an all-inclusive pharmaceutical supply chain management platform with several modules designed to speed up the distribution, retailing, and procurement of medications. Through the incorporation of cutting-edge technologies like distributed ledger technology (DLT), the suggested system seeks to improve transparency, optimise processes, and guarantee the supply of premium pharmaceutical products. This platform, which has modules for suppliers, retailers, and distributors, aims to transform the market by promoting accountability, streamlining inventory control, and enhancing procurement procedures.

1.1 Pharmaceutical Supply Chain Management

The complex coordination of procedures involved in locating, producing, shipping, and selling pharmaceuticals is known as pharmaceutical supply chain management. It entails controlling the flow of drugs and raw materials while upholding strict legal specifications and quality benchmarks. Procurement optimisation, inventory control, logistics coordination, and guaranteeing product safety and authenticity along the supply chain are important factors. In order to avoid counterfeit goods, minimise waste, guarantee prompt access to pharmaceuticals, and ultimately protect public health, effective pharmaceutical supply chain management is crucial.

1.2 Block chain Technology

Block chain technology has become a disruptive force in the field of digital innovation, offering unmatched security, transparency, and decentralization. Fundamentally, block chain is a distributed ledger that securely and impenetrably records transactions via a network of computers. Block chain functions on a decentralized architecture, guaranteeing that no one entity has control over the entire network, in contrast to previous centralized systems. The primary advantage of block chain technology is its capacity to generate an unchangeable and visible ledger, wherein each data block is connected to the one before it via a cryptographic hash, so establishing a chain of information. This preserves the data integrity while also fostering a high level of participant trust. Block chain technology was first created to support cryptocurrencies like Bitcoin, but it has now expanded beyond its original purpose and found use in a wide range of sectors, including supply chain management, finance, and healthcare.

1.3 Traceability

His ability to track and trace the origin, path, and transformation of items and information throughout their lifecycle is known as traceability, and it is a key notion in many

businesses. It is essential to maintaining accountability, transparency, and quality control. In a time when consumers' worries about sustainability, safety, and authenticity are on the rise, traceability systems provide a potent way to boost supply chains' credibility. Traceability helps stakeholders locate product origins, spot any problems, and react quickly to recalls or concerns in the food, pharmaceutical, industrial, or other industries. In addition to improving product safety, this degree of transparency gives companies and government agencies the ability to streamline operations, cut down on waste, and make wise choices. Traceability is becoming increasingly important as global connectivity and technology develop, influencing how we monitor and control the movement of information and things across different domains.

2. LITERATURE SURVEY

Dutta Pankaj [1] et al. According to the theory put forth in this paper, blockchain technology combines a number of distinctive properties, including a distributed note-taking and storage system, a consensus algorithm, smart contracts, and asymmetric encryption, to guarantee network security, visibility, and transparency. Block chain offers enormous potential to change several aspects of the supply chain (SC), including security improvement, business process reengineering, and SC provenance. In recent years, a growing number of research investigating the application of blockchain in SCs have surfaced. In this paper, we analyze all important research conducted in the field related to the usage of blockchain integration in SC operations, taking into consideration a total of 178 papers. We draw attention to the associated opportunities, potential social effects, state-of-the-art technology at the moment, as well as significant trends and difficulties. We look at a number of industries that can be effectively transformed with blockchain-based technologies through improved visibility and business process management, including manufacturing, shipping, and automotive, aviation, finance, technology, energy, healthcare, agriculture and food, e-commerce, and education. It can be used in a plethora of industries, such as creating smart contracts to detect financial fraud or safely transferring patient data between medical providers.

Retailers [2] have been actively working to improve food safety as a result of the many food disasters that have captured the attention of policy makers in recent decades. Blockchain technology lowers food fraud, including adulteration, dilution, and counterfeiting, by enabling customers to track the movement of food goods. We examine how the traceability of food goods affects consumers' faith in the retailer and, in turn, influences consumers' choice of retailer using three experiments with Austrian business students and an online convenience sample. Furthermore taken into account by our model as significant mediators of the effect of blockchain-based traceability systems on trust in the store are retailer familiarity and the disclosure of blockchain benefits. The ANOVA, ANCOVA, and Hayes PROCESS models were used to test the model. The results demonstrate that shops who are unknown to customers benefit more from the usage of blockchain technology than do well-known retailers in terms of building consumer confidence. Additionally, educating customers Food traceability has become a major public and academic concern due to a number of food safety incidents, including diluted milk in developing nations (Yang et al., 2019), mad cow disease in Britain, E. coli-infected cucumber in Germany, and bacterially contaminated peanut butter in the United States (Lethbridge, 2018). (e.g., Liu et al., 2019; Robson et al., 2020; Schroeder & Tonsor, 2012). Governments, producers, and consumers must work closely together because modern food supply chains cross national borders seamlessly. This is because accurate and timely information sharing is a critical component of safe and secure food supply chains (World Health Organisation, 2019).
In addition to being very relevant from the standpoint of global health (Yan et al., 2020), food safety and efficient supply chain management are equally important for profit-driven merchants. Nevertheless, there are additional expenses associated with using traceability systems, which need to be considered in relation to the possible advantages.

By emphasising user-centric [3] system design, the authors of this study sought to increase supply chain efficiency at Company A, a significant participant in China's manufacturing industry. The method comprised examining user attributes at the departmental level in order to provide guidance for creating an ideal human-machine interface. They identified specific user needs across departments like planning, purchasing, receiving, warehousing, production, and quality control by conducting focus groups and card sorting activities. The system design that benefited from the implementation of these insights saw notable operational gains. Significant time reductions were noted in receiving (74.44%) and quality control (41.86%) departments. This customised strategy emphasised how crucial it is to comprehend and incorporate user attributes into supply chain systems in order to improve efficiency and gain a competitive advantage. The study illustrates how supply chain management may be made more efficient and user-satisfied through the application of user-focused system design.The supply chain system is gradually evolving into the most crucial instrument for business operation and income as information technology advances (Nuamah & Seong, 2017).
The supply chain system promotes the departmental synergy, realises the logical allocation of resources, integrates the data from every link in the company supply chain, and continuously raises the productivity and global competitiveness of businesses. User experience (UX) sensing is the main issue to be resolved in an operational supply chain system, and the behaviour and decision-making of the business are directly impacted by the happiness of system users (Cao et al., 2021).

HUSSAM JUMA, SHAALAN, [4] Khaled, and others. Blockchain is a promising technology that has been suggested in this system to guarantee trust between participants. We can create a secure communication paradigm using this technology, ensuring data integrity and immutability. These innate characteristics highlight block chain’s suitability as a technology to optimize the processing model that has been applied in a number of areas, including food safety, commerce supply chains, and health. We provide a thorough review of blockchain technology's application in (international) commerce supply chains in this paper. Additionally, the target

application scenarios have been used to categorize the discussed proposals. Our objectives are to make clear the advantages of utilizing this technology in the trading domain and to draw attention to the difficulties involved in doing so in order to maximize the trading domain. In light of this, we highlight a number of problems that arise when developing a blockchain solution to optimize the supply chain for (international) trade. Blockchain technology offers the benefit of streamlining the monitoring process and guaranteeing the accuracy of the data that is traded, which optimizes the trade supply chain. The benefits of adopting this technology in the trading of highly regulated items, such pharmaceuticals, are highlighted by its data integrity and traceability features.

Food safety [5] is a global issue that is mostly brought on by production and management practices in businesses, environmental contamination, a lack of effective government oversight, and other factors. Because of its decentralisation, traceability, and immutability, blockchain technology, an emerging technology, has considerable relevance and application to food traceability. It is therefore anticipated that it would be successfully implemented in food safety management and raise the standard of food safety guarantee. Blockchain hasn't, however, been extensively applied to food safety management for a variety of reasons. Thus, further research on the benefits and difficulties of its implementation is advantageous for the long-term growth of food businesses, consumers, and the government. Through its use, governments, consumers, and food firms can all obtain traceable information. This can guarantee businesses' food safety while simultaneously raising the bar for government oversight and building consumer, business, and government trust. This raises the bar for food safety management and increases its effectiveness. This study uses 202 text data relating to food safety and blockchain on the Zhihu platform as its research object, based on the information adoption model. This study presents arguments for and against the use of blockchain technology in food safety management based on a summary of some public opinions. Next, a quantitative investigation of the variables impacting the adoption and acceptability of pertinent text material on the Zhihu platform is carried out using Totor Regression. Ultimately, it is discovered that the following four factors—at a confidence level of 0.1—are significant. The public's recognition and adoption of blockchain technology are significantly influenced by the two viewpoints that highlight its advantages and high costs, while the public's recognition and adoption are significantly impacted negatively by the two viewpoints that highlight national policy opinions and the need for blockchain supervision. Based on the regression results and taking into account the state of blockchain technology development and present technological level, this study offers pertinent policy recommendations that will help to improve food sustainability. Food safety is a complex worldwide issue. Occurrences involving food safety are not always easy to track down because of intentional adulteration, microbiological contamination, and environmental contamination.

3. EXISTING SYSTEM

Due to information asymmetry, the globalisation of the food supply chain (FSCs) has created serious hurdles for the food system, including fraud, safety, security, and quality issues. Moreover, globalisation makes it more difficult and complex to find solutions to these issues and raises FSC efficiency. Because of its potential advantages, blockchain technology (BCT) has shown to have the ability to revolutionise fish farming. Studies on the use of BCT in FSC are, however, limited and relatively recent. The present state of research on blockchain technology and food supply chains is thoroughly reviewed in this report. 52 papers covering the period from 2016 to 2021 were synthesised as part of a systematic literature review (SLR) conducted to determine the advantages, disadvantages, and facilitators of blockchain technology. The SLR was conducted using two well-known databases, Scopus and Business Source Complete (EBSCO). A conceptual framework for blockchain adoption in the food supply chain is created based on this review. The analysis determined that the most likely obstacles to blockchain adoption are interoperability, scalability, high cost, inexperience, and restrictions. By offering insights into the deployment of blockchain technology in the food supply chain, this study adds to the corpus of knowledge. It also provides other industries with evidence-based guidance on how to develop their blockchain strategies.

4. PROPOSED SYSTEM

The proposed system is a complete pharmaceutical supply chain management platform made up of multiple modules that aim to expedite medication and raw material procurement, delivery, and retailing. The Distributor Module makes it easier to obtain drugs and submit purchase contracts, and the DLT-1 and DLT-2 Modules offer transparency and quality control through essential contracts using distributed ledger technology. The Retailer Module allows merchants to purchase drugs and manage their inventory seamlessly, whilst the Supplier Module makes it easier to sell raw materials and improves procurement transparency. Together, these modules provide a comprehensive solution that improves efficiency, accountability, and quality throughout the pharmaceutical supply chain.

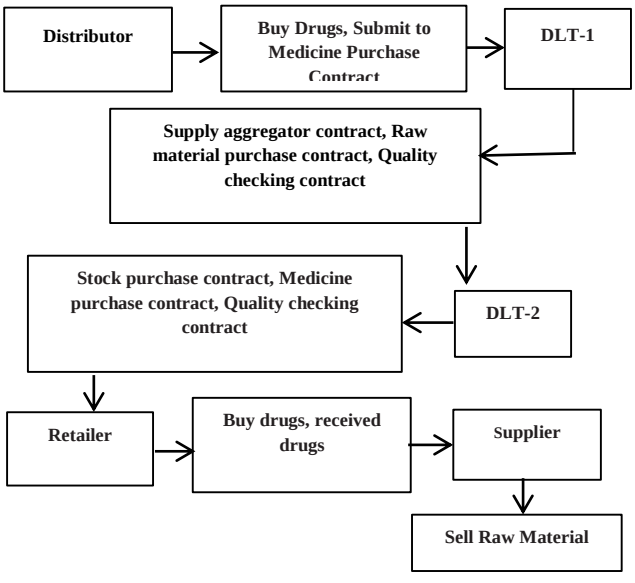

Figure 1. Block diagram

A. Distributor Module

This module simplifies medicine procurement by collecting crucial information such as drug name and amount and submitting them to the stock purchase contract for effective inventory management. It also manages the filing of drug purchase contracts, which simplifies the procedure of procuring medicines from vendors.

B. Dlt-1 Module

This module, which runs on distributed ledger technology (DLT), manages critical contracts such as the supply aggregator contract, which coordinates the aggregation of supplies from various sources, the raw material purchase contract, which is used to source essential ingredients, and the quality checking contract, which ensures that quality standards are met throughout the supply chain.

C. Dlt-2 Module

This lesson, which complements DLT-1, focuses on executing stock buy contracts to manage stock procurement, medication purchase contracts to obtain pharmaceuticals, and quality control contracts to ensure product integrity along the supply chain.

D. Retailer Module

This module, designed for the retail end of the supply chain, allows merchants to acquire pharmaceuticals by providing the medicine name and amount, permitting smooth integration with the medicine purchase contract. It also processes medicine receipts, providing effective inventory management and timely delivery to consumers.

E. Supplier Module

The supplier module, which serves as a critical link in the supply chain, enables providers to sell raw materials by specifying the raw material type, quantity, quality, and projected amount. This information is given to the supply aggregator contract, which streamlines the procurement process while assuring openness and accountability in raw material sourcing.

5. ALGORITHM DETAILS

A. Sha256 Hashing Algorithm

SHA 256 algorithm (sometimes called digest) is a kind of signature for a text or a data file. SHA-256 generates an almost-unique 256-bit (32-byte) signature for a text. A hash is not' encryption'–it cannot be decrypted back to the original text (it is a cryptographic' one-way' feature, and is a fixed size for any source text size). This makes it ideal when comparing' hashed' versions of texts, rather than decrypting the text to obtain the original version. Basic Initialization will be done for 8 items

Step 1: Information is an array 8 things in length where everything is 32 bits.

Step 2: out is an array 8 things in length where everything is 32 bit.

Step: 3 Compute all the capacity boxes and store those qualities. Allude to them by work name

Step: 4 Store input, right moved by 32 bits, into out. Now, in the out exhibit, E is an inappropriate worth and A is unfilled

Step: 5 Store the capacity boxes. Presently we have to compute out E and out A. note: Supplant the modulo orders with a bitwise AND 2^ (32-1)

Step: 6 Store (Input I + CH + ((XT+YT) AND 2^31)) AND 2^31 as Mod1

Step: 7 Store (Sum1 + Mod1) AND 2^31 as Mod2

Step: 8 Store (b + Mod2) AND 2^31 into out E Presently out E is right and all we need is out A

Step: 9 Store (NA + Mod2) AND 2^31 as Mod3

Step: 10 Store (Sum0 + Mod3) AND 2^31 into output A

6. RESULT ANALYSIS

The examination of outcomes from the adoption of the pharmaceutical supply chain management system reveals considerable improvements in a variety of key performance measures. Reductions in procurement lead times, inventory carrying costs, and stock outs show increased efficiency and cost-effectiveness. Furthermore, the system's capacity to give real-time visibility into inventory levels and demand patterns allows for more informed decision-making and efficient resource allocation. Customer satisfaction has also increased significantly as a result of higher order fulfillment rates and on-time delivery of pharmaceutical items. Overall, the findings highlight the system's beneficial influence on simplifying processes, managing resources, and, ultimately, improving outcomes throughout the pharmaceutical supply chain.

Table 1. Comparison table

ALGORITHM	ACCURACY
Existing [Block chain]	79
Proposed [SHA-256]	95

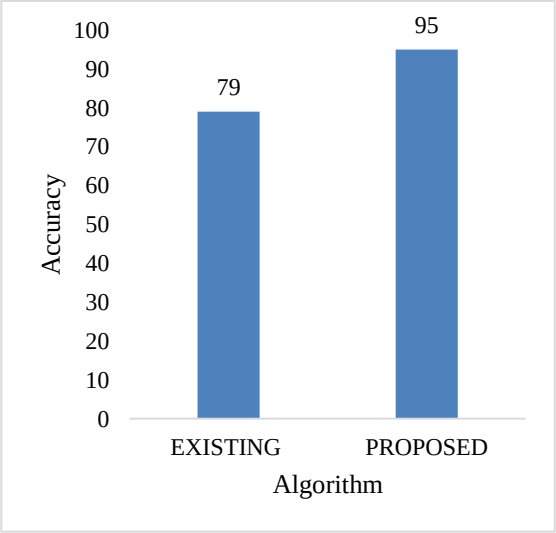

Figure 2. Comparison graph

Table 2. Comparison table

ALGORITHM	SECURITY	EFFICIENCY
Existing [Blockchain]	79	78
Proposed [SHA-256]	94	97

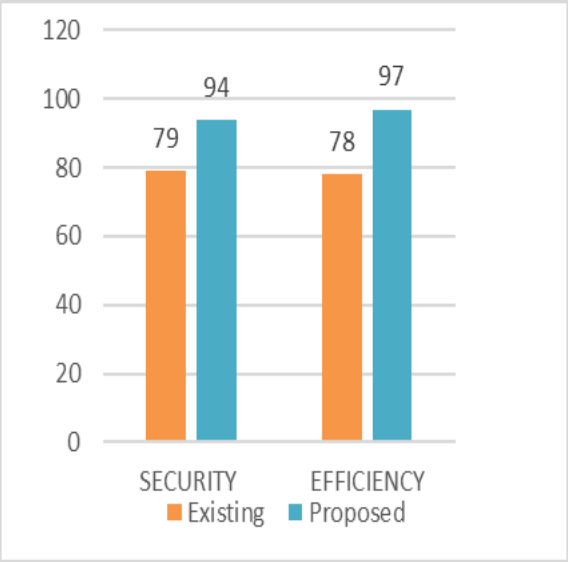

Figure 3. Comparison graph

7. CONCLUSION

Finally, the suggested pharmaceutical supply chain management system provides a comprehensive solution for streamlining the procurement, distribution, and retailing of medications and raw materials. With straightforward input design, informative output presentations, rigorous system testing, and diligent deployment tactics, the system is well-positioned to improve supply chain efficiency, transparency, and accountability. This system has the potential to transform pharmaceutical supply chain operations by harnessing technology and combining crucial features, hence boosting access to essential drugs and ensuring quality standards are maintained across the board.

8. FUTURE WORK

Future development on the pharmaceutical supply chain management system may concentrate on incorporating sophisticated technologies like artificial intelligence and machine learning to provide predictive analytics for demand forecasting and inventory optimization. Furthermore, investigating blockchain technology for improved data security and traceability might boost transparency and confidence in the supply chain. Furthermore, enhancing the system's capabilities to include regulatory compliance monitoring and sustainability measures would match with changing industry norms while ensuring long-term viability and resilience in the face of new problems.

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