International Journal of Scientific Research in Computer Science, Engineering and Information Technology
ISSN : 2456-3307 (www.ijsrcseit.com)
doi : https://doi.org/10.32628/CSEIT228216

Information Sharing Management System Based on Blockchain Using Deep Reinforcement Learning

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Article Info
Volume 8, Issue 2
Page Number : 91-96

Publication Issue :
March-April-2022

Article History
Accepted : 05 March 2022
Published : 21 March 2022

ABSTRACT

In recent years, the food supply system has become increasingly globalized. Traditional traceability systems have issues with centralized administration, opaque information, untrustworthy data, and the ease with which information islands can be created. To address the aforementioned issues, this study proposes a blockchain-based traceability system for storing and querying product information throughout the agricultural supply chain. Most existing systems, on the other hand, are unable to meet the traceability and management requirements of ASCs. To address these concerns, we first develop a blockchain-based ASC architecture for product traceability, which provides decentralised security for agri-food tracing data stored in ASCs. A Deep Reinforcement Learning based Supply Chain Management (DR-SCM) system is then offered to make effective judgments on the production and storage of agri-food commodities for profit optimization. In a variety of ASC scenarios, extensive simulation experiments are conducted out to demonstrate the efficacy of the proposed blockchain-based infrastructure and the DR-SCM strategy.

Keywords: blockchain-based ASC, DR-SCM

I. INTRODUCTION

Blockchain technology is defined as a distributed ledger in which transactions are made digitally and simultaneously recorded, verified, and approved across a network of nodes without the approval of a central authority [1, 2]. The Internet of Things (IoT) is a networked system comprising uniquely identifying equipment, gadgets, animals, items, and people that are interconnected and have the ability to communicate data without interacting with one another [3]. However, the Internet of Things faces some privacy and security issues that can be addressed by incorporating block chain technology. Figure 1 depicts the standard supply chain network configuration. The system is made up of three primary components: upstream (suppliers), producers, and downstream (consumers) (customers).

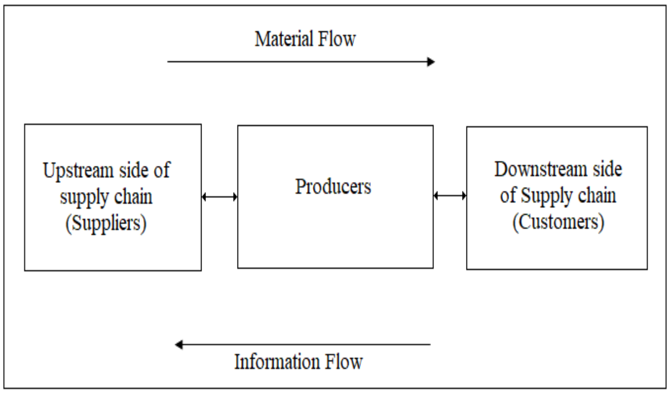

Fig. 1: Key Elements of Traditional System

The following are the issues that traditional supply chains confront [4]:

- Inadequate visibility from upstream to downstream: Inadequate vision from one end to the other leads to a slew of issues, including fraud, code of conduct violations, and so on.
- Lack of flexibility in responding to rapid demand changes and cost control: Changes in demand are common as a result of globalisation, which indirectly raises operating costs.
- Stakeholders' lack of trust in security: As a result of this lack of trust, there is no proper information flow from one end to the other.
- Ineffective supply chain risk management: An ineffective supply chain risk management system is incapable of predicting risk and reacting appropriately to changing circumstances.
- Lack of advanced technologies: Traditional supply chain management lacks advanced technology to address the issues that have arisen as a result of globalization's abrupt developments.

The following are the advantages that blockchain and IOT provide to the supply chain [5]:

- Information continuity and traceability: Blockchain's irreversible and immutable qualities make it easier to transfer information among stakeholders, ensuring that the product and information can be traced without danger.
- Data accessibility: The open nature of blockchain makes it possible to access a massive amount of data generated throughout the supply chain.
- There is a link between the flow of information and the flow of materials. To improve the efficiency of the supply chain network, IOT serves to connect the link between information flow and material flow at various stages.
- Reduced code of conduct violations and fraud: Blockchain's transparent and auditable features aid in the detection of fraud at every level as well as the reduction of code of conduct violations across the supply chain.

II. LITERATURE SURVEY

Studies on transparency indices have been published in the literature. Some of them attempted to quantify transparency, while others calculated a specific component of it [6].

[7] It was claimed that there is no globally acceptable transparency index; instead, transparency indices were produced based on country-specific characteristics using a variety of criteria and approaches.

One of the most basic strategies for guaranteeing food safety is food traceability. When an undesirable scenario happens, it is necessary to pinpoint the cause of the problem by monitoring the products and processes backwards in the transparency framework. It's also a method aimed at establishing the essential information infrastructure for crisis management strategies like forward planning. The concepts of transparency and traceability, thanks to traceability, give benefits such as food safety, food fraud prevention, and food quality [9]. Furthermore, because traceability and transparency create knowledge, organisation information can approach traceability [10] [11] with the implementation of traceability and transparency in food supply chains.

As a result, it is intended to measure information transparency of suppliers in order to avoid the difficulties listed above, such as food security, food quality, and food fraud. If the products are a threat to or a danger to human health, they can be tracked backwards to find the problem's source, origin, and accountable unit. In general, traceability aids in taking essential safeguards, monitoring ahead to gather products that constitute a danger or threat, and conducting hazard analyses for crucial control points [12]. It is crucial as a support tool in product safety and quality, as it ensures the realisation and long-term viability of their strategies [13].

In the last few years, the adoption of several IoT devices and technologies in the supply chain management sector has sparked a lot of research interest. The technological maturity of the devices and sensors is practically altering each step of the process, from the influence of autonomous identification systems [14] to the deployment of RFID technology in logistics [15]. The authors of [16] proposed an inventory transparency use-case for the Agri-Food domain, which included the utilisation of several IoT devices. The purpose was to see if RFID and NFC-based devices could be used to enable transparency and real-time data creation directly on the field, with persistence provided by a centralised, cloud-based database.

This is the traditional paradigm that the vast majority of existing IoT-based solutions follow. The use of Blockchain and IoT technologies in the Agri-Food domain, on the other hand, is still a relatively unexplored yet worthwhile study subject. [17] presented a traceability system based on blockchain and RFID technologies, with a particular focus on Chinese food markets. Fresh food asset tracking, such as fruits, vegetables, and meat, was investigated using RFID-based sensors for data collection and blockchains for data durability. [18] demonstrated a food safety supply chain traceability system based on HACCP (Hazard Analysis and Critical Control Points) and a transparency focus. They detailed the process of crop plants at various stages, from harvesting to retailing, without getting into the nitty gritty of a performance study. To the best of our knowledge, some critical functionalities afforded by certain blockchain implementations are either unexplored or underutilised, one of which is the capacity to conduct autonomous transactions (often referred to as smart contracts [19]).

III. PROPOSED SYSTEM

We proposed a blockchain based online ecommerce system in which farmers will be able to upload and sell their products to processor companies or distributors. The processor companies will process the products and register their products for sell. These products will be visible to distributors. Distributors will purchase products and register their products which will be visible to retailers. Retailer will again register their products for sell and their products will be visible to customers. All the transactions will be maintained in blockchain on blockchain servers. No one can change the blockchain data and hence transparency will be maintained. Before purchase, customers will be able to view all the details starting from farmers to retailer.

Along with the tracing system we proposed decision support system using deep reinforcement model to predict product demands using previous data.

Modules of the system are as given below.

Modules

1. **Admin Panel**

   a. Login

   b. Register product cost percentage (MRP Percentage that the supplier will be able to increase on product's initial cost) for distributors and stores

c. Reports

i. View Farmers
ii. View products
iii. View processors
iv. View Distributors
v. View Stores

d. View Product Details and transactions

2. Products Management

a. Product Registration
b. Product Cost Management
c. Upload Product Photos

3. Order Processing

a. Buyer will Place product order
b. View order details (For buyer and product owner)
c. Process order (current product owner will process the pending order)

4. Supply Chain Management in Blockchain

a. Product Supply chain transactions will be maintained on distributed servers in the form of blocks
b. The blocks will be maintained in sequence so that the consumer can view complete product cost details

5. Product Demand Analysis

a. View Product demand as per the requirements
b. View decision support reports

IV. IMPLEMENTATION OF PROPOSED WORK

Working diagram of products management is as given below. In this application there are 5 users and the flow of the application is connected with each other. Farmer will do registration and logged in into the system and after login farmer will upload their products. The uploaded product details will be stored on block chain servers automatically. We proposed 2 block chain servers. Farmer products will be shown to the processor company. Processor Company will place product order; the order will be placed on block chain servers.

Fig. 2: Working of Proposed System

Products will be maintained on block chain servers. As the transaction and product data will be stored on block chain servers, no one will be able to change it. Therefore the customer will be able to view all the transactions in transparent way.

Fig. 3: Structure of a food traceability system.

V. ALGORITHMS

SHA- Secure Hash Algorithm

- This algorithm will be used to find out unique hash value of every block
- We proposed SHA2 which will generate 32 byte hash value
- SHA2 generate unique representative value, if any single bit changed the hash value will also changed.
- The Secure Hash Technique 2 (SHA-2) is a cryptographic algorithm for computer security. It was developed as an improvement to the SHA-1 algorithm by the US National Security Agency (NSA) in partnership with the National Institute of Science and Technology (NIST). Six alternative variations of SHA-2 exist, each of

which differs in proportion to the bit size used to encrypt data.

Secure Hashing Algorithm (SHA) is an acronym for secure hashing algorithm. MD5 is the basis for SHA, which is a hashing algorithm. It is employed in the hashing of data and certificates. A hashing algorithm compresses the input data into a smaller form that cannot be interpreted using bitwise operations, modular additions, and compression functions. You could question if hashing can be cracked or decrypted. The only difference between hashing and encryption is that hashing is one-way, which means that once data is hashed, the resulting hash digest cannot be cracked without resorting to brute force.

AES- Advanced Encryption Standard

- This algorithm will be used to encrypt block data
- We will use AES 32 byte key encryption to encrypt block data on blockchain server
- The Advanced Encryption Standard (AES) was established by the US National Institute of Standards and Technology (NIST) in 2001 as a specification for the encryption of electronic data. Despite being more complex to construct, AES is still widely used today due to its superior strength than DES and triple DES.
- AES (Advanced Encryption Standard) is a block cypher.The key size can be 128/192/256 bits.
- Encrypts data in blocks of 128 bits each.

Deep Reinforcement Learning Model

Deep reinforcement learning is a machine learning and artificial intelligence category in which intelligent robots can learn from their actions in the same way that people do. The fact that an agent is rewarded or penalised based on their actions is inherent in this sort of machine learning.

VI. CONCLUSION

To make effective judgements on the production and storage of agri-food commodities for profit optimization, a Deep Reinforcement Learning-based Supply Chain Management (DR-SCM) system is proposed. Extensive simulation experiments are carried out in a number of ASC scenarios to illustrate the efficacy of the proposed blockchain-based infrastructure and the DR-SCM method. This improves supply chain transparency and facilitates in the reconciliation of documentation and required data with regulatory authorities for the importation of cold chain components in order to certify the quality of the end product. The implementation of a tamper-proof tracing mechanism ensures reliable traceability and promotes supply chain operations' legitimacy. This article focuses on the various ways in which blockchain can be implemented in the agriculture industry for the benefit of farmers, consumers, and distributors collectively.

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Cite this article as :

Ms. Shruti Belsare, Dr. A. B. Raut, "Information Sharing Management System Based on Blockchain Using Deep Reinforcement Learning", International Journal of Scientific Research in Computer Science, Engineering and Information Technology (IJSRCSEIT), ISSN : 2456-3307, Volume 8 Issue 2, pp. 91-96, March-April 2022. Available at doi : https://doi.org/10.32628/CSEIT228216
Journal URL : https://ijsrcseit.com/CSEIT228216