



Review Article

APPLICATION OF BLOCK CHAIN TECHNOLOGY IN FOOD SAFETY

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Abstract: Blockchain is contributing many promising advances in the areas of food safety. Food safety has become an important food quality attribute. The significant problem of food safety, it is directly rendering people's health and safety. For an effective means of product quality, safety management blockchain traceability technology has used for monitoring the process. Numerous emerging internet technologies have been applied in traceability systems of food products. This study introduces the concept of Blockchain technology that can be applied within food traceability, control and its implication. A general framework for IT architecture for tracking food items in the supply chain is discussed. The blockchain and Internet of things, which could provide an information platform for all the supply chain members with openness, transparency, neutrality, reliability and security. The study concludes with a challenge to adopt blockchain technology in the future food supply chain traceability systems are discussed.

Keywords: Blockchain, IoT, Traceability, Internet

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Introduction

In Supply chain management perspective food sector is a challenging domain. It needs advanced control systems that can deal with perishable products, unpredictable supply variations and stringent food safety and sustainability requirements. Virtualization is a promising approach to meet these challenges. It allows for simulation and optimization of food processes using software systems instead of conducting physical experiments [1]. With current Internet technologies virtualization can also be used dynamically in the operational management of food supply chains [2]. Instead of observation on site, food supply chains can be monitored, planned and controlled and optimized remotely and in real-time via the Internet based on virtual objects. Supply chains build on food traceability systems that provide the information to track the location of certain items and trace its history[3,4]. To record state information over the life cycle of objects sensor technologies are used. This may include the monitoring of temperature, microbiological information and other food quality parameters [5,6]. Food touches everyone and everywhere. People confidence in the food industry was heavily destroyed due to food safety risk incidents. So, people are concise about safety and quality of food has drawn more attentions from academic and industrial areas. In response to growing food safety issues, many internets of things technologies, such as RFID and wireless sensor network-based architectures and hardware, are applied to supply chain traceability and visibility. The innovative technology that could be the key to these issues is the blockchain, which can remove the confidence on a central entity. Using Blockchain, all the information of the food products can be stored in a shared and transparent system for all the members along the supply chain instead of storing data in annet work system. As an emerging technology, blockchain also has its inherent shortcomings, and with the increasing application, scalability has become a primary and urgent concern. In this study, how the blockchain technology has been used in food safety is discussed.

The system could make food traceability from farm to fork become a reality and rebuild public confidence in the food supply chain [7,8].

Blockchain Architecture

A blockchain is a shared distributed among the business network. Business transactions are permanently recorded in the ledger. All the consensually confirmed and validated transaction details are linked from the beginning block to the most current block. The each block linked to its previous block using the cryptographic hash of the previous block. hence the process is named as blockchain. A blockchain is a historical record of all the transactions that have taken place in the network from the beginning of the blockchain to the end. The blockchain serves as a single source of genuineness for the network.

Blockchain Technology in Food safety

The term traceability has become widely used in recent times in various industries [7, 8] particularly in relation to agriculture and food. Agricultural traceability refers to the

- Collection,
- Documentation,
- Maintenance, and
- Application of information related to all processes in the supply chain.

It provides guarantee to the consumer and other stakeholders to provide the history of the product. The origin, location and life history of a product as well as assisting in crises management in the event of a safety and quality breach. With respect to a food product, traceability represents the ability to identify the farm where it was grown and sources of input materials, as well as the ability to conduct full backward and forward tracking to determine the specific location and life history in the supply chain [9].

Table-1 Integrated agricultural and food supply chain traceability system

Product traceability	Determines the physical location of a product at any stage in the supply chain to facilitate logistics and inventory management, product recall and Dissemination of information to consumers and other stakeholders.
Process traceability	Ascertains the type and sequence of activities that have affected the product during the growing and postharvest operations. It include interactions between the product and physical/mechanical, chemical, environmental & atmospheric factors which result in the transformation of the raw material into value-added products; and the absence or presence of contaminants.
Genetic traceability	Determines the genetic constitution of the product. This includes information on the type and origin (source, supplier) of genetically modified in gradients as well as information on planting materials used to create the raw product. (such seeds, stem cuttings, tuber, sperm, embryo)
Inputs traceability	Determines type and origin (source, supplier) of inputs such as fertilizer, chemical sprays, irrigation water, livestock, feed, and the presence of additives and chemicals used for the preservation and/or transformation of the basic raw food material into processed (reconstituted or new) food products.
Disease and pest traceability	Traces the epidemiology of pests, and biotic hazards such as bacteria, viruses and other emerging pathogens that may contaminate food and other ingested biological products derived from agricultural raw materials

In the above diagram, each step in the supply chain of a food commodity, the relevant information and certification can be recorded in a blockchain network, making a permanent record. The details can be accessed by an end customer to view the quality details of the food commodity, ensuring that they are good quality products which have a genuine track record of the supply chain. Traceability adds value to the overall quality management system by providing the communication linkage for identifying, verifying and isolating sources of non compliance to agreed standards and customer expectations. There are some important elements of traceability which put together, constitute an integrated agricultural and food supply chain traceability system. To implement traceable agricultural supply chains, technological innovations are needed for product identification, process and environmental characterization, information capture, analysis, storage and transmission, as well as overall system integration. These technologies include hardware (such as measuring equipment, identification tags and labels) and software (computer programmes and information systems).

Techniques used for Product identification

A major feature of any traceable supply chain is the ability to trace-back the history and consistently track the physical location of the products in the overall supply chain. To achieve these, accurate labelling is essential. The simplest technology to achieve this is to attach a tag to the basic raw material (e.g. the animal, plant or its constituent parts) and to transfer that data on the tag to the bar code of the food product. The Internet of Things (IoT) is stepping out of its beginnings into full maturity and establishing itself as a part of the future Internet. The data retrieved from the IoT are stored in centralized model. To retrieve the data from the global database, access management techniques such as role and permission are assigned to the user. The authors [10] propose a novel method for assigning roles and permissions in IoT. The new method is a distributed access control system for IoT based on blockchain technology.

Technology used for measuring food quality and safety

The traceability is measured by the consistent delivery of products to meet the expectations of the consumer and stakeholders. Each product specifications such as size -mass, dimensions, firmness-crispness, crunchiness, soluble solids, acidity, flavour, etc, are some of the physical, mechanical and chemical properties that may require measurement. Environmental conditions such as temperature and relative humidity, atmospheric composition of the air, including pollutants, impact on the quality stability and safety of food products. The assimilation of global positioning systems (GPS), geographic information systems (GIS) and remote sensing (RS) offers considerable opportunity for site-specific agriculture. The derivation of data related to the agriculture products on the farm and through the subsequent handling operations can be monitored through the above technology. These technologies enable data such as bio-physical properties of the block, yield and selected product attributes to be remotely collected from the individual animals, plants and blocks on a farm, which can be processed, transmitted and accessible as visual spatial information. With respect to traceability, a vital feature of these technologies is the possibility to map the geospatial variability of all the attributes.

Food security

The blockchain system would allow checking at every level of the supply chain, ensuring the highest levels of food security. In the event of a contamination being

detected, the source of the problem can be easily traced and only the affect lot can be pulled off the shelf. Apart from drastically reducing food-related diseases, it would also reduce the healthcare burden associated with the same. From the consumer's point of view, they would be able to verify all details about the food product including information about its origin and expiration date, before deciding to make the purchase. The incorruptible nature of the record would help improve consumer confidence in the products, wherein they can be assured that all information provided is accurate and reliable. An integrated system includes data collection, analysis and transmission of the recorded information. The system is used for effective traceability and history of the product. To links the traceability chain to a central database at the company, national or international level, and integration of technologies relies on the application of appropriate information and computer system.

Application

In the application of integrating blockchain into rice supply chain [11], all supply chain members should have to register themselves in the system, and their unique identities and digital profiles stored in the blockchain system database. In the rice supply chain the paddy Production Procuring, Processing, Distributing and Retailing details are collected and it's stored on the blockchain through handheld tag reader and wireless network.

Conclusion

The emergence of traceable agricultural supply chains is the outgrowth of a long line of developments in improving food quality and safety management.

Application of review: To study the existing process new blockchain technologies can be applied. It is essential functions such as payment, escrow, and title can also reduce fraud, increase financial privacy, speed up transactions, and internationalize markets.

Review Category: Supply chain management

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