AgriChain: Blockchain-IoT Based Smart Farm Supply Chain System

Aditya Ashok
Toc H Institute of Science & Technology (TIST), Kochi, Kerala, India

Afsal S
Toc H Institute of Science & Technology (TIST), Kochi, Kerala, India

Alan V J
Toc H Institute of Science & Technology (TIST), Kochi, Kerala, India

Alfin TR D Silva
Toc H Institute of Science & Technology (TIST), Kochi, Kerala, India

Alvin Sabu
Toc H Institute of Science & Technology (TIST), Kochi, Kerala, India

Abstract

Agricultural supply chains today face major challenges such as data tampering, lack of transparency, loss of trust, and poor traceability. These issues mainly arise from traditional centralized systems that fail to ensure data immutability and proper ownership tracking, often resulting in product fraud, reduced product quality, and inefficient logistics. To address these problems, this paper proposes **AgriChain**, a decentralized agricultural supply chain framework that integrates Internet of Things (IoT) sensors, decentralized storage, blockchain-based smart contracts, and cryptographic verification mechanisms.

In the AgriChain framework, IoT sensors collect real-time environmental and crop data at different stages of the supply chain. This data is secured using cryptographic hashes and Merkle trees to ensure integrity and detect tampering. The data is stored on IPFS using Pinata, while immutable metadata such as the Content Identifier (CID) and Merkle root are recorded on the Ethereum Sepolia blockchain. Smart contracts manage ownership transfers and state transitions through an atomic `transferAndUpdateState` function, ensuring consistency across stakeholders. Additionally, a React-based frontend provides real-time monitoring, supply chain visualization, and QR code-based product verification for consumers. The implementation demonstrates secure traceability, tamper-proof storage, and efficient ownership transfer, making AgriChain a scalable and reliable solution for modern agricultural supply chains.

Keywords

Blockchain, IoT, AI/ML, Predictive Analysis, Pest Detection, Data Security, Supply Chain Transparency, Crop Yield Forecasting, IPFS.