SOFTWARE DESIGN DOCUMENT

ORGANIC FOOD TRACEABILITY SYSTEM USING BLOCKCHAIN

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DEVNEST

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1. Overview of Software Requirements

1.1 Summary

Transparent, impenetrable tracking of organic food products from farm to consumer is made possible by the Organic Food Traceability System Using Blockchain, a comprehensive web and mobile platform. The technology allows farmers, processors, certifiers, distributors, retailers, and consumers to confirm the authenticity of products and their adherence to organic standards by logging all significant supply chain events on a secure blockchain. In order to maintain trust and transparency in the organic food market, users can scan QR codes to obtain comprehensive product journey information, certificates, and handling details.

1.2 Objective

The creation of a strong, open, and safe traceability platform for organic food supply chains is the main goal of this project. This comprises:

Ensuring Product Authenticity

Providing immutable records of organic certification and supply chain events to prevent fraud and mislabeling.

Enabling Consumer Trust

Allowing consumers to verify product origin, handling, and certification through simple QR code scanning.

Streamlining Regulatory Compliance

Automating documentation and audit trails for food safety authorities and organic certification bodies.

Supporting Supply Chain Efficiency

Reducing paperwork, errors, and time delays through digitized, real-time event logging.

1.3 UN-SDGs

Goal 2: Zero Hunger

In addition to promoting sustainable agriculture and lowering food fraud that jeopardizes consumer confidence, the platform guarantees food safety and genuine organic labeling.

Goal 9: Industry, Innovation, and Infrastructure

The platform fosters technological progress and builds robust supply chain infrastructure by integrating blockchain technology into food and agriculture systems.

Goal 12: Responsible Consumption and Production

Through verified transparency, the system supports sustainable production practices and gives consumers the power to make informed decisions about organic products.

1.4 Purpose

Ensure Complete Traceability

to use immutable, cryptographically secured records to track organic food products through the entire supply chain.

Turn on Real-Time Verification

to enable real-time QR code scanning for consumers, merchants, and regulators to confirm the authenticity and certification of products.

Automate Compliance

to expedite the FSSAI, APEDA, and international organic standards regulatory documentation and auditing procedures.

Establish Trust

to restore consumer trust in organic labeling by providing clear, impenetrable supply chain visibility.

1.5 Scope

The goal of this project is to create a thorough blockchain-based traceability platform with the following essential features:

- Multi-Role Access System: Role-based user interfaces for distributors, retailers, farmers, processors, certifiers, administrators, and customers.
- All important supply chain events, such as harvest, certification, processing, transfer, and sale, are permanently recorded by blockchain event logging.
- Certificate Management: Organic certifications can be securely uploaded, validated, and linked to product batches.
- QR Code Generation & Scanning: Every product batch has a unique QR code that allows for immediate customer verification.
- Regulatory Dashboard: Administrative interfaces for system supervision, audit trail creation, and compliance monitoring.

2. System Overview

2.1 Architecture Description

The system uses a multi-tier architecture that includes layers for data storage, blockchain, business logic, and presentation. React.js for web applications and Flutter for mobile are used in the frontend development process to create user interfaces that are responsive and easy to use for various stakeholder roles. The backend, which was created using Node.js, manages APIs, user authentication, and business logic. Hyperledger Fabric is used by the blockchain layer to securely and permissionedly record supply chain events. User profiles and cached data for better performance are examples of non-essential data stored in traditional databases (MongoDB).

2.2 High-Level Functionality

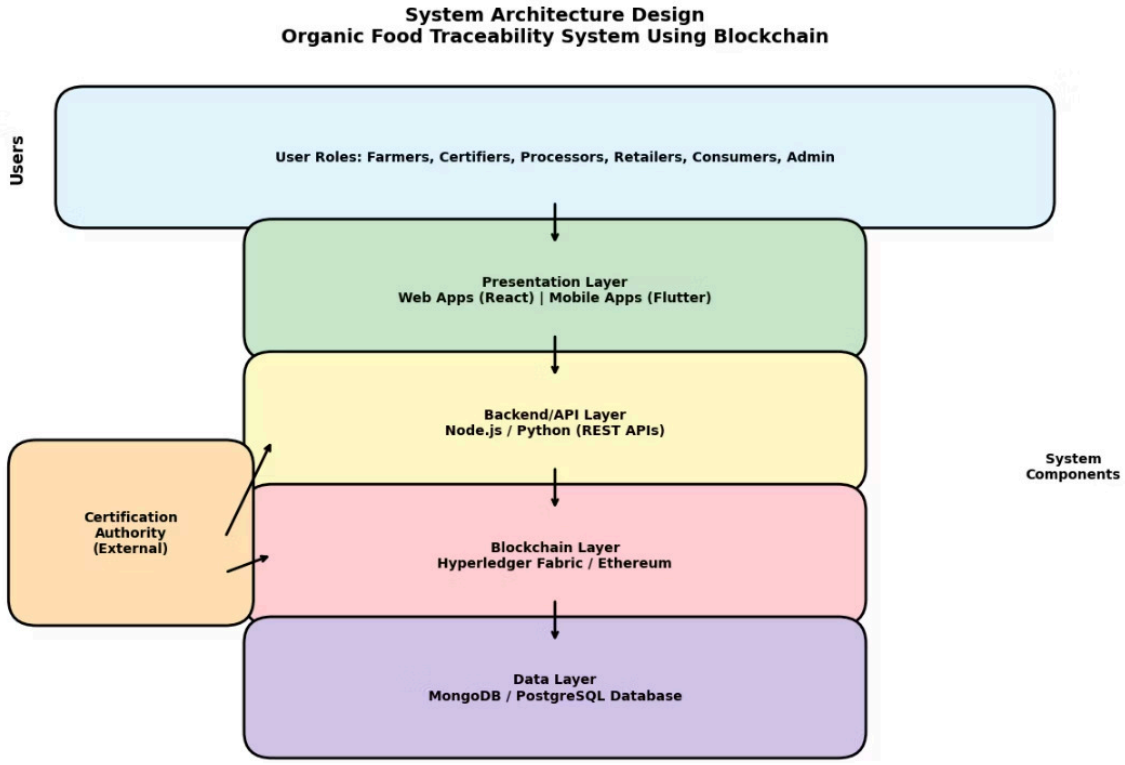
- **User Registration & Authentication**
- **Product Batch Creation & Management**
- **Blockchain Event Recording**
- **Certificate Upload & Validation**
- **QR Code Generation & Scanning**
- **Consumer Verification Interface**
- **Regulatory Compliance Reporting**
- **Supply Chain Analytics**

2.3 Technology Stack

- **Frontend:** React.js, HTML5, CSS3, JavaScript (Web), Flutter (Mobile)
- **Backend:** Node.js, Express.js, RESTful APIs
- **Blockchain:** Hyperledger Fabric
- **Database:** MongoDB, Redis (Caching)
- **QR Code:** qrcode.js, ZXing libraries
- **Tools:** Docker, Git, VS Code, Postman

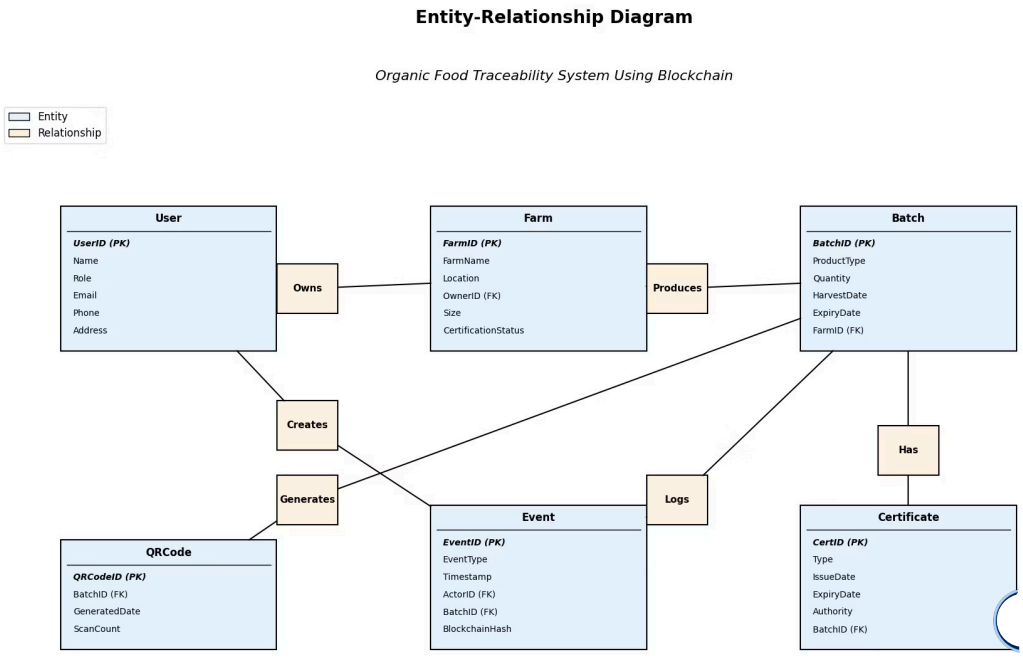
3. System Architecture Design

3.1 Architecture Design

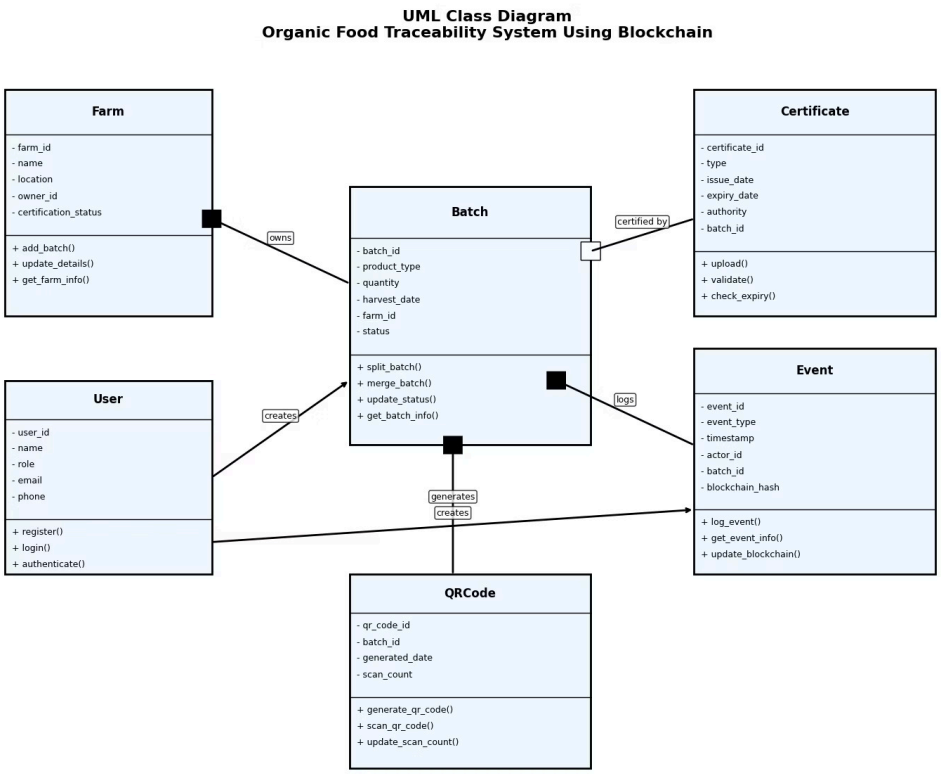


4. Detailed Design

4.1 ER Diagram

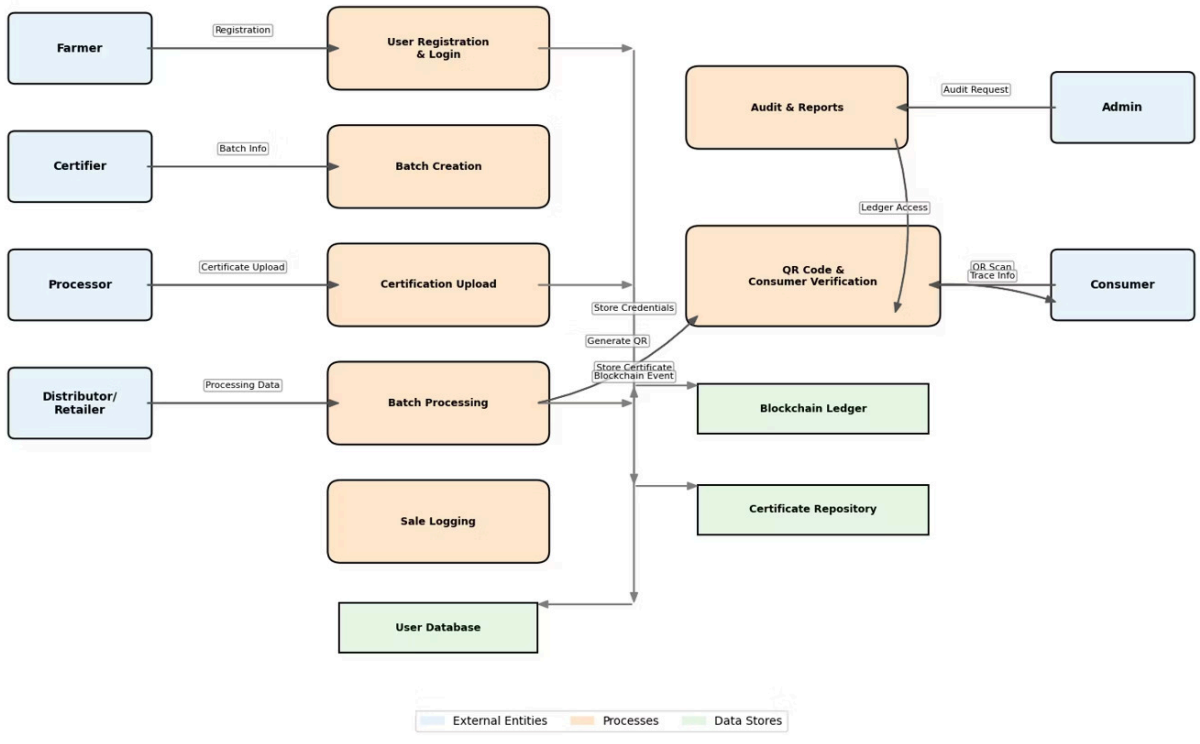


4.2 UML Diagram

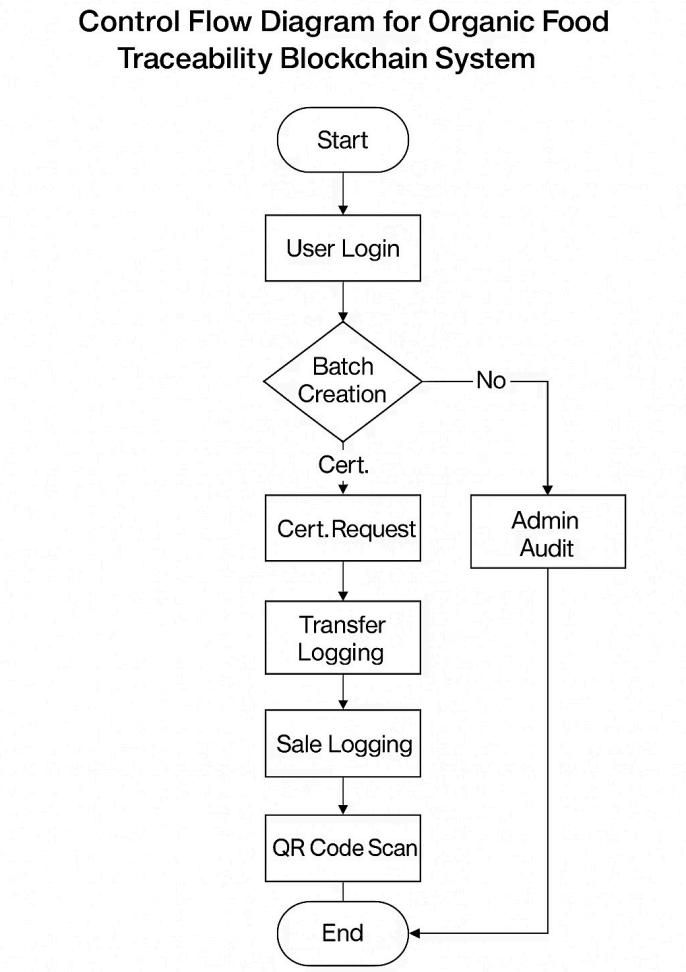


5. Data Flow and Control Flow

5.1 Data Flow Diagram



5.2 Control Flow Diagram



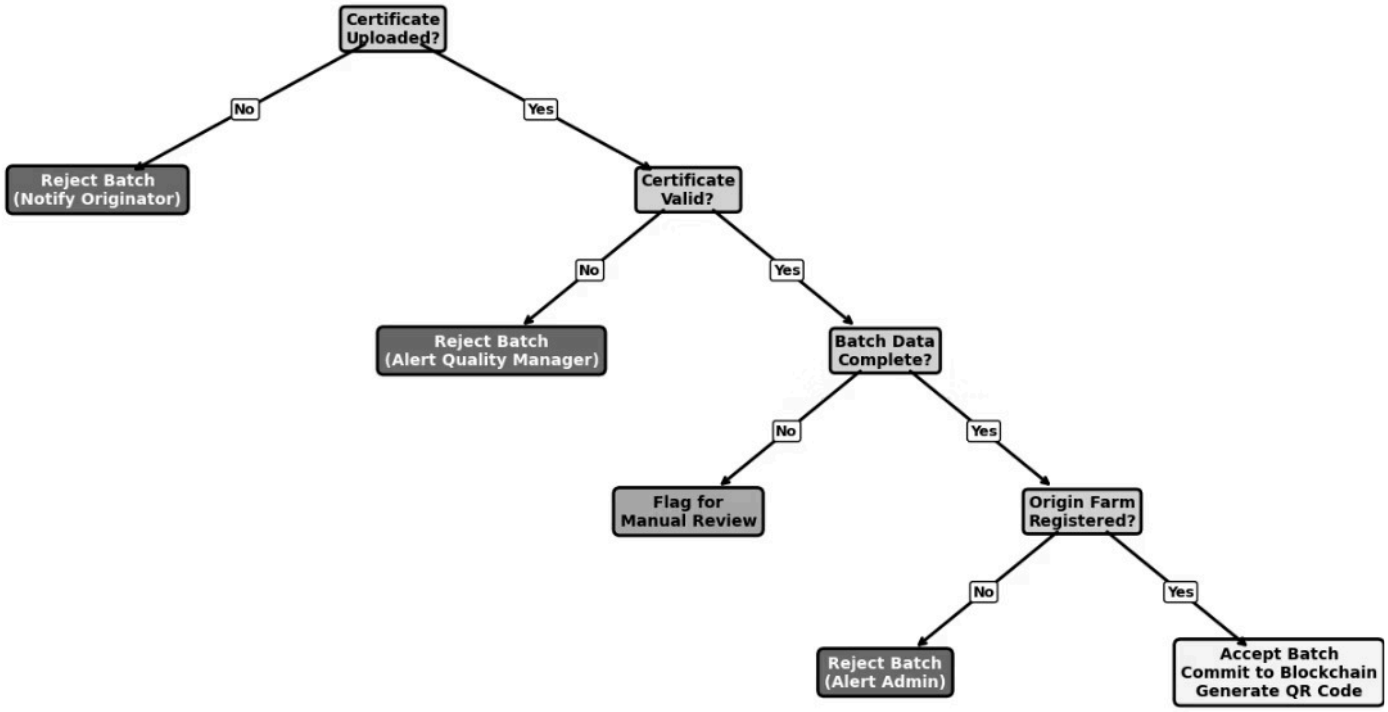
6. Cohesion and Coupling Analysis

Cohesion: The Organic Food Traceability System maintains high functional cohesion where each module performs a single, well-defined task. The User Management module handles only authentication and role-based access, the Batch Tracking module manages product lifecycle events, the Certification module deals exclusively with certificate validation and storage, and the Blockchain Service handles only ledger operations. This high cohesion ensures modules are easily testable, maintainable, and can be updated independently without affecting other system components.

Coupling: The system demonstrates low coupling through well-defined APIs and service interfaces. The frontend communicates with the backend only through RESTful APIs, the blockchain service is abstracted behind a service layer, and external integrations (certification authorities, payment gateways) are isolated through adapter patterns. This loose coupling enables independent development, testing, and deployment of system components while maintaining flexibility for future enhancements and technology changes.

7. Decision Tree & Decision Table

7.1 Decision Tree



7.2 Decision Table

Conditions	Rule 1	Rule 2	Rule 3	Rule 4	Rule 5
Certificate Uploaded	T	F	T	T	T
Certificate Valid	T	---	F	T	T
Batch Data Complete	T	---	---	F	T
Origin Farm Registered	T	---	---	---	F
Actions					
Accept Batch	✓				
Reject Batch		✓	✓		✓
Flag for Manual Review				✓	
Commit to Blockchain	✓				
Generate QR Code	✓				

Rule Explanations:

- **Rule 1:** All criteria met - batch accepted and recorded on blockchain
- **Rule 2:** No certificate uploaded - immediate rejection
- **Rule 3:** Invalid certificate - batch rejected with quality alert
- **Rule 4:** Incomplete data - flagged for manual review and completion
- **Rule 5:** Unknown farm - rejected with administrative alert

ACKNOWLEDGEMENT

We are grateful to our project mentor, for providing invaluable guidance and technical insights throughout the development of this blockchain-based traceability system. We also thank the certification authorities and organic farmers who provided domain expertise and use case scenarios. Last but not least, we would like to thank our families for their constant support and encouragement.

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