**Blockchain-Based Supply Chain System for Fresh Produce with QR Code Traceability**

**Project Title:**

Blockchain-Based Supply Chain System for Fresh Produce with QR Code Traceability

**Introduction**

The agricultural supply chain faces numerous challenges, including lack of transparency, inconsistent quality grading, and disputes between farmers and manufacturers. This project proposes a **Blockchain-Based Supply Chain System** that ensures **transparent produce traceability** from farm to consumer by recording verified product information on the blockchain.

**Problem Statement**

The current supply chain systems in Kenya and globally suffer from:

* Lack of transparency in produce sourcing
* Inconsistent product quality checks
* Disputes caused by different packaging standards
* Unfair pricing models for small-scale farmers
* Inability to trace the origin of produce

**Objectives**

1. Develop a blockchain-based system to provide **transparent produce traceability**.
2. Ensure all product quality information is **verified and immutable** on the blockchain.
3. Provide **QR code-based traceability** for consumers to verify product origin and quality.
4. Simplify the application to focus primarily on blockchain without IoT sensors.
5. Use **minimal AI** to generate a **summary of product information**.

**System Architecture**

**Key Components:**

1. **Blockchain Platform:** Hyperledger Fabric (preferred) or Ethereum for tamper-proof transaction records.
2. **Web & Mobile Application:** Interface for farmers, collection agencies, manufacturers, and consumers.
3. **QR Code Generator:** For produce traceability at packaging points.
4. **AI Module (Minimal):** Briefly summarizes product information for consumers.

**Functional Requirements**

| **Function** | **Description** |
| --- | --- |
| Produce Registration | Collection agency registers produce batches on the blockchain |
| Quality Testing | Input verified test results (size, grade, moisture content) at collection points |
| Blockchain Tracking | Store all product information and transactions on blockchain |
| QR Code Generation | Generate unique QR codes for each produce batch |
| QR Code Scanning | Consumers can scan the QR code to view produce information |
| AI Product Summary | Generate short product descriptions based on blockchain data |

**Non-Functional Requirements**

| **Requirement** | **Description** |
| --- | --- |
| Performance | The system must process produce registration and QR code generation within 5 seconds. |
| Security | Blockchain data should be encrypted and accessible only to authorized users. |
| Usability | The mobile app should have an intuitive user interface for agencies and consumers. |
| Scalability | The system must support up to 500 produce batches simultaneously. |
| Availability | The system should have 99% uptime. |

**System Flow**

1. **Farmer Brings Produce to Collection Point** ➡ 2. **Agency Performs Tests** ➡ 3. **Blockchain Registration** ➡ 4. **QR Code Generation** ➡ 5. **Distributor Receives Produce** ➡ 6. **Retailer Packaging** ➡ 7. **Consumer QR Code Verification**

**Technologies Used**

| **Technology** | **Purpose** |
| --- | --- |
| Hyperledger Fabric | Blockchain ledger |
| React Native | Mobile app development |
| QR Code API | Produce traceability |
| TensorFlow | AI product summary (Minimal Use) |
| AWS EC2 | Hosting backend API |

**Pricing Model**

| **User Type** | **Pricing Model** | **Cost Estimate** |
| --- | --- | --- |
| Small Farmers | Free Registration | $0 |
| Distributors | Pay-Per-Use | $0.05 per shipment |
| Retailers | Enterprise SaaS | $300/month |

**System Diagrams**

**Entity Relationship Diagram (ERD)**

The ERD represents how produce batches, quality test results, users, and blockchain records are related. It includes:

* Farmers
* Produce Batches
* Quality Test Results
* Blockchain Records
* QR Codes
* Distributors
* Consumers

**Use Case Diagram**

This diagram illustrates the interactions between system actors:

* Agency registers produce
* Blockchain stores transaction
* QR Code is generated
* Consumer scans QR Code

**System Sequence Diagram**

Describes the sequential flow of the system from produce registration to consumer verification:

1. Agency performs tests and inputs data.
2. Blockchain records product data.
3. QR code is generated.
4. Consumer scans QR code.
5. System displays product information summary.

**Gantt Chart (Project Timeline)**

| **Task** | **Start Date** | **End Date** | **Duration** |
| --- | --- | --- | --- |
| Requirements Gathering | Week 1 | Week 2 | 2 Weeks |
| System Design | Week 2 | Week 3 | 1 Week |
| Blockchain Implementation | Week 3 | Week 5 | 3 Weeks |
| Web & Mobile Application Dev | Week 4 | Week 7 | 4 Weeks |
| QR Code Generator Integration | Week 5 | Week 7 | 3 Weeks |
| Testing & Debugging | Week 7 | Week 8 | 2 Weeks |
| Documentation | Week 8 | Week 8 | 1 Week |

**GitHub Wiki Structure**

**Home**

Overview of the project, team members, and objectives.

**System Architecture**

Detailed explanation of the system components and technologies used.

**Requirements Specification**

List of functional and non-functional requirements.

**Diagrams**

ERD, Use Case, and System Sequence diagrams with explanations.

**Technology Stack**

Detailed list of software and hardware technologies.

**API Documentation**

Description of backend API endpoints.

**Development Process**

Breakdown of the Gantt chart timeline and project milestones.

**Testing & Deployment**

Guidelines for testing the MVP and steps to deploy the application.

**User Manual**

Step-by-step guide for agencies and consumers on using the system.

**Conclusion**

This project presents an innovative solution to the challenges of fresh produce supply chains by combining **blockchain transparency and QR code traceability**. The system ensures **fair pricing for farmers, consistent quality verification, and enhanced consumer trust** through immutable blockchain records. With further development, this platform can significantly improve the efficiency and transparency of food supply chains in Kenya and beyond.