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Food Product Traceability Using Block Chain Technology

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Abstract:

Discernibility framework is a framework that can record item developments along the inventory network and follow them back.In the food supply chain, traceability systems are considered important to ensure the safety of a product. There are two models ordinarily utilized in detectability frameworks in particular one-advance forward and one-advance back and accumulated data model architecture. In one-step forward and one-step-back architectures, tracing process takes a long time and does not guarantee the integrity of the data. In aggregated architecture, data is integrated but rely on third parties as data managers. However the system has advantages related to access and precision aspect, because all transaction is verified, immutable, and stored locally in the framework has low execution in exchange dealing with identified with broadness and profundity perspective because of restricted server limit and muddled procedure every node. Block chain is a promising technology for food safety traceability system on account of the qualities, for example, irreversible time vector, savvy contract, accord calculation, and so forth. This paper proposes food safety traceability system based on block chain and EPC information Services (EPCIS), and develops a prototype system. For The board design of on - chain &off-chain information proposed also, through which the recognisability framework can ease the information blast issue of the square chain for Internet of Things (IoT).food safety issues have drawn growing concerns from trace society system is indispensable It is particuentire nourishment inventory network including the procedure of creation, preparing So as to effectively distinguish and forestall sanitation issues and follow the responsibility, constructing a reliableability, discernibility frameworks have issues, for example, information intangibility, altering and touchy data revelation.warehousing, transportation and retail. Conventional basic to precisely record, offer and follow the particular information inside the system.

Keywords: Traceability, Block chain, Food supply chain, EPCIS

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1. INTRODUCTION

The traceability system can be defined as a system that is able to guarantee the movement of products along the supply chain can be tracked and traced. Tracking is the ability to record a product movement and changes from upstream to downstream in a supply chain. Tracing is the ability to ensure The origin of a product or to trace the history of it. The traceability system is considered important in the food supply Chain to minimize the constant increase in food crisis related to information about product safety and quality, reducing the risk of unmonitored product, ensuring compliance with policy requirements, reducing withdrawal costs by providing more

Precise information about products targeted, and increasing public health protection because it is possible to investigate sources of food derived disease. There are two information flow models in electronic based traceability systems that commonly used nowadays, namely one-step-forward and one-step-back models and aggregated information model. In one-step-forward and one-step-back models, some information is stored at each stage or at each supply chain company, while some other information is channelled to the next supply chain stage. The process of accessing the data is done by repeatedly accessing data backwards from one stage to the upstream of the supply chain. In the aggregated information model, product information is stored in one database that integrates all data from each stage of the supply chain. The advantages of one-step-forward and one-step-back models are the ease of implementation and the assured security of data access, because data control is only available in the data owner. However, this architecture has the potential to create missing link between data because the data is managed by different parties. On the other hand, the aggregated information model can guarantee data integrity because the data is managed by one party, but the presence of these third parties raises issues of trust, dependency, and additional costs. Although traceability systems are considered important, solutions in the form of aggregated information or centralized systems have not been widely implemented. In addition to the reluctance to share data, the presence of a traceability system does not directly increase the economic value of product so that many parties are reluctant to spend additional costs and processes. Alternative solutions for achieving system integrity as in a centralized system without constructing a new system that requires a third party is to develop a distributed system, one of the method is block chain based system. Block chain is a distributed ledger technology that runs peer to peer. On a block chain based system, all data is distributed to all nodes incorporated in the network, so that third parties are not required to manage data exclusively as in a centralized system. The block chain also allows each party to have a copy of the data to minimize the risk of data loss.

2. FOOD TRAIL BLOCKCHAIN DESIGN

The design is carried out according to the four abstraction layers of the block chain-based system. Block chain based systems are divided into 4 layers of abstraction: application, data model, execution engine, and consensus. The application layer is a layer that states the main functions of the system on the user's side, for example, crypto currency, asset management, security settlement, etc. Data model is a representation of data structures and operations that run in the system. The data model is then implemented in the smart contract executed on the execution engine. The execution engine acts as the runtime environment of the smart contract created. Examples of execution engines are compilers, virtual machines, Dockers, and others. The consensus layer is the layer that is responsible for communication between nodes on the network so that the block chain data in each node is valid.

Application Layer

The traceability system is part of asset management because the main process in this system is managing (recording and retrieving) changing assets or products and moving along the food supply chain. In general, this application consists of two main processes, namely tracking and tracing.

Data Model Layer

The data structure includes transaction data structures and block data structures. While operations in this system are divided into two as functions designed at the application layer, namely data storage (tracking) and data retrieval (tracing).

This layer consists of data structures and operations. Transaction data to be contained in the block must at least include the following information:

1. Transaction Signer, who makes the transaction

2. Time stamp, the time mark when the transaction is made

3. By default, transaction data consists of: user/signer, unique identifier, quantity, source/ingredients, destination, vessel identifier, transport destination, new identifier for received product.

The block data structure consists of at least:

1. Block signer, validate that inserts blocks into the block chain

2. Nonce, random number that will distinguish each block making process

3. Transaction hash, the hash generated from all transactions in the block

4. Transaction list, list of transactions data in the block

There are four operations handled by this application:

1. Produce, storing new product data, including its relation to the previous product (ingredients)

2. Transport, storing transfer of product ownership

3. Accept, confirmation of the transport operation on the receiving side

4. Trace, retrieving data or tracing a product

Execution Engine

Docker is used as runtime environment to run the Food Trail smart contract, which is the server-side program that handles transactions. At the docker, data and operations sent by client are proceeds. On the client side, Nodes is used as an environment runtime.

3. METHODOLOGIES

Food Safety Traceability System based on block chain and EPCIS consists of enterprise-user server and consumer traceability client. The plan of big business client server depends on the design of EPCIS, which is essentially utilized for the procurement and management of key traceability information of products. While consumers trace the information of the products they purchased mainly through the consumer traceability client.

The enterprise-user server is composed of five modules. Detailed description of their features is as follows:

Traceability Information Capture Module

This module is designed to collect key traceability information brought forth by the process of production, storage, circulation of food. It can work automatically and manually to identify and create detailed event information from the circulation of food in the supply chain.

Event Information Database

This database is mainly used for the preservation and management of all food information from the capture module.

Information Extraction Module

This module is primarily devised for extracting information that needs to be uploaded on block chain from the traceability information database as well as preparing the data for the uploading.

Block chain Module

Block chain module has two functions. One is the data interaction including the upload of key traceability information on block chain, the request of on-chain information and the verification of event information. The other is to provide options for users to be the full block chain node or the light-weight block chain node i.e. to decide whether or not to participate in the maintenance of the block chain.

Interaction Authority Management Module

This module is in charge of the verification of enterprise identity when there is any event information interaction there requester who initiates the request for event information is in this supply chain.

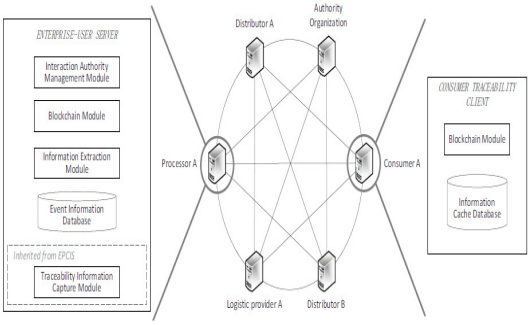


FIGURE 1 The architecture of food traceability system based on Block chain and EPCIS.

The Consumer Traceability Client Is Composed Of Two Modules

Block chain Module

This module is designed for the link between the client and system, through which it can request information on the block chain and verify the legitimacy of the information. A light node is chosen for this module to lower user's maintenance cost.

Information Cache Database

This cache database is built to cache the corresponding food traceability data requested by users.

4. RELATED WORKS

Centralized Traceability System

Centralized or aggregated traceability system is a system that connects all parties throughout the supply chain. In this system all supply chain members are connected to one server and manage the same integrated database. Some characteristics of this type of architecture are:

• The recording and retrieval process possibly done immediately because the data is integrated.

• Supply chain members have to use the same system so that they can be interrelated and must agree on the data standards used.

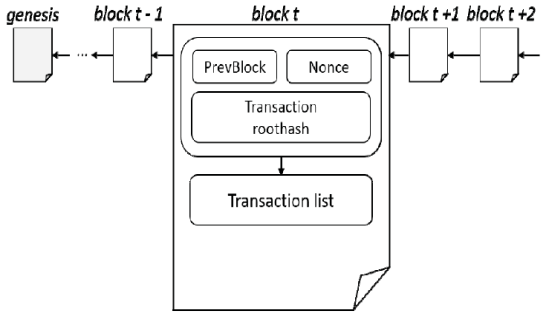
• System users must entrust their data to the same entity and incur additional costs.

• Dependence on third parties as service providers potentially raises trust issues and concerns about sustainability which can lead to setbacks and losses to system user.

• Centralized authentication has the potential to be a single point of failure and a bottleneck of the system.

Block chain Based System

The three main properties of the block chain are distributed, verified, and immutable. Block chain is distributed because the network is fully run by network members, without relying on centralized authority or infrastructure that forms trust. All transactions are recorded in the ledger. Transactions must be shared on the peer to peer block chain network to add to the ledger. All network members keep a copy of the ledger locally. Block chain is verified because all members must sign a transaction when it will be shared to the block chain network using a public private key so that only the owner of the private-key can initiate the transaction. Block chain is immutable so the transactions that submitted to the block chain cannot be changed or manipulated. Transactions on the block chain cannot be changed because it uses an append only scheme. Each block in the block chain is chained back to the previous block. Consensus is the most important part of the block chain. Consensus is a protocol used by the system to make all nodes belonging to the network agrees on the same decision. In addition, consensus must also deal with forking problems, the cases where the chain in the network branches out or has a difference data in one or several nodes. Consensus must be able to determine how to choose a chain that is



considered valid.

Figure 2 Block chain Data Structure

5. FOOD TRAIL BLOCKCHAIN DESIGN

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6. CONCLUSIONS

The evaluation shows that Food Trail Block chain fulfilled the distributed, verified, and immutable aspect. ca the framework has low execution in exchange taking care of identified with expansiveness and profundity viewpoint because of constrained assistance capacity and complicated process. The system has advantages related to access and precision aspect, because all transaction is verified, immutable, and stored locally in every node. The low performance of the block chain system is a trade off from its superiority in terms

of security and trust. One of the aspects that must be improved is the ability to handle transactions. Although it has many weaknesses, the block chain system has the potential to be a system integrity solution in the food supplies chain because the system can be implemented without the need for additional third parties that requires additional costs and dependence on other parties.

7. FUTURE WORKS

OPTIMIZATION OF P2P NETWORK MODE

After the analysis of our test results, we found that one of the crucial factors that limit our system performance is the amount of data. In this paper, we propose a fragmented block chain network to solve this problem. Specifically, original overall P2P network is divided into several different regions. Different region stores food data of different categories. Some super nodes are able to communicate with different regions to manage the whole system. Thus, next step will be the implementation of the fragmentation mode.

OPTIMIZATION OF THE CONSENSUS ALGORITHM OF THE BLOCKCHAIN

The speed of data uploading to the block chain is primarily restricted by the consensus algorithm. Therefore, we should optimize the consensus algorithm to improve the system throughput and accelerate the uploading process.

INFORMATION CLIPPING

Intended for some special food that has a specific expiration date, information clipping function can be set up to reduce the amount of data. For instance, the information of an apple would have no sense after three or five years. The strategy and techniques of the data removal or transfer are still under research.

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