Blockchain for Transparent and Secure Agri-Food Traceability System

Shital A. Kanale
Student, Department Computer Science and Engineering (Data Science), D Y Patil Agriculture and Technical University, Talsande, Maharashtra, India

Rajwardhan S. Todkar
Assistant Professor, Department Computer Science and Engineering, D Y Patil Agriculture and Technical University, Talsande, Maharashtra, India

Dr. Jaydeep B. Patil
Associate Professor (Associate Dean), Department Computer Science and Engineering, D Y Patil Agriculture and Technical University, Talsande, Maharashtra, India

Dr. Sangram T. Patil
Dean, School of Engineering and Technology, D Y Patil Agriculture and Technical University, Talsande, Maharashtra, India

Abstract

In the agri-food industry, traceability plays a vital role in ensuring food safety, quality control, and transparency throughout the supply chain. Traditional traceability systems often face issues like data manipulation, lack of real-time visibility, and inefficiencies in tracking the origin and movement of goods. To overcome these challenges, this project proposes the integration of blockchain technology into agri-food traceability systems. Blockchain offers a decentralized, tamper-proof ledger that records every transaction or event in the supply chain securely and transparently. The proposed system utilizes smart contracts and distributed ledger technology (DLT) to enable trusted interactions among farmers, processors, distributors, retailers, and consumers. Each stakeholder in the agri-food value chain logs data — such as production methods, storage conditions, and transportation — on a blockchain network. This ensures immutable records and enables real-time access to historical and current data. Furthermore, the system aims to reduce fraud, enhance recall efficiency during food contamination incidents, and build consumer trust by offering end-to-end visibility of the food lifecycle. The decentralized architecture also helps eliminate the reliance on centralized intermediaries, thereby reducing operational costs and improving data integrity. By integrating IoT devices, the system can also automate data capture for temperature, humidity, and other critical parameters, enhancing the reliability of input data. This project not only boosts accountability but also empowers consumers with the ability to verify product authenticity and quality before purchase. The transparency enabled by blockchain promotes sustainability, traceable sourcing, and regulatory compliance across the supply chain. Overall, this system represents a significant step toward digitizing and securing agri-food logistics for a safer, smarter, and more efficient future.

Keywords

Blockchain, Agri-Food, Supply Chain, Traceability, Smart Contracts, Food Safety, IoT Integration, Decentralized Ledger, Transparency, Tamper-Proof Records, Food Authenticity, Logistics Optimization.