

High Level Design

Food Traceability System Using Blockchain

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Contents

1.	Introduction	4
1.1	What is High-Level Design Document?	5
1.2	Scope	5
2.	General Description	6
2.1	Product Perspective	6
2.2	Problem Statement	6
2.3	Proposed solution	6
2.3	Technical Requirements	6
2.4	Programming	7
2.5	Tools Used	7
3.	Design Details	8
3.1	Process Flow	8
3.2	Event Log	9
3.3	Error Handling	9
3.4	Performance	9
4.	Conclusion	10

Abstract

This project discusses about the application of Blockchain in enhancing the transparency of food supply chain of agricultural products and identify potential source of contamination to efficiently prevent, contain and rectify outbreaks. It also explores the opportunity to minimize food testing expenses and improve profit margins for stakeholders.

1. Introduction

Food traceability is one of the common challenges faced in global agri-food sector. It takes weeks to track the entire lifecycle of food products right from origin of cultivation to end consumer through every point of contact on its journey. For example, a person consuming food product purchased from a retail store would actually do not know the source of farm from where it was procured. Hence, asymmetric information is prevalent in food supply chain leading to compromise on safety of life of consumers. With growing global supply chains, food safety is a top concern with both consumers and regulators. The World Health Organization (WHO) estimates that 420,000 people die annually from food contamination, which affects one in 10 people worldwide. Children under age five are at the highest risk with 125,000 children dying every year from foodborne illness, according to WHO.

Blockchain enhances the ability to quickly pinpoint potential sources of contamination to efficiently prevent, contain or rectify outbreaks. Transparency in terms of blockchain food traceability can validate and authenticate food origin and improve brand credibility. Additional benefits include fraud prevention and the ability to better tackle outbreaks through prevention methods that can help minimize food testing expenses and improve margins.

1.1 What is High-Level Design Document?

The purpose of this High-Level Design (HLD) document is to add the necessary details to the current project description and be used as a reference manual on how modules interact at a high level. Through this document we aim to provide bird's eye view of the architecture and design of the solution that we are providing to for the traceability issues in supply chain network.

The HLD will:

- Describe the constraints and assumptions taken while doing the project
- Present all the design aspects and define them in detail
- Present the process flow
- Describe the performance and reusability of the asset tracker

1.2 Scope

This document seeks to define the high-level functionalities of Food Quality testing and traceability System in as much detail as possible. The document merges knowledge from past meetings, from blockchain lectures, and from IT expertise to formulate a plan for a blockchain enabled supply chain for asset tracking.

There is a list of non-functional attributes:

- Transparency
- Traceability
- Efficiency
- Enable Clear Visibility & Smooth Collaboration
- Sensor Driven Data
- Smart Contracts

2. General Description

2.1 Product Perspective

It was important in food contamination detection to work with an open-source, vendor-neutral blockchain. Since, the food traceability system was meant to be used by many parties, including suppliers and even direct competitors, the technology ecosystem underlying it needed to be open.

2.2 Problem Statement

When an outbreak of a food-borne disease happens, it can take days, if not weeks, to find its source. Better traceability could help save lives by allowing companies to act faster and protect the livelihoods of farmers by only discarding produce from the affected farms.

2.3 Proposed solution

Blockchain technology is a good fit for the decentralized food supply ecosystem. Hyperledger Fabric is a blockchain framework implementation and one of the Hyperledger projects hosted by The Linux Foundation. Intended as a foundation for developing applications or solutions with a modular architecture, Hyperledger Fabric allows components, such as consensus and membership services, to be plug-and play. Hyperledger Fabric leverages container technology to host smart contracts called “chain code” that comprise the application logic of the system.

2.3 Technical Requirements

The document takes into account, how the perishable food items can be traced for their quality check parameters. For this, the simple RFID/QR code technology can be brought into use.

2.4 Programming

Python programming along with its Hashlib module is used as the interface that builds the MD5 algorithm to develop a 128 bit hash value. SHA 256 cryptographic algorithm is used to build blocks in this blockchain that makes use of the Hyperledger.

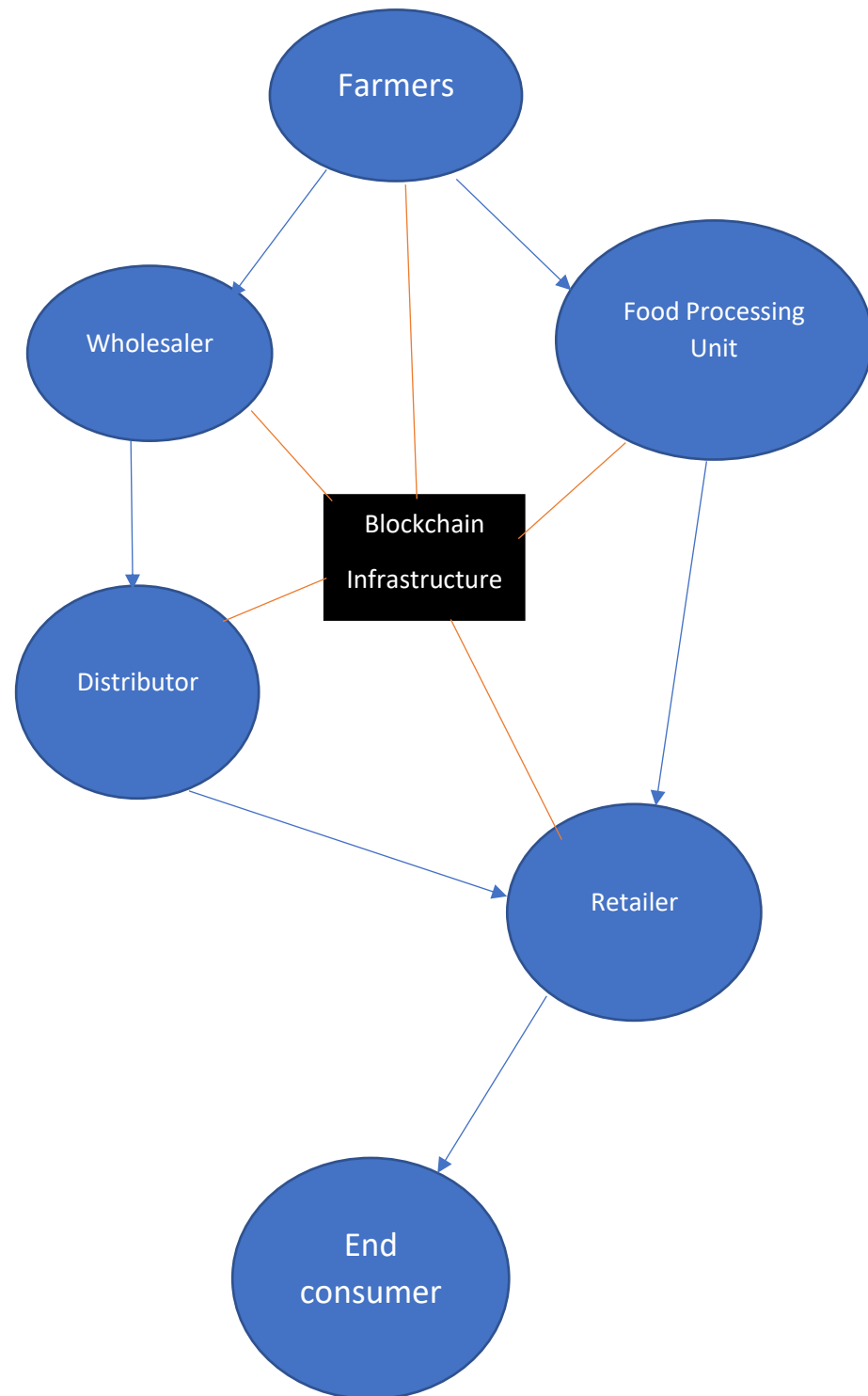
2.5 Tools Used

Tools that were used to create and implement the blockchain were Anaconda Jupyter, Postman, VS Studio. Programming language used was Python with libraries like Streamlit, Jsonify, PyMango etc.



3. Design Details

3.1 Process Flow



3.2 Event Log

Tracking of information like Process the food item is undergoing from Production to processing and distribution and time spent at each stage is necessary to identify the quality of product at retail side. Following information must be captured in blockchain database.

- Food Item ID, Package ID
- IDs of Farm Land, Processing Unit, Interim Storage Unit, Retail Outlet
- Timestamp of Entering and leaving each Unit
- Fertilizer Used
- Date of Harvest
- Chemicals / Methods Used in Processing Unit
- Authenticity Certificate if any

3.3 Error Handling

It is not possible to edit information entered in blockchain. Hence it not possible to correct the errors made by human while entering data. Therefore, a new block has to be created to enter updated information.

It is possible the quality of food that is distributed id reduced due to improper transportation of item. Any damage happening to the skin of item may reduce the life of the item. Real time tracking this attribute in blockchain using appropriate devices requires some additional research and hence it is not included in this project.

3.4 Performance

Identifying the life of a food item not only depends on the tracking the food item but also on transparency in the entire supply chain to know what that product has undergone. The decentralized Hyperledger system of blockchain can help to log the information which can enhance traceability of an item as well as transparency in the entire process.

The information logged in in the blockchain will reduce the time taken to trace the origin and each stages of a product from days to minutes. This also will reduce the time taken to test the quality of the product as the blockchain system logs the information about the process the product has undergone and time spent in each stage. Additionally, as stated in the problem statement regarding safeguarding the suppliers and customers from any outbreak of food related diseases in any locality can be done by isolating the products traced to that particular location and having all other similar products from different location be kept for sales and consumption instead of removing all the products of similar category from stores.

Apart from the stated advantages regarding validating the quality of the item, blockchain can help is identifying the bottlenecks in the supply chain there by providing the stakeholder a picture of where things are getting delayed and rectify things to reduce delays in the supply chain process.

Blockchain cannot be applied to any specific company of region. It has to be applied for entire industry or at least the entire supply chain. Hence it is necessary that all the stakeholders must cooperate to implement this system. For capturing the information that required to blockchain, the maker first embeds a code into it, which is then hashed and posted on the blockchain. By scanning or registering the code, the product movement through the supply chain would be documented on the ledger.

4. Conclusion

Blockchain which is nothing but the decentralized hyper ledger made its position in all industry through its diversified application of storing and securing data and making it available for all stakeholders. Its application in food processing and supply chain is emerging and being tested by industry players for mass adoption. This application helps to build trust between customers and the retailers regarding the quality of the products being sold as customers is provided with the real time data of the product being bought and this was made possible by the traceability and transparency created by the blockchain technology. The application of blockchain in food safety is tend to raise by its increased scope of providing better and quality products to customers at reduced costs.

