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Blockchain-Based Supply Chain Tracking System Using RFID

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Abstract
Modern supply chain systems demand secure, transparent, and real-time tracking mechanisms to ensure product authenticity, operational efficiency, and long-term sustainability. With the increasing adoption of digital technologies in Supply Chain 4.0 and Agriculture 4.0 paradigms, issues such as data manipulation, lack of trust, fragmented information flow, and limited traceability have become critical concerns [1], [2], [3]. Conventional centralized supply chain tracking solutions are prone to single points of failure and unauthorized data modification, reducing reliability across multi-stakeholder environments. Recent studies highlight that blockchain-enabled traceability frameworks can significantly enhance transparency, trust, and accountability in complex supply chains [4], [6], [7]. To address these challenges, this paper proposes a Blockchain-Based Supply Chain Tracking System using Radio Frequency Identification (RFID). RFID technology enables automatic, contactless, and non-line-of-sight identification of products across different supply chain stages, while blockchain provides a decentralized and immutable ledger for secure event recording. In the proposed system, RFID-generated data is collected at checkpoints, processed through a middleware layer, and stored on a permissioned blockchain using smart contracts. This ensures data integrity, controlled access, and transparent information sharing among authorized stakeholders. Each blockchain transaction represents a verified supply chain event, enabling complete end-to-end traceability from manufacturing to final delivery. Experimental evaluation indicates that the proposed approach improves trace-back efficiency, prevents unauthorized data alteration, and enhances transparency compared to traditional centralized systems. The system is well suited for applications such as logistics, agri-food supply chains, and pharmaceutical distribution, where trust, security, and traceability are critical requirements [4], [5], [6].
Keywords: *Blockchain; RFID; Supply Chain Tracking; Supply Chain 4.0; Traceability.*

1. Introduction

1.1. Background and Challenges in Modern Supply Chains

The rapid digitalization of global supply chains has led to increasingly complex and interconnected networks involving manufacturers, suppliers, logistics providers, distributors, and retailers. Emerging paradigms such as **Supply Chain 4.0** and **Agriculture 4.0** emphasize the use of digital technologies to improve efficiency, resilience, and sustainability across supply chain operations [1]. However, this growing complexity also introduces challenges such as lack of transparency, limited trust among stakeholders, data inconsistency, and difficulty in tracing product origin and movement across multiple entities [2], [3]. Traditional supply chain management systems largely rely on centralized databases controlled by a single authority, making them vulnerable to cyberattacks, data manipulation, and single points of failure.

1.2. Role of RFID in Supply Chain Automation

Radio Frequency Identification (RFID) technology has been widely adopted to improve automation and visibility in supply chains. RFID enables rapid,

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contactless, and non-line-of-sight identification of products, reducing manual intervention and operational errors. Despite these advantages, conventional RFID-based tracking systems typically store collected data in centralized repositories, which do not guarantee data integrity or transparency among stakeholders. As highlighted in recent studies, such architectures are insufficient to address issues related to counterfeit products, unreliable recalls, and trust deficits in large-scale supply chains [5], [6].

1.3. Blockchain for Secure and Transparent Traceability

Blockchain technology has emerged as a transformative solution for secure and transparent supply chain management. Blockchain provides a decentralized, immutable, and cryptographically secured ledger where transactions are time-stamped and validated through consensus mechanisms. Recent research has demonstrated that blockchain-based traceability systems significantly enhance trust, accountability, and data reliability in distributed supply chains [4], [7]. Moreover, the integration of blockchain with RFID and IoT technologies enables automatic and trustworthy recording of real-time supply chain events, eliminating the need for intermediaries and reducing the risk of data tampering [5].

1.4. Motivation and Contribution of This Work

Motivated by these advancements, this paper proposes a **Blockchain-Based Supply Chain Tracking System using RFID** to ensure secure, transparent, and tamper-proof monitoring of products throughout the supply chain lifecycle. By combining RFID's real-time data acquisition capabilities with blockchain's immutable storage and decentralized access control, the proposed system enhances traceability, operational efficiency, and stakeholder trust. The solution is particularly relevant for modern logistics, agri-food systems, and pharmaceutical supply chains, where regulatory compliance, sustainability, and data authenticity are critical concerns [1], [2], [6].

2. Methodology

This section describes the design and implementation methodology of the proposed **Blockchain-Based Supply Chain Tracking System using RFID**. The methodology focuses on secure data acquisition, reliable data transmission, blockchain-based storage, and smart contract–driven validation to ensure transparency, traceability, and data integrity throughout the supply chain lifecycle.

2.1. Overall System Architecture

The proposed system adopts a layered architecture integrating RFID hardware with blockchain infrastructure. The architecture consists of four major layers:

- Data Acquisition Layer,
- Processing and Communication Layer,
- Blockchain and Smart Contract Layer, and
- Application Layer.

At the data acquisition layer, RFID tags are attached to products and uniquely identify each item. RFID readers installed at different supply chain checkpoints—such as manufacturing units, warehouses, and distribution centers—scan the tags automatically. The scanned data is processed by a microcontroller unit and transmitted securely to the blockchain network. The blockchain layer records verified transactions in an immutable ledger, while the application layer enables authorized stakeholders to view product traceability information (Figure 1).

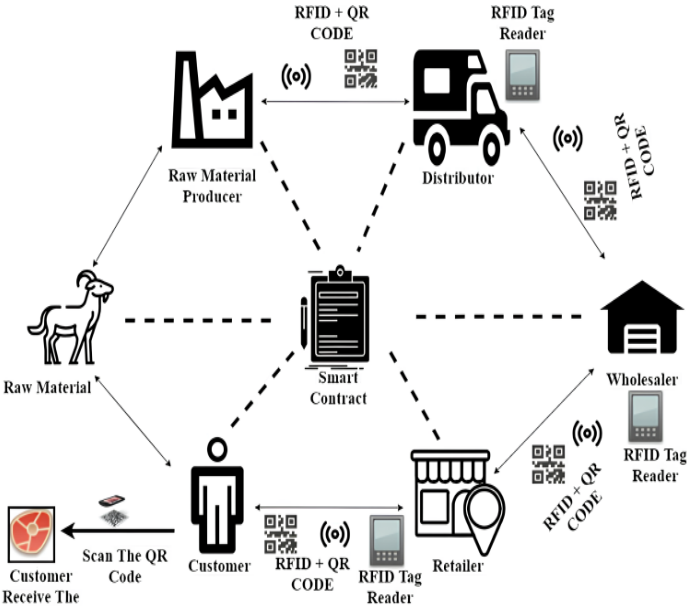

Figure 1 The Overall System Architecture and Data Flow of the Proposed Solution

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2.2. RFID-Based Data Acquisition

RFID technology serves as the primary mechanism for real-time product identification and tracking. Passive Ultra High Frequency (UHF) RFID tags are attached to each product and store a unique identification number. These tags do not require an internal power source and can be read from a distance using RFID readers. When a product passes through a supply chain checkpoint, the RFID reader captures the tag ID and time-stamp information. This data acquisition process eliminates manual data entry and reduces operational errors. The use of RFID enables non-line-of-sight scanning, allowing multiple items to be scanned simultaneously, thereby improving efficiency and scalability in large supply chain environments [5].

2.3. Processing and Communication Layer

The processing layer consists of a microcontroller unit such as Arduino or ESP32, which interfaces with the RFID reader. The microcontroller processes the scanned RFID data, formats it into a structured transaction, and forwards it to the blockchain network. For communication, Wi-Fi or Ethernet modules are used to transmit data securely to the middleware layer. The middleware acts as an interface between the physical hardware and the blockchain network. It performs preliminary validation, data filtering, and authentication before invoking smart contracts. This layered approach reduces blockchain overhead and enhances system performance [6].

2.4. Blockchain Network and Smart Contracts

A permissioned blockchain platform, such as Ethereum or Hyperledger Fabric, is employed to store supply chain events securely. Permissioned blockchains are preferred due to their controlled access, higher throughput, and suitability for enterprise-level applications.

Smart contracts are developed using Solidity and deployed on the blockchain network. These smart contracts define rules for transaction validation, access control, and event recording. Each RFID scan generates a blockchain transaction that includes the product ID, location, time-stamp, and supply chain stage. Once validated, the transaction is permanently recorded in the blockchain ledger, ensuring immutability and non-repudiation [4], [7].

2.5. Data Flow and Transaction Lifecycle

The complete transaction lifecycle of the proposed system is as follows:

- An RFID reader scans a tagged product at a supply chain checkpoint.
- The microcontroller processes and forwards the data to the middleware layer.
- The middleware authenticates the request and invokes the smart contract.
- The smart contract validates the transaction and records it on the blockchain.
- Authorized users access traceability data through the application interface.

This workflow ensures real-time, tamper-proof recording of supply chain events and provides end-to-end product visibility.

2.6. System Components and Configuration

Table 1 summarizes the key hardware, software, and blockchain components used in the proposed system.

Table 1 System Components and Operational Parameters

Component	Specification	Description
RFID Tag	Passive UHF	Stores Unique Product Identification
RFID Reader	UHF Reader Module	Reads Tag data at checkpoints
Microcontroller	Arduino/ESP 32	Processes RFID Data
Communication	Wifi/Ethernet	Transfer Data to Blockchain
Blockchain Platform	Ethereum / Hyperledger	Secure distributed ledger
Smart Contract	Solidity-based	Validates and records Transaction
Middleware	Node.js/REST API	Interfaces hardware with blockchain

3. Results and Discussion

This section presents the results obtained from the implementation of the Blockchain-Based Supply

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Chain Tracking System using RFID and discusses its performance in terms of transparency, security, and traceability. The system was evaluated by tracking products across multiple supply chain checkpoints, including manufacturing, storage, and distribution stages.

3.1. Results

The proposed **Blockchain-Based Supply Chain Tracking System using RFID** was implemented and evaluated across multiple supply chain stages, including manufacturing, warehousing, and distribution. Passive UHF RFID tags were attached to products, and RFID readers captured real-time identification data at predefined checkpoints. Each RFID scan generated a blockchain transaction containing the product identifier, location, timestamp, and supply chain status. The results demonstrate successful **end-to-end traceability**, with all transactions securely recorded in the blockchain ledger. Authorized stakeholders were able to retrieve the complete movement history of products in chronological order. The system ensured high data integrity, as once transactions were recorded, they could not be altered or deleted. Smart contracts enforced validation rules and access permissions, preventing unauthorized data submission. The integration of RFID technology reduced manual data entry and operational errors, improving the accuracy and reliability of supply chain records. The use of a permissioned blockchain enabled consistent performance with manageable transaction latency.

3.2. Discussion

The results indicate that integrating RFID with blockchain significantly enhances transparency, trust, and traceability in supply chain operations. Unlike traditional centralized systems, the proposed approach eliminates single points of failure and ensures tamper-proof data storage through blockchain immutability. The use of smart contracts automates verification processes and reduces dependency on intermediaries. Although blockchain-based systems introduce slight transaction latency due to consensus mechanisms, this trade-off is acceptable for supply chain applications where data reliability and regulatory compliance are critical. The findings align with recent studies highlighting blockchain's effectiveness in improving secure traceability and sustainability in modern supply chains [4], [6], [7]. Overall, the proposed system provides a scalable and reliable solution for logistics, agri-food, and pharmaceutical supply chains (Table 2). Future enhancements may focus on optimizing transaction throughput, integrating off-chain storage, and applying advanced analytics to support predictive and intelligent supply chain management (Figure 2).

Table 2 Risk Reduction Across Supply Chain Stages

Stages	Traditional System	Blockchain-RFID System
Manufacturer	40%	5%
Warehouse	45%	6%
Distributer	42%	5%
Retailer	38%	4%

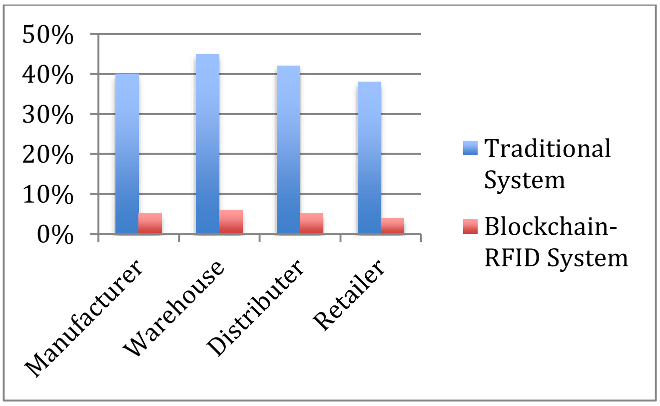

Figure 2 Supply Chain Technology Performance Analysis

Conclusion

This paper presented a Blockchain-Based Supply Chain Tracking System using RFID to enhance transparency, security, and traceability in modern supply chain operations. By integrating RFID-based real-time data acquisition with a decentralized and immutable blockchain ledger, the proposed system ensures tamper-proof recording of supply chain events and reliable end-to-end product traceability.

The experimental results demonstrate improved data integrity, reduced manual errors, and increased stakeholder trust compared to conventional centralized tracking systems. Smart contracts enable automated validation and secure access control, making the system suitable for applications such as logistics, agri-food, and pharmaceutical supply chains. Future work may focus on improving transaction efficiency, incorporating off-chain storage, and integrating data analytics for intelligent supply chain decision-making.

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References

[1]. M. E. Latino et al., "Agriculture 4.0 as an enabler of sustainable agri-food systems," IEEE TEM, 2023.
[2]. A. Corallo et al., "Digital technologies for sustainable supply chains," IEEE TEM, 2024.
[3]. World Economic Forum, "Global Supply Chain Risk Report," 2024.
[4]. S. Casino et al., "Blockchain-based traceability," IEEE Access, 2023.
[5]. K. Leng et al., "RFID and blockchain integration," Computers & Industrial Engineering, 2024.
[6]. R. K. Kasera et al., "Blockchain for smart logistics," Elsevier, 2024.
[7]. M. E. Latino et al., "Blockchain adoption in supply chains," IEEE TEM, 2025.