Food Supply Chain Using Ethereum Blockchain and Smart Contracts

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Abstract:
Information sharing is essential for coordination and stakeholder integration and is crucial to achieving sustainable supply chain operations. Agriculture plays a vital role in feeding and clothing the world's seven billion citizens. Over 25% of the world's population is employed in the agriculture sector. Agriculture supply chains have formed as long and complex network of production, processing, distribution, and marketing channels in order to meet demand in a globalized world. They are made up of farmers, producer, retailer, customer and many other, each with interests that are often widely varied and in conflict. Our system consists of smart contracts that connect the individual users such as farmers, producers, consumers to the blockchain. Farmers, manufacturers or produces and upload their information of the product into the blockchain using the smart contract. The consumer can check the information using a mobile application.

Keyword:
Information sharing, Blockchain, Ethereum, Smart contracts

1 INTRODUCTION

Blockchains are primarily administered using peer-to-peer (P2P) computer networks for use as public distributed ledgers. To add and validate new transaction blocks, nodes cooperate according to a consensus algorithm protocol. Blockchains may be regarded as safe by design and serve as an example of a distributed computing system with strong Byzantine fault tolerance even if blockchain records are not unchangeable and blockchain forks are conceivable.

There are many characteristics of a blockchain, some of them are -

- Immutable
- Distributed
- Decentralized
- Secure
- Consensus
- Unanimous
- Faster Settlement

A food supply chain describe how food from a farm ends up on our tables. The processes include production, processing, distribution, consumption and disposal. The food we eat reaches us via food supply chains through which food moves systematically in domino-like motion from producers to consumers while the money consumers pay for food goes to people who work at various stages along the food supply chain in the reverse direction. Every step of the supply chain requires human and/or natural resources. Because a food supply chain is domino-like, when one part of the food supply chain is affected, the whole food supply chain is affected, which is often manifested through changes in price.

In this supply chain process the food moves from producer to consumer via the processes of production,

processing, distribution, retailing and consumption; The, food moves from farmer to consumer in a domino-like fashion. Also the money that consumers pay for food moves from consumers to producers in the reverse process. Then in a domino type process from consumer to retailer to distributor to processor to farmer. In such ways the two-sided causality that connects farmers and consumers is mediated by these two sets of domino casualties.

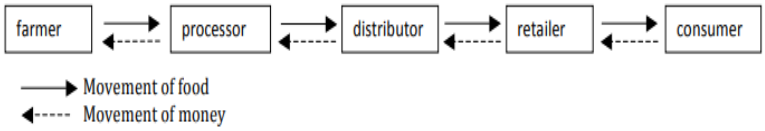

Fig 1. Sample Blockchain showing Food chain

The role of retailers in the supply chain has drastically changed since the 1980s. Previously, retailers held passive power positions where upstream suppliers would push prod-ucts regardless of customer choice or retailer predicted de- mand. Blockchain technology creates a single source of truth. This is important for supply chains that involve multiple participants in a network who don't necessarily trust each other.

2 METHODS

Blockchain technology allows firms to track their transactions more securely and transparently. The impact on the supply chain process is immense. with help of Blockchain, firms can trace the links of a product right from its point of origin to where it currently sits. Thus a product changes hands, the transaction is documented securely. It creats a permanent history, from manufacture to sale

. Using this powerful technology, firms collaborating on one shared platform could dramatically minimised the time delays, with adding the costs, and human error frequently associated with transactions. The reduce in the intermediaries in the supply chain helps in the reduces of the risks of fraud. Thus the less in fraud occurs, complex records enable organizations to pinpoint its source

A shared types of blockchain ledger provides a trusted and tamperproof trails of the flow and direction of the information, inventory, and finance within a supply chain. Using a such shared blockchain, the firms can synchronize logistics data, track shipments, and automate payments. In same way, they can do so without much altering their legacy systems while sharing such most relevant data.

3 OVERVIEW

- **Not much available supply chain transparency is one of the greatest challenges that organizations currently facing.**

There are 2 dimensions to supply chain transparency:
Visibility: The level of accurately identifying and collecting data from all links in the supply chain

- **How Blockchain solves this problem**

Businesses can use blockchain to track a product's history from its point of origin to its present location. A secure record of every transaction involving a product is created, providing a complete history from production through sale. The time delays, additional costs, and human error that are usually connected to transactions might be significantly reduced with the use of this potent technology if parties work together on a single shared platform. The risk of fraud is also decreased by fewer middlemen in the supply chain. Finally, thorough records help businesses identify the source of fraud wherever it occurs. A shared types of the blockchain ledger provides a trusted and tamperproof audit trail of the flow and directions of the information, inventory, and finance within a supply chain. Using such a shared blockchain technology, the firms can synchronize logistics data, track shipments, and automate payments. In the simillar way they can do so without significantly altering their legacy systems while sharing only the most relevant data.

- **Blockchain and supply chain: The perfect union of efficiency and transparency**

Efficiency
Blockchain enables businesses to conduct transactions directly and without the involvement of a third party, increasing the efficiency of global supply chains. Additionally, it makes it easier for financial and logistical services to be more integrated, enhancing stakeholder data collaboration.

The proper, timely movement of goods is ensured by integrated payment systems, which shorten the time between ordering and payment processing. Blockchain technology and smart contracts also assist businesses in improving compliance, lowering legal costs and penalties for late tax payments, and reducing counterfeiting and fraud.

Transparency
A transparent supply chain may be created via the blockchain since entries on it cannot be deleted. Additionally, because every step in the supply chain is securely recorded, logistics problems may be quickly traced back to their origin. The same is true for obtaining raw materials or components that can be used to track down their place of origin, improve accountability and transparency, and reduce unlawful behavior.

Food supply blockchains can be used to allow trading partners to protect their business operations and the supply chain while instituting better performance, control, and systems security. In more basic terms, a blockchain is a digital “record”, maintained by a network of multiple computers. Increased transparency on a product's maker, origin, transfer, and use helps build trust and confidence across the supply chain.

4 PROPOSED PLAN

The proposed plan is to use blockchain technology to host a platform for food supply chain management. The software will be utilized for facilitating transactions and networking stakeholders, with the goal of automating and reducing the costs of supply chain operations. SOme Android Application which can be used by the suppliers and consumers to put data into the blockchain, on the other hand an ethereum smart contract will be running to save all the information provided by the users using the smartphone application. Users can upload images of the food product with the time stamp.

- In the blockchain, a farmer creates a product and lists it to be purchased by a Distributor.
- Farmer ships the product.
- Distributor receives the product
- From there the product is bought by the retailer after verifying the distributor authentication and info from the blockchain.
- From there the retailer sells the product to the Consumer.
- And the Consumer can track all this backwards and access all the information by using the barcode on the product.

it, packages it, and puts it on sale. retailer buys the product form Distributor. Distributor ships the product to the retailer. Retailer receives the product and put it on sale. Consumers purchase the product. The tasks can be done by developing a flutter application which will connect the smart contract using the address of the deployed smart contracts. The smart contracts and the blockchain can be used by any developer for using the smart contract

A contract used for defining the roles of the users. It provides the functions to add, remove and query information about roles. This will then be imported into our other roles in smart contracts. Now a struct role is created to set an address. To do this, mapping must be done which maps addresses in boolean value to the bearer. Internal function "add" with storage role, and account address to check the address is passing is not a connected account and has not been added before. Similarly "remove" function is created where we check the passing address is not the connected account that the address does exist in a given role and the last set role value in storage to false. A function "has" is created to check if the account has a role or not, it returns a boolean value.

We create a farmer role for defining the roles of the farmer. Two events are created to capture if farmers are added or removed successfully. A struct farmers has been defined by inheriting from roles. The deploying address o0f the contract would be added as the first farmer. When using the constructor of a contract, we must perform the initial step of the contract. Using a constructor will ensure initialization during contract creation. A modifier needs to be defined to check the address that is calling the function has an appropriate role.

A function can check if the address is farmer or not it returns a boolean value. Add and remove farmer roles are created. Similarly, other roles form distributor, retailer and we repeat the same process as the farmer role just by changing the name of the functions and variables according to the role.

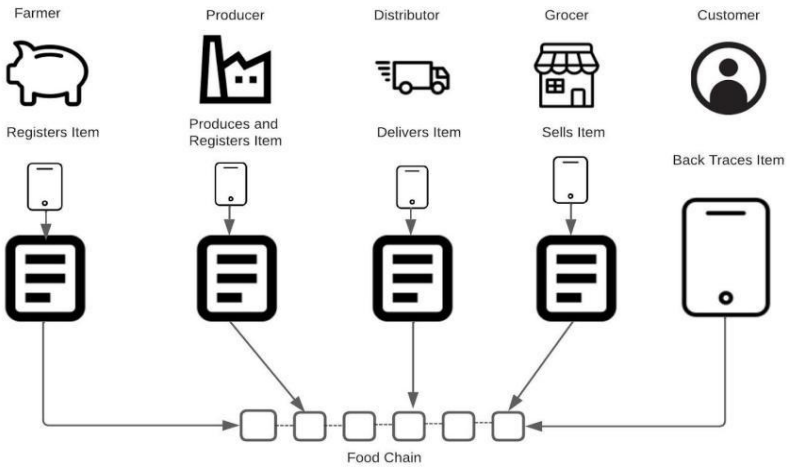

Fig 2: Architecture Diagram

5.RESULTS

```
// SPDX-License-Identifier:
MIT pragma solidity ^0.8.0;

library
Roles {
struct
Role {
mapping(address => bool) bearer;
}
    /**
*this function gives an account access to this role
*/
function add(Role storage role, address account) internal {
require(account != address(0)); require(!has(role, account));
    role.bearer[account] = true;
}
    /**
* rthis function emovse an account's access to this role
*/
require(account != address(0));
require(has(role,
    account));
    role.bearer[account] =
    false;
}
    /**
* check if an account has this role
* return bool
*/
function has(Role storage role, address account)
internal
view
returns (bool)
{
require(account != address(0));
return role.bearer[account];
}
}
```

6 CONCLUSION

In our paper, we implement a blockchain-based solution for inventory sharing between retailers and suppliers. Our Proposed solution captures the main interactions that take place between these stakeholders. We will discuss the costs and security analysis of the proposed system.

7 REFERENCES

1. [online] Available: https://www.leewayhertz.com/supply-chain-Block-chain-reinventing-food-supply/.
2. [online] Available: https://ifinca.co/?gclid=EAIaIQobChMI8o2suO_D5QIVkR0rCh1zvwbCEAAYAiAAEgL5WPD_BwE.
3. Mohamed A Awwad, Sohit Reddy Kalluru, Varun Kazhana Airpulli et al., "Block-chain implementation for Efficient Management of Supply chain", *Proceedings of the International Conference on Industrial Engineering and Operations Management Washington DC*, pp. 440-449, September 27-29, 2019.
4. [online] Available: https://www.hyperledger.org/resources/publications/walmart-case-study.
5. Andreas Kamilaris, Agusti Fonts, Francesc and X. Prenafeta Boldv, The Rise of Block-chain Technology in Agriculture and Food Supply chains", *Trends in food science and technolog*, vol. 91, pp. 640-652, Sep 2019.
6. Feng Tian, 2016 An Agri-Food supply chain traceability system for China based on RFID & Blockchain Technology, 2016