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Decentralized Network of Public Distribution System Using Blockchain

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ABSTRACT

The effort each farmer takes to produce food grains has to be appreciated and we should minimize the wastage of food grains. To solve the problem of wastage of food grains in Fair Price Shops due to factors like poor storage, transportation or poor management, we've been working on Decentralized Public Distribution System using blockchain. By this we might able to track from where the food grains have been purchased and how it is transported and stored. Also we can track it up to how it reaches the public. By tracking this we can come to an idea of how to not waste food grains and also audit it properly. This will create an impact in the traceability of food grains so that we will be able to minimize the wastage of food grains during the supply. This will also point out the suspicious activities that takes place in the supply chain. This application also helps to audit the food chain and store transactions in an organized manner. Everyone will be accountable for the food grains they've wasted and they'll try to act more responsibly than before. This idea will also make the existing system more secure, advanced and automated.

Keywords: Fair price shops, Decentralized, Traceability, Public Distribution System, Blockchain

1. INTRODUCTION

A public distribution shop, also known as fair price shop (FPS), is a part of India's public system established by the Government of India which distributes rations at a subsidized price to the poor. Locally these are known as ration shops and public distribution shops, and chiefly sell wheat, rice and sugar at a price lower than the market price called Issue Price. Other essential commodities may also be sold. To buy items one must have a ration card. These shops are operated throughout the country by joint assistance of central and state government. The items from these shops are much cheaper but are of average quality. Ration shops are now present in most localities, villages towns and cities. India has more than 5.5 lakh (0.55 million) shops, constituting the largest distribution network in the world.

A blockchain is a growing list of records, called blocks that are linked using cryptography. Each block contains a cryptographic hash of the previous block, a timestamp, and transaction data. By design, a blockchain is resistant to modification of its data. This is because once recorded, the data in any given block cannot be altered retroactively without alteration of all subsequent blocks. For use as a distributed ledger, a blockchain is typically managed by a peer-to-peer network collectively adhering to a protocol for inter-node communication and validating new blocks. Although blockchain records are not unalterable, blockchains may be considered secure by design and exemplify a distributed computing system with high Byzantine fault tolerance. A blockchain is a decentralized, distributed, and oftentimes public, digital ledger consisting of records called blocks that is used to record transactions across many computers so that any involved block cannot be altered retroactively, without the alteration of all subsequent blocks.

A public blockchain is a non-restrictive, permission-less distributed ledger system. Anyone who has access to the internet can sign in on a blockchain platform to become an authorized node and be a part of the blockchain network. A node or user which is a part of the public blockchain is authorized to access current and past records, verify transactions or do proof-of-work for an incoming block, and do mining. The most basic use of public blockchains is for mining and exchanging cryptocurrencies. Public blockchains are mostly secure if the users strictly follow security rules and methods. However, it is only risky when the participants don't follow the security protocols sincerely. Example: Bitcoin, Ethereum, Litecoin.

Blockchain like bitcoin has consensus mechanisms which require every participating node to verify the transaction. It limits the number of transactions a blockchain network can process. So bitcoin was not developed to do the large scale volumes of transactions that many of the other institutions are doing. Currently, bitcoin can process a maximum of seven transactions per second. In the blockchain, we know that a block can be created in every 10 minutes. It is because every transaction made must ensure that every block in the blockchain network must reach a common consensus. Depending on the network size and the number of blocks or nodes involved in a blockchain, the back-and-forth communications involved to attain a consensus can consume a considerable amount of time and resources.

2. LITERATURE SURVEY

[1] The traditional supply chains are centralized and they depend on a third party for trading. These centralized systems lack transparency, accountability and auditability. In our proposed solution, we have presented a complete solution for blockchain-based Agriculture and Food (Agri-Food) supply chain. It leverages the key features of blockchain and smart contracts, deployed over Ethereum blockchain network. Although blockchain provides immutability of data and records in the network, it still fails to solve some major problems in supply chain management like credibility of the involved entities, accountability of the trading process and traceability of the products. Therefore, there is a need of a reliable system that ensures traceability, trust and delivery mechanism in Agri-Food supply chain. In the proposed system, all transactions are written to blockchain which ultimately uploads the data to Interplanetary File Storage System (IPFS). The storage system returns a hash of the data which is stored on blockchain and ensures efficient, secure and reliable solution. Our system provides smart contracts along with their algorithms to show interaction of entities in the system. Furthermore, simulations and evaluation of smart contracts along with the security and vulnerability analyses are also presented in this work.

[2] Current IoT-based traceability and provenance systems for Agri-Food supply chains are built on top of centralized infrastructures and this leaves room for unsolved issues and major concerns, including data integrity, tampering and single points of failure. Blockchains, the distributed ledger technology underpinning cryptocurrencies such as Bitcoin, represent a new and innovative technological approach to realizing decentralized trust less systems. Indeed, the inherent properties of this digital technology provide fault-tolerance, immutability, transparency and full traceability of the stored transaction records, as well as coherent digital representations of physical assets and autonomous transaction executions. This paper presents Agri Block IoT, a fully decentralized, blockchain-based traceability solution for Agri-Food supply chain management, able to seamless integrate IoT devices producing and consuming digital data along the chain. To effectively assess Agri Block IoT, first, we defined a classical use-case within the given vertical domain, namely from-farm-to-fork. Then, we developed and deployed such use-case, achieving traceability using two different blockchain implementations, namely Ethereum and Hyperledger Sawtooth. Finally, we evaluated and compared the performance of both the deployments, in terms of latency, CPU, and network usage, also highlighting their main pros and cons.

[3] Existing food traceability systems do not guarantee a high level of system reliability, scalability, and information accuracy. Moreover, the traceability process is time-consuming and complicated in modern supply chain networks. To alleviate these concerns, blockchain technology is promising to create a new ontology for supply chain traceability. However, most consensus mechanisms and data flow in blockchain are developed for cryptocurrency, not for supply chain traceability; hence, simply applying blockchain technology to food traceability is impractical. In this paper, a blockchain-IoT-based food traceability system (BIFTS) is proposed to integrate the novel deployment of blockchain, IoT technology, and fuzzy logic into a total traceability shelf life management system for managing perishable food. To address the needs for food traceability, lightweight and vaporized characteristics are deployed in the blockchain, while an integrated consensus mechanism that considers shipment transit time, stakeholder assessment, and shipment volume is developed. The data flow of blockchain is then aligned to the deployment of IoT technologies according to the level of traceable resource units. Subsequently, the decision support can be established in the food supply chain by using reliable and accurate data for shelf life adjustment, and by using fuzzy logic for quality decay evaluation.

[4] In this paper aims to avoid the illegal activities and manual data registration in fair price shops. Using the technology like smart card and GSM (Global System for Mobile Communication). The data are stored in the database it is easier for higher authority to check the data at any time intervals. [5] Fair price shops is connected to the government database via GSM Modules which will able send the information to the government and the people of the state. This paper aims to stop the corruption in public distribution system using AVR (Aortic Valve Replacement). This AVR make the power supply unit is fully made alternate to solar power.

[6] This project is to scan the QR Code of Aadhar Card of the public to provide the goods. This program used to scan the OR Code of the public is scanned by the camera to check the duplicate or the real one, and also using the Raspberry Pi act as the main control unit and it will store the data in it. After the goods delivered the message acknowledgement through to his/her mobile number, the data will be updated on the embedded web server. The server can be authorizes by the both government servant and the consumer who have access to it. [7] In this paper aims to provide the goods using RFID Technology. This project checks id and password of the consumer and if the password is wrong the alarm will be triggered. Otherwise the goods information will be displayed to the consumer to select the goods and quantity of the goods and then the consumer need to done payment for the goods brought by them. When the payment is done goods will delivered by the automatic dispenser. The SMS notification sends to consumer mobile phone. [8] The paper proposed the solution to overcome manual data register by implementing E- Public Distribution System it can reduce the human errors and the falsification of the information. This project to check the customer fingerprint verification and biometrics using the

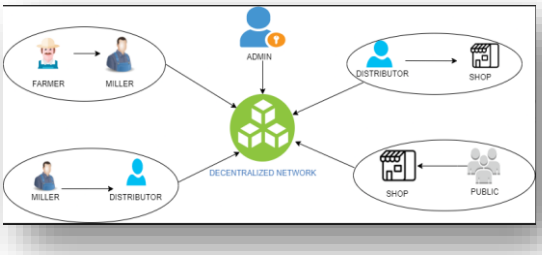
fingerprint sensor to avoid the unauthorized access. E-PDS also have the web application to store the database and the public servant can access the application using the authorized mail id and password. [9] The proposed paper implements that by using barcode scanner in Raspberry pi 4B, camera and the prototype of automatic weighing machine for the goods in the ration shop by using Internet of Things technology. It show cardholder brought goods and timestamp in excel spreadsheets. It has the disadvantage of security and accessibility. [10] This paper is search for the examine of digitalized PDS to represented the no hunger situation in the country. It will collect the primary and secondary data from the website, documents from central and state government. This has the study of the Public Distribution System in India. [11] Dr.P.Shanumugam has conducted the survey on Public Distribution System. The PDS has plays major role in the people life. It has been practically proved that the people depend on the distributed food grains.

3. METHODOLOGY

Using blockchain in Public Distribution System creates a transparency to the public as well as the government starting from the goods purchased from the farmers and till being received by the Public. Developing a web application and providing a secured login access for the government officials who is about to initiate the transaction. Each local admins will be provided with a unique address for unique identification. Their role is to check if the goods are received and to update the date and time of delivery and the quantity received has to be measured and fed into the smart contract. Then the transaction has to be updated in the Ethereum network where everybody will be able to have a look at the

Fig 1. System Architecture

transaction. To update the transaction into the Ethereum network the government have to pay a gas fee to the Ethereum network. We can track the food chain just by knowing our Ethereum address itself. We can backtrack the addresses to know the origin of the product and also we can know about the transactions handled by each individual. People can check the details of the shops to



know if the food grains are currently available in the shop or not.

4. IMPLEMENTATION AND WORKING

Using blockchain in current public distribution system will bring transparency and automation to the whole system. We can use this application with a browser having MetaMask extension itself. This Web Application is built using React JS and the smart contract is written using solidity code. This application will let government to audit the whole supply and the users will be benefited by this automated system. Other users will be benefited by having their transactions in an organized manner.

4.1 Adding Users

This module is exclusive to Admin and Local Admins only. In this module Admin will be able to add the Local Admins into the blockchain network. Then the Admin and Local Admins can add the other members such as Farmers, Millers, Distributors and the Shops into the blockchain network. The users who are not registered into the blockchain network will be considered as the public.

4.2 Updating Transactions

This module is used to update the quantity of food grains information into the network. By recording these information we will be able to get the proper details whenever necessary. In this module the information like To Address, quantity of rice, quantity of wheat, quantity of sugar and quantity of kerosene is entered and recorded. As this information is entered in blockchain it is nearly impossible to alter. This module cannot be accessed by the public as they are not going to update any transaction and to avoid confusion.

4.3 Getting Transactions Details

This module is the key for tracking the food chain and making the food traceability possible. In this module when you enter an address it'll return you the transaction details that they've done since the beginning. This module will help to check the quality of work and workers at the same time monitor the errors present in the system. The transactions will be displayed with timestamps for quick understanding and proper tracking.

4.4 Getting Shop Details

Public can know if the food grains are available in the shop by entering the address of the shop in this section. It'll return the shop's address, its PIN Code, and the quantity of food grains available in the shop. The quantity will increase and decrease as per the goods bought by the shop and sold from the shop.

4.5 Getting User Details

This module is also exclusive for Admin and Local Admin only. They can use this module to check the details of users such as Farmers, Millers, Distributors and Local Admins. Their info will be available in this section.

5. RESULT AND CONCLUSION

This implementation of Blockchain in Public Distribution System will make the system trustworthy. This decentralized application will let everyone have a clear look over their Public Distribution System so that they can know what's actually happening during the whole supply. This will create an impact in the traceability of food grains so that we will be able to minimize the wastage of food grains during the supply. This will also point out the suspicious activities that takes place in the supply chain. This application also helps to audit the food chain and store transactions in an organized manner. Everyone will be accountable for the food grains they've wasted and they'll try to act more responsibly than before.

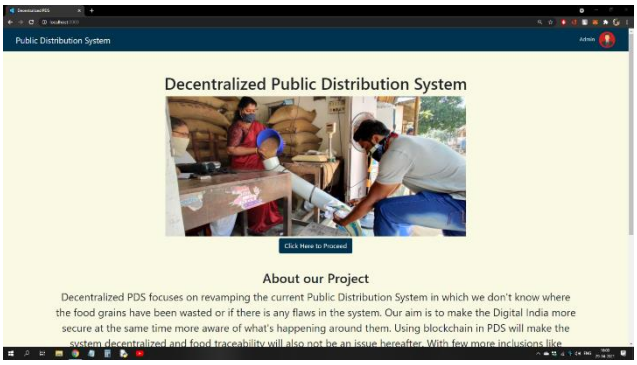


Fig 2. Home page

6. FUTURE ENHANCEMENTS

This is not the complete package of Decentralized Public Distribution System but once when people start using crypto-wallets and crypto currencies, this will become a standard and the system will be more automated and become easy to use. Payments can be done with Proof of Work. RFID Smart cards or QR Code Smart cards can be used to fetch the data directly into the network to reduce time delay. Electronic weighing scales can be used to reduce the human error. Feedback system can be included further to track the quality of food over the supply chain as well as it will help get farmer's some recognition.

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