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A Systematic Literature Survey on a Blockchain-Based Solution to Address the Issue of Counterfeit Drugs in Supply Chain Management

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Abstract*— This study explores the development and implementation of a robust supply chain man- agement system to address the pervasive threat of counterfeit drugs. Leveraging Ethereum blockchain technology, alongside Metamask for authentication and Ganache for local blockchain development, the system ensures end-to-end transparency and trace- ability. Smart contracts written in Solidity enforce business rules, while MySQL facilitates decentral- ized data storage, and PHP enables seamless back- end integration with a frontend interface created in HTML, CSS, and JavaScript. This integrated approach, encompassing blockchain, authentication protocols, database management, and frontend de- velopment, exemplifies a holistic strategy in com- bating the multifaceted challenges posed by coun- terfeit drugs in today's complex supply chain land- scape. By enhancing traceability and accountabil- ity, this system demonstrates the effectiveness of Ethereum-based solutions in combating counterfeit drugs within the supply chain.

Index Terms*— Blockchain, Decentralized, Ethereum, Supply Chain, Smartcontacts.

I. INTRODUCTION

Lung disease is common The global pharmaceutical industry plays a critical role in safeguarding public health by providing lifesaving medications to individuals worldwide. However, this vital supply chain is under constant threat from the infiltration of counterfeit drugs, which not only endanger patients' lives but also erode the trust in the pharmaceutical sector. To address this pressing issue, innovative and robust solutions are needed to ensure the authenticity and traceability of pharmaceutical products throughout the supply chain.

The project at hand addresses a pressing global concern: counterfeit drugs and their detrimental impact on public health. Counterfeit drugs infiltrate supply chains, posing risks to patients and eroding trust in pharmaceutical products. To combat this threat, the project focuses on developing a comprehensive solution leveraging cutting-edge technologies. By integrating Ethereum blockchain for transparency, Metamask for authentication, Ganache for local blockchain development, Solidity for smart contracts, MySQL for data storage, and PHP for backend integration, the project aims to establish a robust and secure supply chain management system. This system will ensure end-to-end transparency, traceability, and immutable record-keeping, thereby enhancing accountability and safeguarding public health against the dangers of counterfeit drugs.

II. LITERATURE SURVEY

The author of this study outlines a comprehensive strategy aimed at bolstering the security and trustworthiness of the food supply chain. Central to this strategy is an end-to-end solution that enhances transparency by securing all supply chain components. This is achieved through a universal information monitoring system based on blockchain technology, which ensures data integrity [1].

The paper introduces a product traceability system based on blockchain technology. This system leverages blockchain's key attributes, including decentralization, transparency, and immutability, to enhance traceability. It uses smart contracts to record all product transfer histories in a distributed ledger, creating a chain that can trace the source of products [2].

The paper emphasizes the critical importance of traceability and audit management within supply chain management and construction. It underscores that customer trust is the cornerstone of these systems and the necessity of relying on third parties in centralized systems. Existing frameworks for supply chain solutions are criticized for their poor traceability [3].

The issue of counterfeit drugs in the pharmaceutical industry has emerged as a critical concern, jeopardizing both patient safety and the pharmaceutical sector's credibility. This literature review underscores the potential of blockchain technology as a solution to bolster supply chain management in the pharmaceutical industry, guaranteeing heightened security, safety, traceability, and transparency. By examining the successful deployment of blockchain technology in the context of smart hospitals, this paper demonstrates its effectiveness in establishing a secure, transparent, and decentralized drug supply chain management system [4].

The integration of blockchain technology within the pharmaceutical supply chain, with a focus on its application in Egypt, is a subject of critical examination in this research.

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The study underscores the potential for blockchain to enhance integration, coordination, and communication among supply chain stakeholders. It acknowledges a range of benefits while also acknowledging the inherent challenges, notably the delicate balance between achieving transparency and maintaining privacy. The research offers practical insights and recommendations to navigate these complexities, outlining steps for the successful incorporation of blockchain technology in the pharmaceutical supply chain, which holds the potential to foster more secure and efficient operations in this vital sector [5].

This paper presents an innovative solution, PharmaChain, a decentralized framework built on Hyperledger Fabric, which addresses the critical issues of pharmaceutical product traceability and security. The primary objective is to mitigate the pervasive problem of counterfeit drugs and bolster public health safety.

PharmaChain harnesses the power of Hyperledger Fabric, employing cuttingedge cryptographic technology, smart contracts, and a three-step data security approach to ensure robust pharmaceutical supply chain security and transparency. The framework's comprehensive design anticipates real-world deployment, with ambitions to extend its application to a broader spectrum of supply chain scenarios, promising substantial contributions to the ongoing battle against counterfeit drugs and the safeguarding of public health [6].

This paper addresses the growing global concern of counterfeit drugs by proposing a blockchain-based method for detecting fake medicines. The system meticulously monitors the entire drug lifecycle, from manufacturing to distribution,using a decentralized ledger to record every transaction. This approach allows for real-time verification of drug authenticity, ensuring that only genuine medicines reach patients [7].

This study aims to address coordination issues and bolster end-to-end security within the drug distribution market (DDM). Notably, the DDM faces problems related to a lack of centralized monitoring for market control, real- time information on prices, availability, and authenticity, as well as the prevalence of tampering, which contributes to a significant global market for counterfeit drugs. The paper introduces a blockchain-based solution to tackle these challenges, offering a framework for drug distribution optimization [8].

This study highlights the significant potential of the technology under investigation in mitigating not only the issue of counterfeit drugs but also in addressing broader concerns related to product authenticity within the supply chain [9].

This study highlights the approach of storing the data in ethereum in the form of trie data structure and how it is organized using this data structure effectively [10].

A. Technical Background

The technical background of this project involves leveraging a combination of blockchain technology, authentication protocols, database management systems, and web development frameworks to create a comprehensive solution for combating counterfeit drugs in the supply chain. The project will utilize Ethereum blockchain as the founda- tional technology, providing a decentralized and transpar- ent ledger for tracking pharmaceutical products. Smart contracts written in Solidity will enforce business rules and automate processes within the supply chain, enhancing efficiency and reliability. Metamask will be employed for secure user authentication, ensuring only authorized per- sonnel can access and interact with the system. Ganache will facilitate local blockchain development and testing, allowing for seamless integration and deployment of smart contracts. MySQL will serve as the database management system for decentralized data storage, enabling auditable and tamper-resistant record-keeping crucial for regulatory compliance. PHP will be used for backend integration for an

In terms of project structure, the development process will be divided into several phases: planning, design, development, testing, and deployment. During the planning phase, project goals, requirements, and timelines will be established. This will involve conducting thorough research into the current challenges of counterfeit drugs in the supply chain and identifying the specific functionalities and features required for the solution. In the design phase, the system architecture, database schema, and user interface will be designed, taking into consideration factors such as scalability, security, and usability. The development phase will involve coding the smart contracts, backend logic, frontend interface, and integrating all components into a cohesive system. Rigorous testing will be conducted to ensure the reliability, security, and performance of the system. Finally, the deployment phase will involve deploying the solution to a production environment, ensuring seamless integration with existing supply chain processes and providing ongoing support and maintenance. Throughout each phase, regular communication and collaboration among team members will be essential to ensure the successful implementation of the project.

III. CHALLENGES

One of the primary challenges for this project lies in the integration and interoperability of diverse technologies across the supply chain. Combining blockchain technology with authentication protocols, database management sys- tems, and frontend frameworks requires careful coordina- tion and compatibility to ensure seamless communication and functionality. Moreover, ensuring data privacy and reg- ulatory compliance poses another significant challenge. As healthcare data is sensitive and subject to strict regulations, implementing robust security measures while adhering to privacy laws such as HIPAA (Health Insurance Porta- bility

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and Accountability Act) or GDPR (General Data Protection Regulation) presents a complex task. Addition- ally, overcoming resistance to change within the industry and establishing trust among stakeholders, including pharmaceutical companies, regulatory bodies, and end-users, are crucial hurdles. This project requires navigating these challenges effectively to develop a successful solution that addresses the pressing issue of counterfeit drugs in the supply chain while maintaining security, compliance, and stakeholder confidence.

IV. METHODOLOGIES

The software platform that utilized to create this framework and its benefits. The most wellknown and important components of this framework's implementation, Ethereum and Interplanetary File System (IPFS), are also described in the next section.

A. Ethereum

Ethereum plays a pivotal role in the world of blockchain as a decentralized platform that enables smart contracts and decentralized applications (DApps). It's a blockchain network designed not just for cryptocurrency transactions (like Bitcoin) but also for executing code in a trustless and secure manner. Ethereum's native cryptocurrency, Ether (ETH), powers these smart contracts and transactions,

serving as both a digital currency and a fuel for executing operations on the network. This innovative approach to blockchain has led to the creation of a wide range of applications, from decentralized finance (DeFi) platforms to non-fungible tokens (NFTs) and more, making Ethereum a driving force in the evolution of blockchain technology.

B. The Smart Contract

A set of instructions that can be used to complete any blockchain transaction is known as a smart contract. This piece of code is executed when users send transactions. They use the blockchain directly for their operations, mak- ing them resistant to alteration and manipulation. Con- tracts can program any kind of blockchain activity using the Solidity programming language. After they have completed the necessary tasks, the programmers can compile the had a program. After that, they might be used. following compilation, on the Ethereum blockchain. JavaScript is a language for programming that uses Ethereum's writing the code for the smart contract in Solidity

C. Ganache

It is a local Ethereum blockchain for the rapid creation of decentralized programs. Ganache can be used to deploy, develop, and test in a predictable and secure environment throughout the development cycle. It works both ways: as a desktop program and as a command-line tool.

D. MetaMask

It is an entry point that allows you to view the decentralized web of the future in your browser right now. It allows you to execute Ethereum decentralized applications with- out having to run a full Ethereum node in your browser.

E. MySql

MySQL is an open-source relational database management system (RDBMS) widely used for storing and managing structured data. Developed by Oracle Corporation, MySQL is renowned for its reliability, scalability, and ease of use.

V. CONCLUSION

In conclusion, the implementation of a blockchain-based supply chain management system in the pharmaceutical industry is a significant step towards combating counter- feit drugs. By prioritizing security, traceability, and transparency, this research has the potential to revolutionize the pharmaceutical supply chain, safeguarding patient health and industry integrity. Throughout our research, we have identified the challenges posed by counterfeit drugs and recognized blockchain technology's potential to provide a comprehensive solution.

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