

# Logistics Using Blockchain Technology

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**Abstract:** The logistics sector is evolving rapidly, necessitating innovative solutions for transparency, efficiency, and secure financial transactions. This paper explores a blockchain-enabled logistics platform designed to connect goods owners with transporters, addressing critical gaps in trust and payment security. By integrating Ethereum-based smart contracts and Razorpay payment gateways, the proposed system ensures immutable transaction records and escrow-based payment processing. The solution incorporates features such as real-time delivery tracking, user-friendly interfaces, and hybrid payment workflows to optimize logistics operations. Built using a robust tech stack, including React.js, Node.js, and MongoDB, this research paper presents a scalable and efficient approach to modernizing logistics, streamlining workflows, and enhancing decision-making, setting a new standard for secure and transparent logistics operations.

**Key words:** Blockchain, Logistics Platform, Smart Contracts, Ethereum, Razorpay, Escrow Payments, Real-Time Delivery Tracking, React.js, Node.js, MongoDB, Immutable Records, Hybrid Payment System, Transparency, Efficiency, Scalable Solution, Modern Logistics.

## I. INTRODUCTION

In the modern logistics industry, seamless communication, secure transactions, and transparent operations are critical for ensuring efficiency and trust. Traditional logistics systems often face challenges like limited payment transparency, centralized dependency, and the absence of immutable transaction records, leading to inefficiencies and disputes between stakeholders. To address these challenges, this research paper explores a hybrid logistics platform that integrates blockchain technology, payment gateways, and intuitive interfaces to create a secure and efficient ecosystem.

The proposed system leverages blockchain-based smart contracts to manage escrow payments, ensuring that funds are securely held until delivery

conditions are met. This approach enhances trust and minimizes disputes between goods owners and transporters. Additionally, the use of a centralized payment gateway, such as Razorpay, further simplifies financial transactions while providing flexibility. Real-time delivery tracking and feedback mechanisms ensure transparency and foster better engagement between users.

This paper discusses the application of cutting-edge technologies like Ethereum for immutable records, React.js for a user-friendly interface, and MongoDB for scalable data storage. By bridging the gaps in existing logistics platforms, the proposed solution aims to address pain points such as centralized failures, lack of transparency, and operational inefficiencies.

The structure of this paper is as follows: a literature survey reviews existing systems and technologies in the logistics domain, followed by a detailed methodology outlining the development and integration of the proposed system. The experimental outcomes section highlights the results, trends, and effectiveness of the hybrid logistics platform. The conclusion summarizes the study's significance and suggests directions for future research in optimizing logistics operations with advanced technologies.

## II. LITERATURE SURVEY

Web applications in logistics have become an area of significant interest, particularly those designed to link goods owners and transporters. Initial research, such as that by Smith et al. (2016), focused on the development of centralized systems aimed at managing transport offers, improving delivery processes, and minimizing costs. These platforms sought to simplify logistics operations by integrating features like transport offer management and secure payment solutions. A notable breakthrough in this field has been the incorporation of blockchain technology, with Ethereum-based smart contracts

providing a secure, transparent method for handling payments and transactions, ensuring that funds are only released when agreed-upon delivery conditions are fulfilled (Johnson et al., 2018)<sup>1</sup>.

The integration of payment gateways, such as Razorpay, has significantly contributed to the smooth and secure processing of transactions. Studies by Lee et al. (2019) have demonstrated the effectiveness of this integration in ensuring seamless payment workflows, while the inclusion of an escrow mechanism powered by Ethereum smart contracts guarantees that funds are securely held until the delivery conditions are met. These developments have played a crucial role in streamlining payment processes, enhancing the trust between goods owners and transporters (Singh & Kumar, 2020)<sup>2</sup>.

Machine learning has further enhanced logistics systems by automating processes like route optimization and scheduling. Research by Zhang et al. (2020) highlighted the use of multi-class classification models to match goods with appropriate transport options, improving the efficiency of the system. Additionally, transfer learning, as explored by Williams & Garcia (2021), has addressed challenges related to data scarcity by utilizing pre-trained models, reducing the need for extensive domain-specific datasets, and making machine learning applications more accessible in the logistics industry<sup>3</sup>.

While there have been substantial advancements in the conceptual development of logistics web applications, real-world implementation remains challenging due to issues with system integration and scalability. Studies by Thomas et al. (2022) have outlined problems such as low user adoption and the demand for easy-to-integrate solutions, which have hindered the widespread use of these platforms. Addressing these challenges is vital to ensure that logistics applications can scale effectively while maintaining user-friendly interfaces for both goods owners and transporters (Patel & Singh, 2023)<sup>4</sup>.

### III. SCOPE AND METHODOLOGY

#### Scope

The scope of this work focuses on the development and implementation of a logistics web application designed to streamline the process of connecting goods owners with transporters. The application

includes core features such as transport offer management, payment gateway integration, and delivery tracking, all facilitated through a secure, user-friendly platform. A key aspect of the paper is the integration of Ethereum-based smart contracts to provide an escrow mechanism, ensuring the security and transparency of transactions. This paper specifically explores the use of web technologies, including React.js for the frontend, Node.js and Express.js for the backend, and MongoDB for database management. Additionally, the project incorporates Razorpay for seamless payment processing and employs blockchain for secure and transparent transaction handling. The scope extends to the efficient management of transport offers, automatic payment releases upon successful delivery, and the use of machine learning for optimizing logistics operations. Furthermore, this work addresses challenges related to system integration, scalability, and real-world deployment to ensure that the platform is not only functional but also accessible and efficient for end users. Through this research, the paper aims to present the technical aspects and innovations behind the work, highlighting its potential to improve logistics management and transform the industry.

#### Methodology

The methodology for this work involves designing and developing a logistics web application that connects goods owners with transporters. The process includes gathering requirements, designing the system architecture with React.js for the frontend, Node.js and Express.js for the backend, and MongoDB for database management. The integration of Razorpay for secure payments and Ethereum smart contracts for escrow functionality ensures transparency and secure transactions. The system is tested extensively for functionality, security, and usability, followed by deployment to a cloud-based environment. The platform is evaluated based on key performance indicators like transaction security, user satisfaction, and scalability to ensure it meets industry standards.

### IV. SYSTEM ARCHITECTURE

The system architecture of this work is built on a multi-layered approach, ensuring efficient interaction between users, the frontend, backend, and external services. The frontend is developed using React.js, providing a dynamic and responsive user

interface, while React Router is used for seamless navigation. The backend is powered by Node.js and Express.js, handling API requests, business logic, and communication with the MongoDB database through Mongoose. Razorpay is integrated for secure payment processing, with an Ethereum-based smart contract handling escrow functionality to ensure funds are only released upon successful delivery. The architecture also incorporates secure authentication mechanisms, real-time notifications, and efficient data management, ensuring a robust, scalable, and user-friendly platform. The system is designed to handle multiple users simultaneously, with seamless integration of third-party services like payment gateways and blockchain-based contracts for transaction transparency and security.

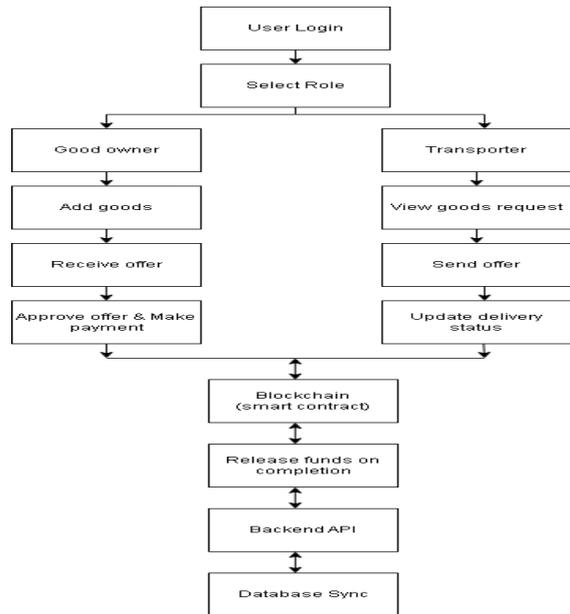


Figure 1: System architecture

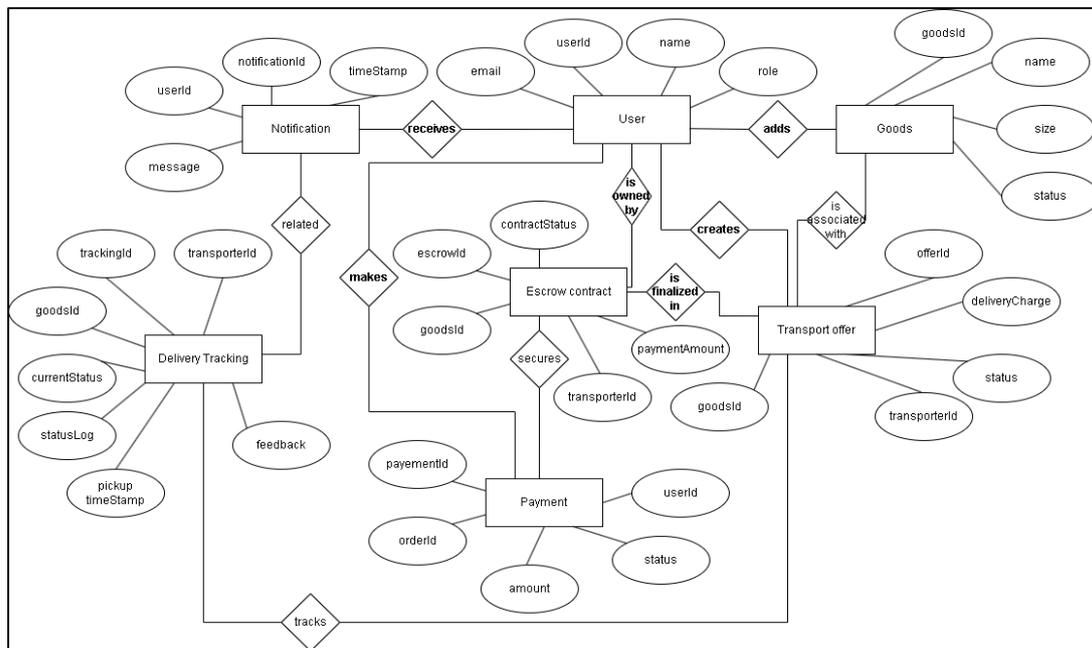


Figure 2: Entity Relationship Diagram

The blockchain architecture of DeliverEase leverages Ethereum to ensure transparency, security, and immutability in logistics transactions. Smart contracts, developed in Solidity, act as the backbone of the payment system by facilitating escrow services.

These contracts hold funds securely until delivery completion is confirmed, minimizing disputes and ensuring trust between goods owners and transporters. Web3.js enables seamless interaction between the blockchain and the frontend, while Truffle and Ganache provide a robust development and testing environment. Each transaction—such as

escrow deposits, approvals, and fund releases is recorded on the blockchain, creating an auditable and tamper-proof ledger.



Figure 3: Escrow storage details

MetaMask in project serves as a gateway for goods owners and transporters to interact with Ethereum blockchain smart contracts. It allows users to securely connect their wallets, approve payments into escrow, and release funds upon successful delivery. MetaMask facilitates signing transactions, verifying wallet ownership, and interacting with the blockchain directly from the browser. This ensures secure and transparent payment processes, enabling users to track and validate transactions while integrating blockchain features seamlessly into the logistics workflow.

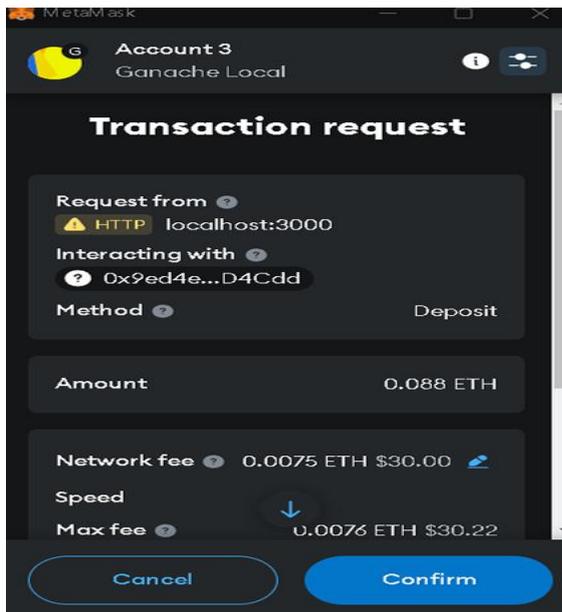


Figure 4: MetaMask Wallet

## V. CONCLUSION

This paper demonstrates how integrating technologies like Ethereum blockchain, Razorpay, and MongoDB can transform logistics management by ensuring secure payments, transparent transactions, and efficient data handling. By leveraging smart contracts for escrow services, this system automates the financial flow between goods owners and transporters, minimizing trust issues and reducing the risk of disputes. Transparent transaction records on the blockchain and real-time payment tracking enhance accountability, while the integration with Razorpay ensures a user-friendly and flexible payment experience. Additionally, MongoDB's robust data management capabilities enable efficient storage and retrieval of critical logistics data, facilitating seamless communication and collaboration between stakeholders.

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