

A Review on Traceability System for Fruit and Vegetables Agricultural Products Using Blockchain

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Abstract: *This paper presents a blockchain-based traceability system designed to enhance the transparency and efficiency of the agricultural supply chain for fruits and vegetables. By leveraging blockchain technology, the system enables real-time tracking of products from farm to consumer, ensuring data integrity and reducing the risk of food fraud. Each transaction is recorded on a decentralized ledger, allowing stakeholders—farmers, distributors, retailers, and consumers—to access accurate information regarding product origins, handling processes, and quality metrics. This traceability system not only fosters consumer trust but also assists in compliance with regulatory standards and enhances food safety by enabling quick identification of contamination sources. The implementation of this solution can significantly improve supply chain management, reduce losses, and promote sustainable agricultural practices, ultimately benefiting both producers and consumers*

Keywords: Blockchain Based System, Smart Contract, Trusted Supply Chain, Traceability, Transparency, Quality Control

I. INTRODUCTION

In recent years, the global food industry has witnessed a growing demand for transparency, safety, and sustainability throughout the supply chain. Fruits and vegetables, being essential components of a healthy diet, are subject to increasing scrutiny regarding their origin, production practices, and handling processes. The need to address food safety concerns, mitigate risks associated with contamination or adulteration, and meet regulatory requirements has prompted the exploration of innovative technologies to enhance traceability in the agricultural sector. Among these technologies, blockchain has emerged as a promising solution due to its inherent characteristics of decentralization, transparency, immutability, and security.

A blockchain-based traceability system offers a transformative solution to these challenges. By leveraging the immutable and decentralized nature of blockchain technology, this system can provide real-time tracking of agricultural products throughout their lifecycle. From seed planting and harvesting to packaging, transportation, and retail, every step can be recorded and verified, creating a comprehensive digital ledger. This introduction sets the stage for a comprehensive examination of the application of blockchain technology in enabling traceability for fruits and vegetable agricultural products. It outlines the significance of traceability in ensuring food safety and quality, highlights the challenges faced by the current supply chain systems, and introduces blockchain as a transformative tool for enhancing transparency and accountability in the agricultural industry. Through an exploration of relevant concepts, principles, and emerging trends, this report aims to elucidate the potential benefits and implications of adopting blockchain-based traceability solutions, thereby contributing to the advancement of food safety and consumer confidence in the global agricultural market.

II. LITERATURE SURVEY

Sr. No.	Name of the Paper	Publisher	Authors	Year	Description
1	A Trusted Blockchain Based Traceability System for Fruit and Vegetable Agricultural Products	IEEE Access	Xinting Yang Mengqi Li, Huajing Yu	2021	Traditional traceability system has problems of centralized management, opaque information, untrustworthy data, and easy generation of information islands. To solve the above problems, this paper designs a traceability system based on blockchain technology for storage and query of product information in supply chain of agricultural products.
2	A Trusted Blockchain Based Traceability System for Fruits and Vegetable Agricultural Products	IEEE Access	Ms. Suchithra, R. Subha, K Raja Vignesh, E Keerthivasan	2022	Blockchain is an arising computerized innovation permitting universal monetary exchanges among disseminated untrusted parties, without the need of middle people like banks. This article analyses the effect of blockchain innovation in agribusiness and food production network, presents existing continuous tasks and drives, and examines generally suggestions, difficulties and potential.
3	Blockchain in Indian Agriculture to Disrupt the Food Supply Chain	IEEE Access	Gyan Prakash Singh, Virat Singh Tomer	2023	The Supply chain was always a complex task to manage the integrity, accountability, traceability, and quality of the products. The food supply chain is more important than any other supply chain. India is the second largest producer of fruits and vegetables in the world succeeding China. Although having a low level of processing, the quality of the final produced goods is not properly matched.
4	Traceability System for Fruit and Vegetable Agricultural Products Using Blockchain	International Journal for Multidisciplinary Research (IJFMR)	Prof. Amreen Anjum, Tuba Nazish Maniyar, Reba Maheen	2024	This study explores the implementation of traceability systems utilizing blockchain technology in the agricultural sector, specifically focusing on fruits and vegetable products. Traceability is crucial for ensuring food safety, quality control, and supply chain transparency.

III. PROPOSED SYSTEM

This system divides the traceability of agricultural products into the links of production, processing, logistics, and sales. The production link involves planting, transplanting, watering, fertilizing and picking operations of fruits and vegetables agricultural products, and records key information such as seedling information, planting process information, environmental information, and product transaction information. The processing link includes classifying, weighing, packaging, pasting two-dimensional code and other operations for the picked fruits and vegetables, and recording the product information, processing process, processing environment, product transaction and other key information. The main components or technologies to implement the system are as below

Blockchain:

Blockchain is a decentralized digital ledger technology that securely records transactions across multiple computers. It enables data to be stored in "blocks" that are linked together in a chronological "chain." Each block contains a list of transactions, a timestamp, and a cryptographic hash of the previous block, ensuring the integrity and immutability of the data.

A blockchain traceability system leverages blockchain technology to track and verify the movement and authenticity of products throughout the supply chain. It tracks the journey of fruits and vegetables from farm to consumer, recording every transaction and movement on the blockchain.

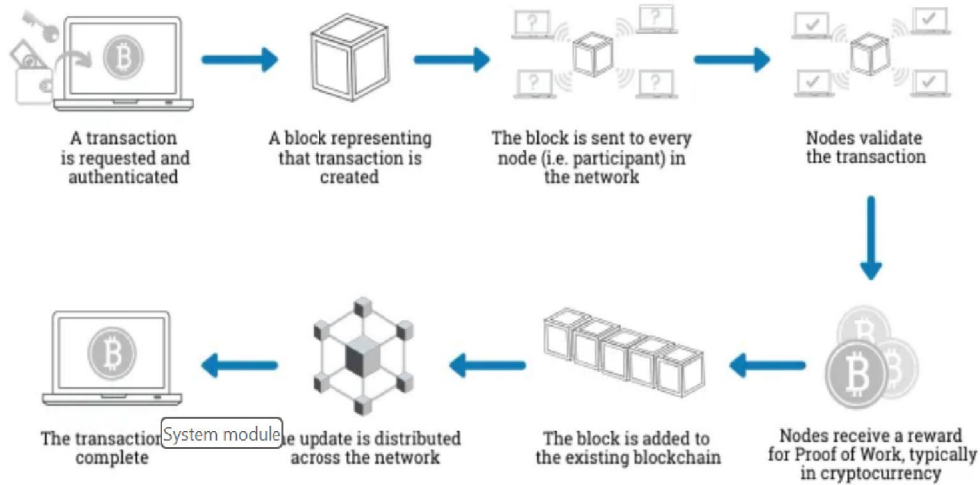


Fig. Blockchain transaction

Smart Contract:

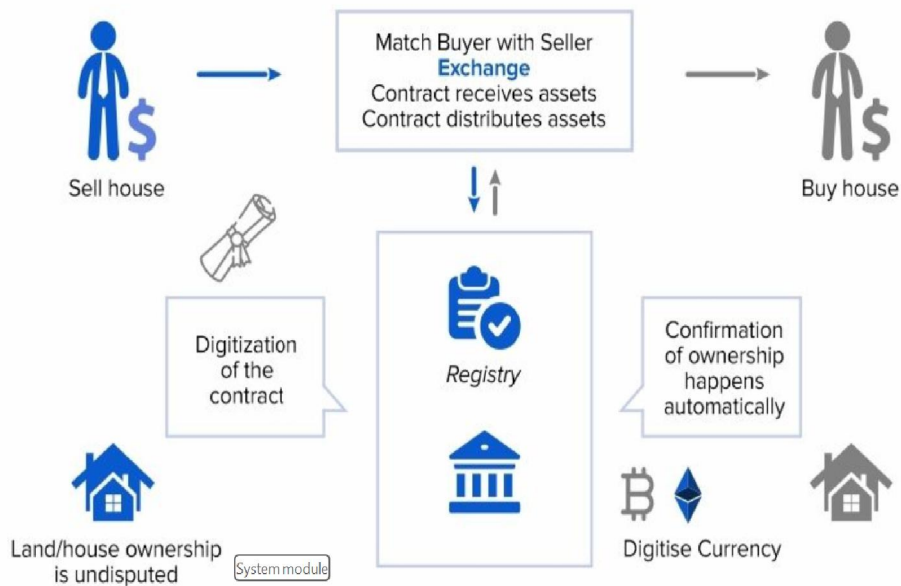


Fig. Smart Contracts

A smart contract is a self-executing contract with the terms of the agreement directly written into code. It runs on a blockchain, which allows it to be decentralized, secure, and tamper-proof. Smart contracts automate and enforce the performance of contractual obligations without the need for intermediaries. The contract's code and transactions are visible to all participants on the blockchain, promoting trust and accountability. Smart contracts are secured by cryptography and the blockchain's immutability, making them resistant to tampering and fraud. By eliminating intermediaries and reducing paperwork, smart contracts can speed up transactions and lower costs.

QR Code:

A QR code (Quick Response code) is a two-dimensional barcode that can be scanned using a smartphone or a QR code reader. It consists of black squares arranged on a white grid and can store various types of information, such as URLs, text, contact details, or product information.

Consumer can scan QR codes and access real-time information about product origin, quality, and handling history.

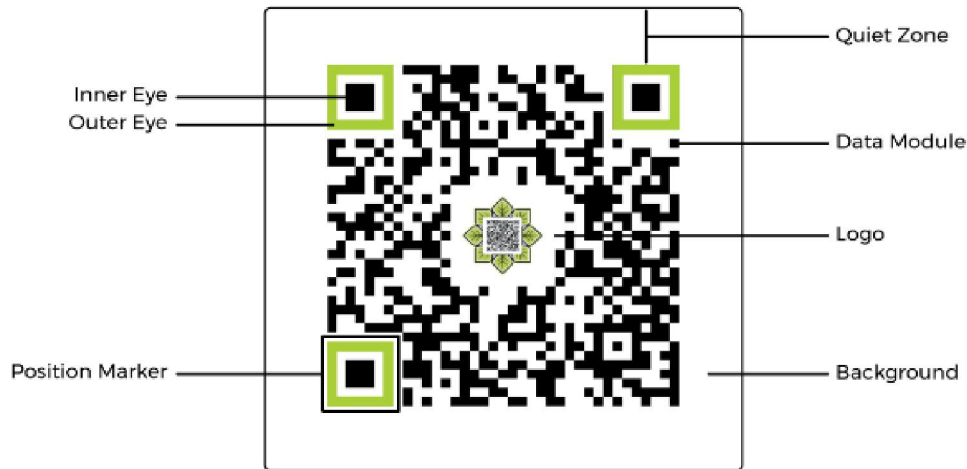


Fig. QR Code parts

System Architecture

User Access: Farmers and stakeholders log in or register to use the system.

Data Entry:

- **Farmers:** Input agricultural product data, which is hashed and stored in a public database.
- **Stakeholders:** Enter sensitive data (like transport or quality details), which is encrypted and stored on the blockchain.

Data Storage:

- **Public Data:** Hashed and accessible for transparency.
- **Private Data:** Encrypted and secured on the blockchain to ensure privacy and tamper-resistance.

QR Code Generation: The system generates a QR code linked to the product's traceability information.

Consumer Interaction: Consumers scan the QR code to view the product's history and decide whether to purchase it. This architecture ensures secure, transparent, and traceable product information using blockchain and traditional databases.

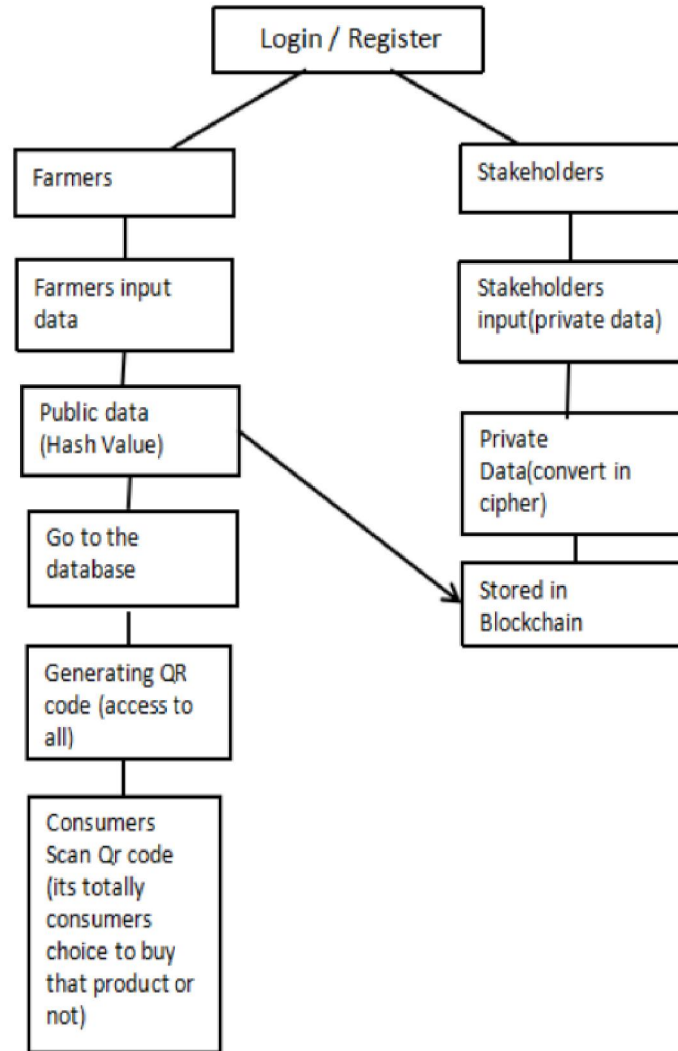


Fig. System Architecture

IV. SYSTEM REQUIREMENT

Software Requirement:

- **Technology:** Java, Python
- **Database:** MySQL, SQLite
- **Blockchain Platforms:** Ethereum, Hyperledger
- **Smart Contract Tools:** Solidity, Chaincode
- **Data Collection:** Microsoft Excel, Google Forms

Hardware Requirement:

- **Processor:** Intel 5 Processor or more
- **RAM:** 4GB or more
- **Internal Storage:** 256GB or more
- **Operating System:** Android 7.0 or higher

V. SCOPE

- **End-to-End Traceability:** Track fruits and vegetables from farm to consumer using blockchain for secure and transparent data.
- **Data Security:** Ensure tamper-proof, immutable records of all transactions across the supply chain.
- **Smart Contracts:** Automate key processes like payments and compliance checks through blockchain-based smart contracts.
- **Regulatory Compliance:** Help businesses meet food safety regulations with accurate, unchangeable data.
- **Consumer Transparency:** Provide consumers with verified product information, building trust in food quality and origin.

VI. CONCLUSION

Agricultural chain improves traceability and transparency in the supply chain. The System provides secure, immutable records from farmer to consumer. Blockchain addresses the food safety, quality assurance and trust issues by using smart contracts. Smart contracts automate processes and ensure compliance. The system promotes a safer, more efficient and sustainable food supply chain.

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