

Block Chain Based Shipment Management and Tracking System

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Abstract:- A blockchain-based shipment management and tracking system utilizes Ethereum technology and address critical challenges in traditional tracking systems, including lack of transparency, inefficiencies, and trust issues. The solution facilitates decentralized product tracking, automating key processes such as product registration, shipment updates, and delivery confirmations through the implementation of smart contracts. Unlike centralized systems employed by companies like Amazon and Flipkart, this approach offers comprehensive end-to-end traceability, enhanced security, and the elimination of intermediaries. The decentralized framework ensures that all stakeholders—suppliers, distributors, and buyers—have access to an immutable record of product status and history, thereby fostering increased trust and accountability. The survey delves into the development process, encompassing smart contract creation, front-end and back-end integration, and addresses the challenges associated with deployment on a public blockchain. By highlighting the transformative potential of blockchain technology, the study underscores how it can significantly enhance supply chain operations through improved efficiency, transparency, and cost reduction, positioning it as a superior alternative to conventional tracking systems.

Keywords:- Blockchain, Ethereum, Supply Chain Management, Smart Contracts, Decentralization, Product Tracking, Transparency, Trust, Automation, Immutability.

I. INTRODUCTION

Blockchain technology has revolutionized traditional supply chain systems by introducing transparency, immutability, and security, addressing common challenges such as inefficiency, lack of trust, and reliance on intermediaries. Systems are plagued by opaque processes, fraud risks, and centralized data management, leading to errors and delays. The problem lies in ensuring trust and transparency throughout the supply chain, as centralized systems are vulnerable to manipulation and inefficiencies. To tackle these issues, this project presents a decentralized application (DApp) built on Ethereum, aimed at creating a more transparent and secure supply chain process. The DApp allows sellers to add items to a blockchain-based inventory, where buyers can track and purchase items, with each transaction recorded immutably through smart contracts. This system eliminates the need for intermediaries, providing a trustless environment where every step—from listing to shipment to receipt—is verifiable and secure. This survey evaluates existing blockchain-based supply chain solutions

and compares them with the proposed DApp, demonstrating its ability to enhance transparency, reduce costs, and improve accountability.

II. LITERATURE SURVEY

Overview of the literature survey is essential because it looks at different analyses. It explores every corner of the earlier works that has been released, taking into account various project characteristics and the project's scope. A literature review's main aim is to look into the project's history in detail, pointing out flaws in the current setup and highlighting concerns that still need to be addressed. The subjects addressed not only shed light on the project's history but also highlight the issues and shortcomings that motivated the project's conception and remedy proposals.

➤ *A Blockchain-Enabled IoT Logistics System for Efficient Tracking and Management of High-Price Shipments:*

A Resilient, Scalable, and Sustainable Approach to Smart Cities – Mohammed Balfagih, Zain Balfagih, Miltiadis D. Lytras, Khaled Mofawiz Alfawaz, Abdulrahman A. Alshdadi, Eesa Alsolami (2023): In this paper, Balfagih et al. (2023) present a blockchain-enabled IoT logistics system designed to manage and track high-value shipments efficiently. The system uses smart contracts on the Ethereum blockchain to automate approvals and payments, ensuring transparent and secure transactions between legitimate parties. IoT sensors provide real-time monitoring of shipment conditions, enabling violation detection, such as theft or severe falls, through piezoresistive sensors. This approach aligns closely with the project's objective of creating a secure, decentralized platform for managing supply chains. By utilizing blockchain and smart contracts, it aims to improve transparency, security, and automation within the system.

➤ *Blockchain Technology Implementation in Supply Chain Management:*

A Literature Review – Abdel-Aziz Ahmad Sharabati, Elias Radi Jreisat (2024) : Sharabati and Jreisat (2024) offer a comprehensive literature review on the adoption and implementation of blockchain technology in the shipment management. Their paper examines the advantages of blockchain in improving transparency, traceability, and security across SCM systems while addressing challenges like scalability, high implementation costs, and integration with existing systems. This review supports the objectives of your project by emphasizing the transformative potential of decentralized blockchain solutions in creating efficient, secure supply chains. It also contextualizes your DApp as a necessary

innovation to address current SCM inefficiencies (sustainability-16-02823).

➤ *Blockchain Adoption in the Shipping Industry:*

An Empirical Study, authored by Kapnissis et al. in 2022: analyzes the adoption of blockchain in the shipping industry, particularly focusing on port authorities and logistics providers. The study aims to explore how blockchain enhances transparency, ensures data integrity, and reduces fraud in shipping operations. By utilizing empirical data from various shipping entities, the paper examines the potential of blockchain to revolutionize shipping by enabling real-time tracking and minimizing manual processes. However, the authors also discuss the high implementation costs into the existing infrastructure, emphasizing that while the benefits are clear, significant barriers still exist.

➤ *Blockchain Technology Implementation in Supply Chain Management:*

A Literature Review, authored by Abdel-Aziz Ahmad Sharabati and Elias Radi Jreisat in 2024: This paper offers a comprehensive review of blockchain applications in supply chain management, analyzing literature published between 2016 and 2022. The paper highlights how blockchain increases transparency, security, and traceability throughout the supply chain process. It identifies key areas where blockchain can resolve inefficiencies, such as reducing delays and fraud. Despite these benefits, the authors discuss challenges related to standardization, regulatory issues, and the energy-intensive nature of blockchain technologies. The paper concludes that blockchain holds significant potential for improving supply chain processes, despite these obstacles.

➤ *In Blockchain Applications in Circular Marine Plastic Debris Management, published in 2022, authors Gong Yu, Wang Y., Frei R., et al. explore the use of blockchain in tracking and managing marine plastic waste:*

The objective of the paper is to propose a blockchain framework that enhances sustainability by improving the tracking efficiency of marine waste in logistics. The paper demonstrates how blockchain can promote transparency and accountability within supply chains, especially when applied to environmental sustainability initiatives. However, the authors note the complexities and scalability challenges that arise when attempting to apply blockchain to larger logistics networks, limiting its widespread application in this field.

➤ *Blockchain Applications in Interport Communities, authored by Serra P., Fancello G., Tonelli R., and Marchesi L. in 2022:*

This paper investigates the use of blockchain in connecting port authorities to enhance logistics management across multiple ports. By implementing blockchain, the authors propose a decentralized framework that improves collaboration and transparency between different ports. The study highlights the advantages of seamless data sharing and better coordination in port operations. However, regulatory hurdles and issues related to the interoperability of blockchain systems between different authorities are discussed as significant challenges to this approach.

➤ *Blockchain-Based Electronic Bill of Lading for Container Transport, 2021, Wang X. and Shi H:*

Examine the potential of blockchain to streamline the handling of electronic bills of lading, a critical aspect of container transport. The study argues that blockchain can reduce the administrative burden by automating documentation processes and ensuring data security. The authors highlight how blockchain technology can improve the efficiency of container shipping operations by securing digital documentation. However, for blockchain-based solutions to be fully effective, the paper points out that widespread adoption across the shipping industry is necessary, which remains a challenge.

➤ *Blockchain for Sustainable Maritime Logistics by Raja Wasim A., Haya H., Haya J., and Khaled S., published in 2021:*

Discusses the potential of blockchain to promote sustainable practices within maritime logistics. The authors explore how blockchain can facilitate environmentally friendly logistics operations by ensuring transparency and accountability in tracking shipments and carbon emissions. While the paper highlights blockchain's ability to support sustainability efforts, it also discusses the high costs of implementation and the lack of regulatory frameworks as significant barriers to adoption. Nonetheless, the study underscores the potential for blockchain to drive sustainability within the logistics sector.

The key takeaways from the mentioned papers highlight the transformative potential of blockchain technology in supply chain management. By leveraging Ethereum and smart contracts, the proposed blockchain-based system ensures secure, decentralized, and transparent shipment tracking. Its immutable records reduce fraud risks, while real-time updates enhance trust among stakeholders. The automation of critical processes minimizes reliance on intermediaries, leading to faster operations and lower costs. Additionally, incorporating QR codes improves accessibility for users with varying technological proficiency, ultimately showcasing how blockchain can revolutionize logistics by promoting transparency and efficiency.

III. OBJECTIVES

➤ *To Track Supply Chain Stages on the Blockchain:*

The project implements a system where a Seller can add items to the inventory, and a Buyer can purchase these items. The contract tracks the entire lifecycle of the item.

➤ *To Utilize Smart Contracts for Automation:*

The supply chain is managed by smart contracts written in Solidity. These smart contracts automate the process.

➤ *To Access Control and Permissions:*

The project uses an access control system with roles such as "Seller" and "Buyer" to ensure that only authorized participants can perform certain actions.

➤ *To Test Contracts and Blockchain Deployment:*

Using the Truffle Framework for developing, testing, and deploy smart contracts.

➤ *To build a Decentralized Application (DApp):*

Build a front-end interface for the decentralized application that interacts with the deployed smart contracts.

IV. PROPOSED SYSTEM

It utilizes a decentralized blockchain-based approach to track shipments across the process. It employs smart contracts to automate updates to the shipment status and verify ownership records at each stage. Advantages: The DApp provides real-time, immutable updates accessible to all authorized participants, enhancing trust and transparency. Since the blockchain is decentralized, there is no single point of failure, and all transaction records are secure and tamper-proof. The proposed DApp overcomes the limitations of existing solutions by providing a secure, transparent, and automated shipment tracking, reducing the intermediaries and enhancing trust across the supply chain.

➤ *System Architecture Review:*

The system architecture is built on a decentralized blockchain platform, where all participants interact directly with the blockchain to manage shipment tracking. Key components include smart contracts for automating operations like shipment registration and updates, along with a decentralized ledger that ensures data immutability.

➤ *Analysis of Security:*

Security is a crucial element of the system, maintained through blockchain's inherent cryptographic features. Transactions on the blockchain are permanent and resistant to tampering. Smart contracts undergo testing to minimize vulnerabilities and ensure safe execution. Access control measures limit actions by unauthorized users, and the decentralized design reduces dependence on a central authority, enhancing the system's resilience.

➤ *Assessment of Performance:*

Performance assessment is conducted through load testing, ensuring the system can handle a high volume of transactions. Factors like transaction throughput and latency are analyzed, with optimization steps such as exploring layer-2 scaling solutions.

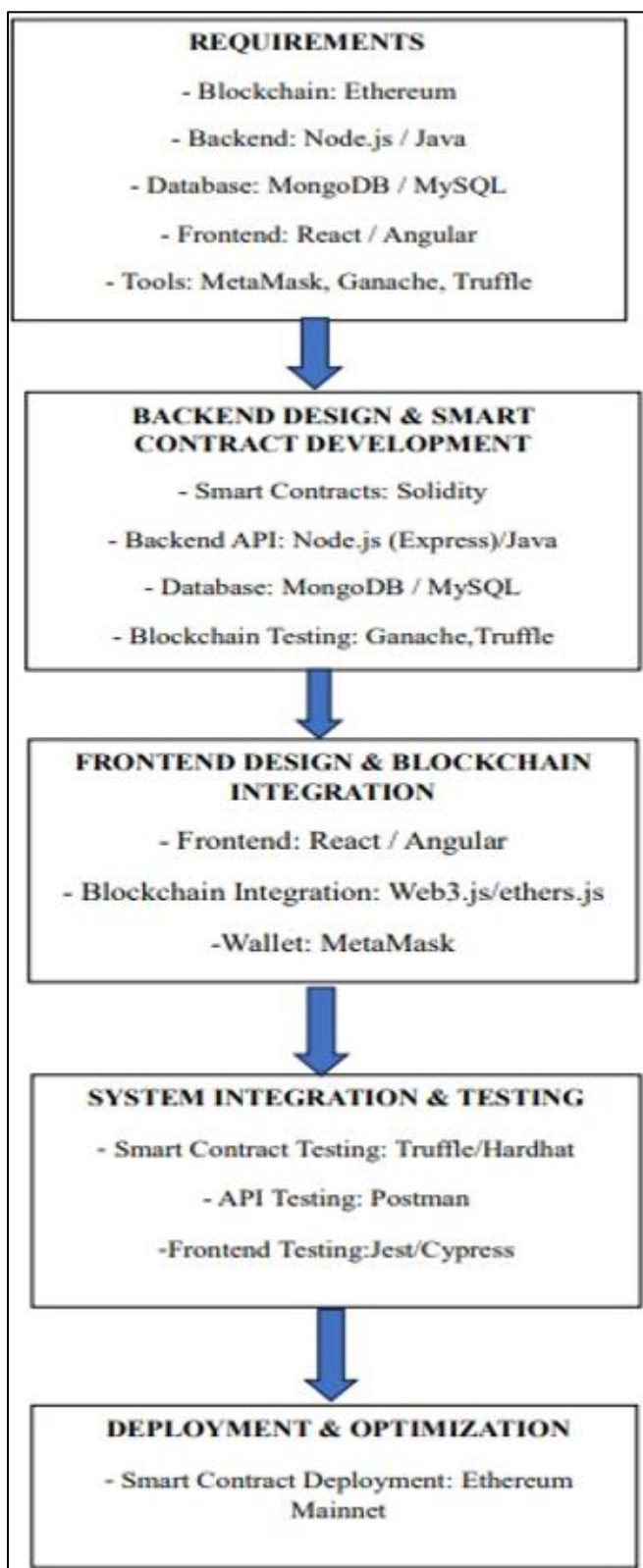


Fig 1 Objectives of the System

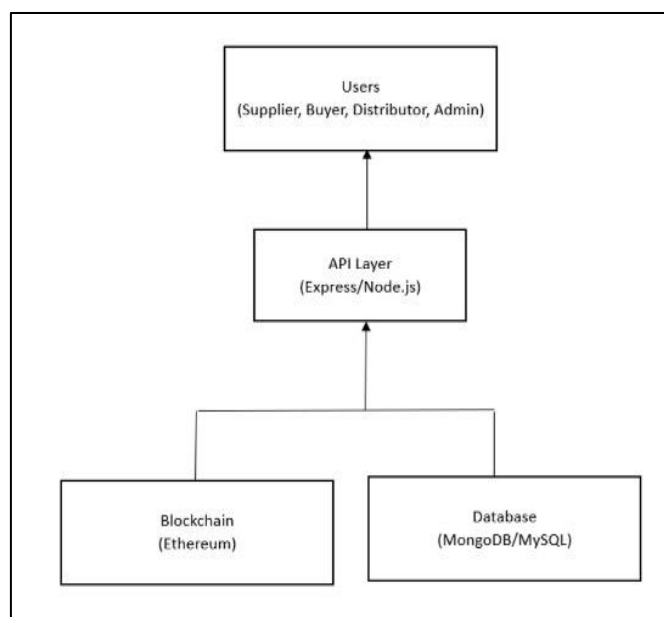


Fig 2 Data Process

V. ADVANTAGES OF THE PROPOSED SYSTEM

- *The system provides continuous, real-time updates that can be accessed by all involved parties, ensuring accurate and timely tracking throughout the supply chain.*
- *Data stored in the system is permanent and cannot be altered, offering greater integrity and protection against unauthorized changes or tampering.*
- *It enhances transparency by allowing all participants to view the history and status of shipments, improving trust and reducing the potential for disputes. and eliminates the need for intermediaries by automating key processes and reducing manual intervention, leading to faster and more efficient operations.*

VI. CONCLUSION

The blockchain-based shipment and tracking system is designed to enhance the management of high-value shipments, especially within smart cities. Leveraging blockchain technology, this system increases transparency, traceability, and operational efficiency in logistics. The proposed solution provides a scalable, privacy-focused, and robust approach to supply chain management, addressing critical challenges like trust, security, and streamlined information sharing among various logistics participants. Blockchain technology holds vast potential to transform supply chains, offering significant benefits to industries adopting this innovation.

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