International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

MediChain: Ensuring Authentic Pharmaceuticals with Blockchain Traceability

Rhea M Thomas[1], Dr. N P Nethravathi[2], Shekamoori Pavithra[3], Soundrya Samrat[4], Shyamali Bharti[5]

[1,3,4,5]Students, School of Computer Science and Engineering, Reva University
[2]Professor and HOD, School of Computer Science and Engineering, Reva University

Abstract
Counterfeit pharmaceuticals pose a significant threat to patient safety and the integrity of the pharmaceutical supply chain in India. To combat this challenge, our project focuses on developing a secure and transparent pharmaceutical traceability system using blockchain technology. By leveraging blockchain's inherent features of decentralization and immutability, the project aims to establish a tamper-proof system for tracking the movement of pharmaceutical products from manufacturers to consumers. Through a systematic methodology, including feasibility studies, budget planning, design, development, and testing, we seek to ensure the authenticity of drugs at all stages of the supply chain. The project encompasses various modules, such as authentication and user management, blockchain integration, drug record creation, supply chain tracking, website development. Each module plays a crucial role in creating a holistic solution. With a focus on continuous learning, our student-led project aims to contribute to the eradication of counterfeit drugs and the restoration of trust within the pharmaceutical industry. Our efforts are guided by a commitment to patient safety and industry integrity, making this project a vital step toward securing the pharmaceutical supply chain in India.

I. INTRODUCTION

The pharmaceutical industry plays a pivotal role in safeguarding public health, ensuring that patients receive safe and authentic medications. However, the global pharmaceutical supply chain has encountered significant challenges related to counterfeit drugs, substandard products, and unscrupulous practices. The consequences of these issues are far-reaching, endangering the lives of patients and eroding trust in the pharmaceutical sector.

In the context of India, a country renowned for its pharmaceutical production and distribution capabilities, the need for a robust and secure system to combat counterfeit medicines is more pressing than ever. Counterfeit drugs often infiltrate the supply chain, posing grave risks to patients, healthcare providers, and the entire healthcare ecosystem. These counterfeit products not only endanger lives but also impose substantial economic burdens on both the public and private sectors.

The motivation for this project arises from a deep-seated commitment to addressing this critical issue. We aim to harness the transformative potential of blockchain technology to create a comprehensive and secure system that authenticates pharmaceutical products at every stage of the supply chain. By doing so, we endeavor to eliminate counterfeit medichain and enhance the integrity of the pharmaceutical supply chain, and rebuild trust among all stakeholders.

Our project's mission is to develop a blockchain-based drug traceability system, known as "MediChain,"

which will serve as a beacon of transparency and accountability in the pharmaceutical industry. This system will provide manufacturers, distributors, pharmacists, and consumers with the tools they need to validate the authenticity of pharmaceutical products in real-time. We aspire to revolutionize the way medicines are produced, distributed, and accessed in India, ensuring that each patient receives only genuine and safe healthcare products.

II. LITERATURE SURVEY

In [1], The paper explores the critical issue of counterfeit drugs within the pharmaceutical supply chain and investigates the potential of blockchain technology to address this problem. The literature reveals that blockchain's decentralized and immutable ledger has gained prominence as a promising tool to ensure drug traceability, authenticity, and integrity. Researchers have shown that the implementation of blockchain in pharmaceutical supply chains can substantially reduce counterfeit drugs' circulation by providing a tamper-proof system for tracking drug movements. By analyzing existing literature, this paper contributes to the understanding of blockchain's pivotal role in countering counterfeit drugs in the pharmaceutical industry.

In [2], The paper delves into the integration of blockchain and the Internet of Things (IoT) to enhance drug traceability within the pharmaceutical sector. The literature surrounding this topic underscores the growing significance of both technologies in addressing pharmaceutical supply chain challenges. The literature demonstrates that this combination can significantly improve drug traceability, reduce counterfeit drugs, and enhance patient safety. This paper contributes to the existing knowledge by exploring the synergistic potential of blockchain and IoT for drug traceability.

In [3], The paper introduces a unique approach to drug traceability management through a sewage automatic sampling and traceability system. Literature in this field reveals the increasing concern about pharmaceutical residues in water systems and the potential impact on the environment and public health. This paper reviews methodologies used in various systems, including automatic sampling and analysis techniques. The literature also highlights the significance of traceability in sewage systems to identify and address drug residues effectively. By combining these elements, this paper presents a novel approach to drug traceability management and contributes to the growing body of knowledge surrounding the importance of environmental monitoring in pharmaceutical traceability.

In [4], The paper employs Petri-net modeling to analyze the drug traceability system based on blockchain. Existing literature underscores the advantages of modeling and analysis techniques for understanding complex systems, especially in domains with high stakes like pharmaceutical traceability. Researchers have discussed the potential of Petri-net models in capturing the dynamics of drug traceability within a blockchain-based system. The literature reveals that modeling and analysis can identify bottlenecks, vulnerabilities, and optimization opportunities in the pharmaceutical supply chain. This paper contributes to the field by offering a structured and analytical approach to understanding the dynamics and performance of blockchain-based drug traceability systems.

In [5], the paper introduces the supply chain management of pharmaceutical drugs is fraught with difficulties, especially when it comes to tracking and tracing prescriptions. The global threat posed by counterfeit medications is substantial, and current supply chain management strategies frequently fall short of preventing adulteration. Through the establishment of a distributed and decentralized ecosystem, blockchain technology presents a viable remedy for these problems by enabling stakeholders to build reliable relationships. We suggest a blockchain-based medicine supply chain monitoring system that

includes a reputation system to guarantee openness and responsibility amongst parties in order to overcome these drawbacks. We use the burn-to-claim protocol to implement inter-blockchain communication in order to lessen the difficulties associated with interoperability between blockchain networks. Because it maintains secrecy between several companies, Hyperledger Fabric is the main blockchain, and Quorum is the other is blockchain alternative. Our system places a high priority on trust, traceability, openness, and accountability in order to provide customers with safe, genuine medications.

In [6], This paper proposes a a decentralized application (Dapp) on the Ethereum blockchain is suggested in this study. The decentralized application is operated by the Ethereum blockchain without the involvement of outside parties. For the pharmaceutical business, the Dapp offers a peer-to-peer connection between the manufacturer and the consumer, enabling the purchase of pharmaceutical products and tracking their trip to the client, thereby assisting in the prevention of counterfeit goods.

In [7], This paper provides the issues with the pharmaceutical industry's supply chain management, such as transparency, immutability, and traceability, and counterfeit medications, including vaccines exist. Because the public is less aware of and knowledgeable about vaccines, it is more difficult to standardize and identify fraudulent vaccines. Furthermore, the rise in internet pharmacies creates new avenues for vaccine fraud to infiltrate the real supply chain management system.

they introduce the transparent, immutable, and secure vaccine supply chain (TISVSchain), a blockchain-based system designed to address concerns with vaccine supply chain traceability, transparency, and immutability as well as counterfeiting. Our suggested framework is compatible with both public and private blockchains. Using remix idea, we have put the framework into practice on a public blockchain.

In [8], This article presents that pharmaceutical businesses have created traceability platforms based on distributed or centralized databases to meet regulatory requirements and improve drug safety. With centralized platforms, tracking products through the supply chain and identifying problems is made simpler by using a single database that is controlled by a single entity. Distributed platforms, on the other hand, allow users to keep control over their data while fostering transparency and collaboration. They do this by connecting several databases via a network. Non-fungible tokens (NFTs) are a useful tool for pharmaceutical companies to improve supply chain accountability and traceability. NFTs are distinct digital assets that can be utilized to stand in for tangible products or resources. Pharmaceutical businesses can use NFT to generate an unchangeable, safe record of a medicine product's journey through the supply chain.

In [9], In this paper, we provide a decentralized off-chain storage solution and smart contract-based Ethereum blockchain approach for effective product tracing in the healthcare supply chain. The smart contract ensures the provenance of data, does away with the need for middlemen, and offers a secure, unchangeable transaction history for all parties involved. We outline the system architecture and specific algorithms that underpin the operation of the suggested fix. We carry out system testing and validation, as well as a cost and security analysis, to assess how well the system improves traceability in pharmaceutical supply chains.

In [10], In order to facilitate and improve the efficiency of the medication supply chain management process, this study suggests a DLT-based technique. creation of these kinds of apps. A system based on the web3.py library, the Ethereum blockchain, and the Django Python framework has been developed for specific domains like drug management and traceability. It can be tailored to most real supply chains and generates the necessary applications (smart contracts, database schema, and apps) automatically. To

demonstrate how this strategy functions, a case study describing a basic drug traceability system for a producer to hospital wards is provided.

In [11], This study suggests a way to create a safe pharmaceutical supply chain management system utilizing blockchain Technology. This Technology can improve the supply chain system's visibility, traceability, security, and transparency. It is anticipated that this system will use a permissioned blockchain to store the transactions, with access to the blockchain restricted to trusted parties only. The researcher will present a safe blockchain-based medication supply chain management system by the end of this work.

In [12], The study suggests a permissioned blockchain network-based supply chain management system that will include role-based permission to prevent tampering with the network's accessible data. By offering transparency, traceability, and consistency of all the item units, the blockchain-based decentralized solution will help to minimize the effects caused by information asymmetry, hence improving issues of trust and collaboration.

In [13], This paper offers an Archimedes Optimization with Blockchain Support and Machine Learning-Driven Drug Method of Supply Management (BAOML-DSM) for the Pharmaceutical Industry. The pharmaceutical industry's medicine suggestion is the main emphasis of the BAOML-DSM technique that is being provided. The Hyperledger fabric for DSC management, which enables the achievement of tracking procedures in the smart pharmaceutical business, is exploited by the BAOML-DSM technique to do this. Preprocessing and the Glove-based word embedding process are done at the beginning. The gradient boosting decision tree (GBDT) model is also used and used to the recommendation of drugs. Additionally, the GBDT model's optimal parameter tuning is facilitated by the use of the Archimedes Optimization Algorithm (AOA) in the hyperparameter tuning process. The proposed BAOML DSM algorithm's experimental result analysis is conducted utilizing a benchmark dataset. The enhanced performance of the BAOML-DSM technique in terms of several metrics was guaranteed by the thorough results of the BAOML DSM technique.

In [14], This article describes our experience establishing a UHT milk traceability system, which included combining ontology technology to help milk cooperatives offer a thorough understanding of the system and blockchain technology to manage the factory's food safety system. to be sold unprocessed. The main topic is the traceability of milk. UHT milk facilitates knowledge sharing amongst supply chain partners and acts as a guiding principle for ensuring milk quality across the whole production chain.

In [15], This paper suggest a method that makes use of both current and developing technology, including virtual simulation, blockchain, machine learning, and quantum computing. By developing impenetrable encryption algorithms and an Internet of Things (IoT) tracking system, these technologies can be leveraged to improve security. Drugs can be tracked from the producer to the final user using a decentralized, secure system that can be created with blockchain technology. The technology can guarantee medication authenticity, stop counterfeiting, and give stakeholders transparency. With the aid of machine learning, and here it is able to examine enormous volumes of data and spot trends that may be used to spot fake medications.

In [16], This paper suggests that one way to reduce the spread of fake medications is through the application of blockchain technology. The User Center Design (UCD), a qualitative method, was used to perform the research. An industry group including five specialists from several fields validates the outcomes of a blockchain-based business model in one of Indonesia's biggest pharmaceutical sectors. Forum Group Discussions are used to carry out validation. The FGD's final report indicates that the

pharmaceutical industry can employ and find suitability in the blockchain-based business model for the medication production process. This blockchain technology offers outstanding data integration for every transaction, enabling every party to view and complete transactions so that owners of the pharmaceutical sector might feel confident in the production section since data can be traced accurately.

In [17], False medications have a potential to enter the real drug supply chain through distributed complicated networks. The medication supply chain's security has evolved into the top priority for the public health field. In this study, a drug management system is constructed using the Hyperledger Fabric Blockchain platform to obtain secure medication supply chain information. This system's development creates a digital, intelligent drug supply chain by facilitating drug record transactions on a blockchain network. A smart contract is introduced to restrict access to computerized drug records. To improve medication traceability.

In [18], Blockchain technology can enhance medical medicine distribution and supply chain management in a number of ways. It can verify the ownership of drug lots, increase confidence, data integrity, transparency, and trace a medicine's whole life cycle in an unchangeable manner. This paper describes a blockchain-based process that starts with a description of the particular supply chain in question and automatically develops a Dapp for medicine supply chain management. It is carried out by creating customisable SCs and makes use of the Python Django framework. We also present a straightforward case study to illustrate the operation of our methodology.

In [19], This study proposes a decentralized system for supply chain management that tracks and traces counterfeit medications. To effectively track and trace the counterfeit pharmaceuticals in the system, an encrypted QR code mechanism and the Ethereum platform, an advanced blockchain technology, are also incorporated into the system.

In [20], This paper provides a system, the super account book (Hyperledger) Fabric block chain platform is used to construct the system. The hospital, dealer, consumer, and pharmaceutical manufacturer are the four organizations that make up the system environment. The drug traceability function in the chain code initiates the query request, the client software is implemented in Node.js, and the chain code is developed in Java. In the end, the web page query can retrieve drug information for the certificate-certified user account. Block chain data is hard to tamper with, and time stamp and transaction traceability are useful additions to the pharmaceutical anti-counterfeiting traceability system. This enhances the system's traceability function and allows consumers to obtain all relevant traceability data, including details about drug production, logistics, and use.

III. METHODOLOGY

We begin by gaining a deep understanding of the project's objectives and requirements. This phase helps us define the scope of the project and aligns our goals with the problem we aim to address.

As students, research is integral to our process. We thoroughly investigate the technical and economic feasibility of the project to ensure we can navigate its complexities successfully. Later we move to the design phase, where we'll create the architectural design of our blockchain-based pharmaceutical traceability system. Prototyping will help us visualize the system's structure and functionality. Then in the development phase, we'll put our programming skills to work, coding the system's components. As students, this is where we apply our learning to practical implementation. Rigorous testing and quality assurance processes are in place to ensure that the system functions correctly. We'll test our code, identify and address issues, and make improvements as needed. We understand the importance of documentation.

We'll also maintain detailed records of our work, from architectural design to code and testing. This documentation will be a valuable learning resource and help us communicate our progress effectively.

Project Conceptualization: First, we thoroughly comprehend the goals and specifications of the project. This stage assists in defining the project's scope and coordinating our objectives with the issue we seek to solve.

Research and Feasibility: Research is a crucial part of our work as students. We conduct a detailed analysis of the project's technical and financial viability to make sure we can effectively manage its intricacies.

Design and Prototyping: Next, we will develop the architectural blueprint for our blockchain-powered pharmaceutical tracking system. We can see the architecture and operation of the system with the aid of prototyping.

Development and Coding: During the development stage, we will code the system's component parts using our programming abilities. Here is where we, as students, put everything we've learned to use.

Testing and Quality Assurance: Strict procedures are in place for both testing and quality assurance to guarantee that the system operates as intended. We'll test our code, find and fix problems, and make adjustments as necessary.

Reporting and Documentation: We recognize the value of reporting. Every step of our process, from architectural design to coding and testing, will be meticulously documented. This documentation will help us successfully share our efforts and serve as a useful learning tool.

User Training and Feedback: To guarantee that stakeholders are able to utilize the system, we will give them training materials. We also value customer feedback, which helps us to hone and enhance our work.

Constant Learning: We understand that learning never stops as students. We'll keep an eye on the status of our project and modify our strategy when we obtain fresh knowledge and skills. This iterative process is a core part of our methodology.

IV. SYSTEM ARCHITECTURE

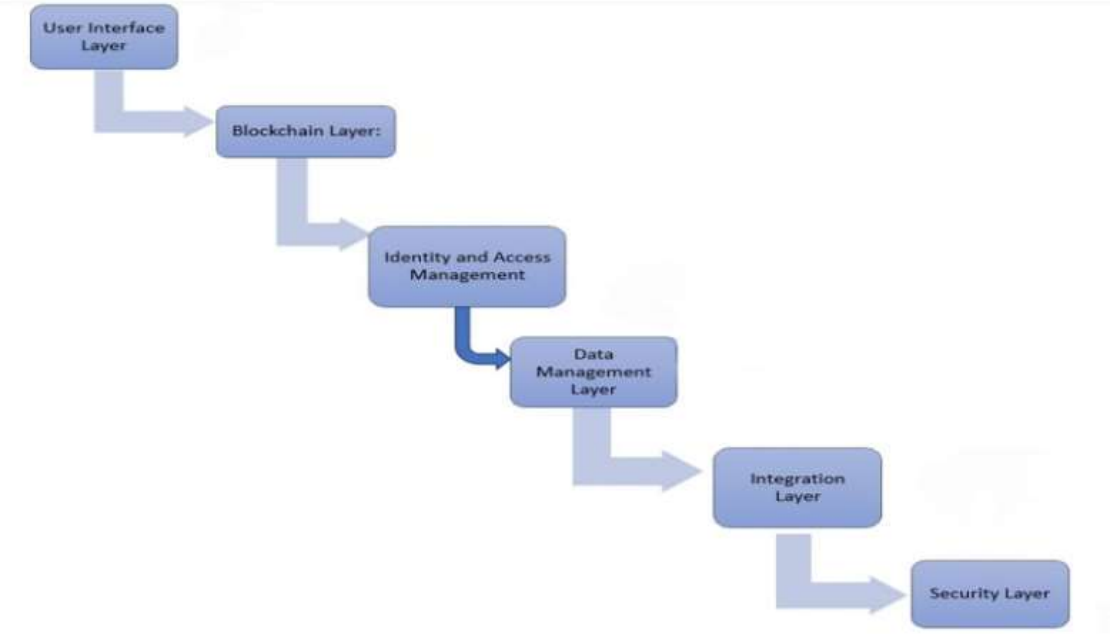

FIG 1: SYSTEM ARCHITECTURE

V. SEQUENCE DIAGRAM

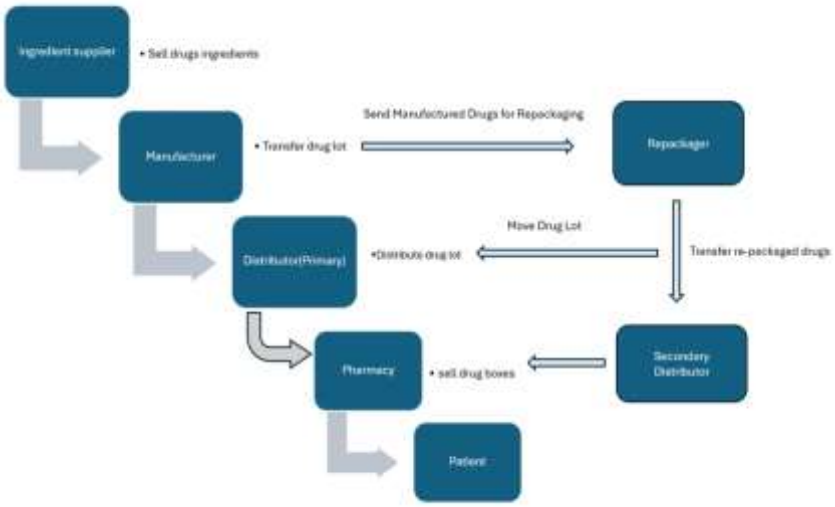

FIG 2: SEQUENCE DIAGRAM

VI. STAKEHOLDER DESCRIPTION

Pharmacists: Pharmacists play a vital role in dispensing medications to patients. They are key user stakeholders who will use MediChain to verify the authenticity of pharmaceutical products.

Patients: Patients are the ultimate beneficiaries of the healthcare system. They are also user stakeholders as they can use Medichain's website to authenticate the medications they receive.

Healthcare Providers: Doctors and healthcare professionals who prescribe medications will rely on MediChain to ensure that the drugs they recommend are genuine and safe for their patients.

Manufacturers: Pharmaceutical manufacturers are user stakeholders as they will use MediChain to record and verify the authenticity of their products.

Distributors: Pharmaceutical distributors who play a critical role in the supply chain will use MediChain to validate incoming shipments and maintain the integrity of the products they handle.

Regulatory Authorities: Regulatory agencies overseeing the pharmaceutical industry in India will use the data provided by MediChain for compliance and auditing purposes.

Pharmaceutical Industry Associations: Associations representing the pharmaceutical industry are user stakeholders, as they can leverage MediChain for the benefit of their member organizations.

VII. MODULES IDENTIFIED

1. Authentication and User Management Module:

Processes: User registration, login, and authentication.

Packages: User authentication package, User profile Management

2. Blockchain Module:

Processes: Blockchain node setup, smart contract development, and integration.

Packages: Smart contract package, Ethereum node package.

3. Drug Record Creation Module:

Processes: Creating digital records for pharmaceutical products.

Packages: Drug record creation package, data encryption.

4. Pharmaceutical Supply Chain Tracking Module:
Processes: Real-time tracking of pharmaceutical products throughout the supply chain.
Packages: Supply chain tracking package, data transmission.
5. Website Development Module:
Processes: Web interface design, development, and testing.
Packages: Front-end development package, web server setup.
6. **Data Verification and Authentication Module:**
Processes: Real-time data verification and authentication by users.
Packages: Verification and authentication package, real-time data update.
7. Documentation and Reporting Module:
Processes: Documentation of system architecture, user manuals, and project progress reporting.
Packages: Documentation package, reporting tools.
8. User Training and Support Module:
Processes: Creation of user training materials and user support.
Packages: User training package, user support package

VIII. CONCLUSION

In embarking on our journey to create a secure and transparent pharmaceutical traceability system, we recognize the significance of our project's mission. This project, led by students, seeks to address the critical issue of counterfeit pharmaceuticals within the Indian supply chain. Our feasibility study assures us of the project's viability, while a thoughtful budget and a focus on continuous learning enable us to navigate its complexities effectively.

The project's modules, each dedicated to specific functional areas, provide a roadmap for building the system. From user authentication to blockchain integration, drug record creation to real-time supply chain tracking, website development, and data verification to comprehensive documentation, every aspect of our project is systematically addressed.

As students, we embrace the dynamic nature of our learning journey. We understand that this project will provide valuable experiences and learning opportunities as we tackle real-world challenges. With each module we develop, we take a step closer to our goal of creating a system that safeguards patient health and integrity within the pharmaceutical industry. Our dedication, enthusiasm, and commitment to transparency and security form the bedrock of this endeavor. Together, we will work towards a future where counterfeit drugs are eradicated, and trust in healthcare is restored.

IX. REFERENCES

1. P. Saindane, Y. Jethani, P. Mahtani, C. Rohra and P. Lund, "Blockchain: A Solution for Improved Traceability with Reduced Counterfeits in Supply Chain of Drugs," 2020 International Conference on Electrotechnical Complexes and Systems (ICOECS), Ufa, Russia, 2020, pp. 1-5, doi: 10.1109/ICOECS50468.2020.9278412.
2. S. D. Nawale and R. R. Konapure, "Blockchain & IoT based Drugs Traceability for Pharma Industry," 2021 IEEE International Conference on Engineering, Technology and Innovation (ICE/ITMC), Cardiff, United Kingdom, 2021, pp. 1-4, doi: 10.1109/ICE/ITMC52061.2021.9570251.
   Q. Jia, J. Li, Y. Li, Y. Liu, X. Gao and B. Li, "Sewage Automatic Sampling and Traceability System for Monitoring and Assessment of Drug Situation," 2022 6th Asian Conference on Artificial

Intelligence Technology (ACAIT), Changzhou, China, 2022, pp. 1-6, doi: 10.1109/ACAIT56212.2022.10138004.
3. Y. Li and Q. Ruan, "Petri Net Modeling and Analysis of the Drug Traceability System Based on Blockchain," 2021 IEEE International Conference on Consumer Electronics and Computer Engineering (ICCECE), Guangzhou, China, 2021, pp. 591-595, doi: 10.1109/ICCECE51280.2021.9342402.
4. D. H. Tanvir, R. Amin, A. Islam, M. S. Islam and M. M. Rashid, "Blockchain Interoperability for A Reputation-Based Drug Supply Chain Management," 2023 6th International Conference on Information Systems and Computer Networks (ISCON), Mathura, India, 2023, pp. 1-6, doi: 10.1109/ISCON57294.2023.10112196.
5. M. M. Rani and A. Jawahar, "Traceability of Pharmaceutical Products using Blockchain," 2023 International Conference on Research Methodologies in Knowledge Management, Artificial Intelligence and Telecommunication Engineering (RMKMATE), Chennai, India, 2023, pp. 1-6, doi: 10.1109/RMKMATE59243.2023.10369971.
6. M. Rehman, I. T. Javed, K. N. Qureshi, T. Margaria and G. Jeon, "A Cyber Secure Medical Management System by Using Blockchain," in IEEE Transactions on Computational Social Systems, vol. 10, no. 4, pp. 2123-2136, Aug. 2023, doi: 10.1109/TCSS.2022.3215455.
7. A. Sarkar and M. Roy, "Blockchain Based Drug Supply-Chain Management System," 2023 OITS International Conference on Information Technology (OCIT), Raipur, India, 2023, pp. 950-956, doi: 10.1109/OCIT59427.2023.10430923.
8. A. Musamih et al., "A Blockchain-Based Approach for Drug Traceability in Healthcare Supply Chain," in IEEE Access, vol. 9, pp. 9728-9743, 2021, doi: 10.1109/ACCESS.2021.3049920.
9. L. Marchesi, "Using Django Framework and DLT for Drug Supply Chain Management," 2023 IEEE International Conference on Decentralized Applications and Infrastructures (DAPPS), Athens, Greece, 2023, pp. 94-99, doi: 10.1109/DAPPS57946.2023.00021.
10. M. Dashtizadeh, F. Meskaran and D. Tan, "A Secure Blockchain-based Pharmaceutical Supply Chain Management System: Traceability and Detection of Counterfeit Covid-19 Vaccines," 2022 IEEE 2nd Mysore Sub Section International Conference (MysuruCon), Mysuru, India, 2022, pp. 1-5, doi: 10.1109/MysuruCon55714.2022.9972646.
11. M. Dave, K. Patil, R. Jaiswal and R. Pawar, "Monitoring Supply Chain of Pharmaceutical Drugs Using Blockchain," 2022 IEEE Delhi Section Conference (DELCON), New Delhi, India, 2022, pp. 1-5, doi: 10.1109/DELCON54057.2022.9753598.
12. S. P and K. Venkatesh, "Blockchain Assisted Archimedes Optimization with Machine Learning Driven Drug Supply Management for Pharmaceutical Sector," 2023 International Conference on Advances in Computing, Communication and Applied Informatics (ACCAI), Chennai, India, 2023, pp. 1-8, doi: 10.1109/ACCAI58221.2023.10199884.
13. P. Hemnil, E. Boonchieng and S. Osiriphun, "Food Safety Block Chain System using Ontology in UHT Milk Factory," 2023 17th International Conference on Ubiquitous Information Management and Communication (IMCOM), Seoul, Korea, Republic of, 2023, pp. 1-5, doi: 10.1109/IMCOM56909.2023.10035606.
14. B. S. Teja, B. C. Sri, G. Vindya and C. M. Babu, "Emerging Technologies in the Fight Against Drug Counterfeiting - A Survey of Security Measures," 2023 16th International Conference on Security of

Information and Networks (SIN), Jaipur, India, 2023, pp. 1-6, doi: 10.1109/SIN60469.2023.10475082.

15. Meyliana, E. Fernando, Surjandy and Marjuky, "The Business Process of Good Manufacturing Practice Based on Blockchain Technology in the Pharmaceutical Industry," 2021 Fifth International Conference on Information Retrieval and Knowledge Management (CAMP), Kuala Lumpur, Malaysia, 2021, pp. 91-95, doi: 10.1109/CAMP51653.2021.9498104.
16. S. Raxit, J. Hossain Gourob and H. Kabir, "A Comprehensive Drug Management System by Segregating Spurious and Substandard Drugs Using Blockchain Technology," 2021 International Conference on Automation, Control and Mechatronics for Industry 4.0 (ACMI), Rajshahi, Bangladesh, 2021, pp. 1-5, doi: 10.1109/ACMI53878.2021.9528238.
17. L. Marchesi, "Automatic Generation of a Blockchain-based Drug Supply Chain Management System," 2023 IEEE/ACM 6th International Workshop on Emerging Trends in Software Engineering for Blockchain (WETSEB), Melbourne, Australia, 2023, pp. 25-32, doi: 10.1109/WETSEB59161.2023.00009.
18. T. S, K. S, R. H. B, T. K. N and S. M. P, "Med Secure: A Blockchain based Authenticated System for Counterfeit Medicine in Decentralized Peer to Peer Network," 2021 Asian Conference on Innovation in Technology (ASIANCON), PUNE, India, 2021, pp. 1-7, doi: 10.1109/ASIANCON51346.2021.9544648.
19. H. Tian and Y. Li, "Pharmaceutical anti-counterfeiting traceability system based on block chain double chain," 2021 International Conference on Computer Engineering and Application (ICCEA), Kunming, China, 2021, pp. 45-49, doi: 10.1109/ICCEA53728.2021.00016.