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Supply Chain Management In Public Distribution System Using Blockchain

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Abstract

The Public Distribution System (PDS) in the country facilitates the supply of food grains and distribution of essential commodities to a large number of poor people through a network of Fair Price Shops. But currently it faces a lot of corruption in managing and transporting food grains throughout the nation. Corruption happens because there is no authority to make the system transparent to the public. The proposed idea is to deploy a Blockchain network on which a digital and distributed record that keeps track of the food grains resides. If we use a simple database and client – server architecture , the system may be prone to network attacks and thus the system may fail.
Blockchain Technology provides a secure and distributed platform for suppliers, distributors, retailers, auditors, and consumers to have an efficient management of the supply chain. Blockchain has the potential to drive cost-saving efficiencies and to enhance the consumer experience through traceability, transparency, and tradeability by providing a digital record of each transaction made with respect to a commodity .
We will be deploying a Blockchain Network on which each transaction is processed and this network is developed by Hyperledger Sawtooth.

Keywords: *Hyperledger,Sawtooth, Blockchain , PDS,Supply Chain,Transparency,Network.*

1. INTRODUCTION

The Public Distribution System (PDS) of our nation is the largest food distribution program in the world. It was established in June 1947, distributing few of the food grains like wheat, rice, sugar, etc. and fuel like kerosene among most of the states[1]. PDS distributes over 19 million tons of rice and wheat to 27 million citizens of the nations, apart from this India produces 600 million tons of fruits and vegetables, but 25% - 30% of this gets wasted due to poor management and logistic support. Millions of people sleep at night with empty stomachs and many die of hunger.
The idea is to implement a digital supply chain management system that keeps track of the materials and make crucial transportation or logistics decisions to avoid wastage of food grains.
If we use simple database and client-server architecture which is now digitized, but the data is easily modifiable thus leading it to corruption or can be hacked killing the entire system. Blockchain is a secure, tamper-proof and decentralized technology where we can implement our supply chain management system for PDS.

Supply Chain Management

Supply chain management (SCM) is the process and activity of sourcing the raw materials or components an enterprise needs to create a product or service and deliver that product or service to customers. The objective of SCM programming is to improve production network execution[2]. Convenient and precise inventory network data permits makers to make and boat just as much item as can be sold. Powerful production network frameworks help the two makers and retailers reduce overabundance stock.

Public Distribution System Of India

Public distribution system is a government-sponsored chain of shops entrusted with the work of distributing food and non-food commodities to the needy sections of the society at very low prices. Wheat, rice, kerosene, etc. are a few major commodities distributed by the public distribution system through fair shops [1]. Food Corporation of India as a government entity manages the public distribution system. The system is often blamed for its inefficiency in management and rural-urban bias. It has not been able to fulfill the purpose for which it was formed. But still it has been criticized by the public for instances of corruption and black marketing. TPDS intends to give sponsored nourishment and fuel to the poor through a system of fair shops. Nourishment grains for example, rice and wheat that are given under TPDS are acquired from farmers, dispensed to states and conveyed to the fair shop where the consumer purchases his privilege [1].

2. EXISTING SOLUTION

From 10th of April 2018 onwards, ration is supplied using this system. With this, people cannot buy ration using other ration cards. Presently, the details of the remaining stock in the shops is being linked to the new system. As per the new scheme, the card holder will be correctly identified and the allotted quantity of supply will be distributed. The consumers will be recognized by cross checking their fingerprint in Aadhaar using the biometric system in the machine[3]. The name and details of all the members will be displayed on the screen, when the card number is entered. As the finger is touched on the machine, the ration supply allotted for each card and its price also will be displayed and the bill will be printed[3].The machine has a facility to connect with Aadhaar, so that those who do not have Aadhaar can buy products with the OTP sent to their registered phone number.

Figure 1: E-POS Machine

3. LITERATURE REVIEW

Application development on top of blockchain technology is an emerging field thus, there is a scarcity for successfully running applications. We have prepared case studies of enterprises that uses blockchain to implement supply chain management for their products.

[4] ScanTrust brought transparency in their supply chain management using blockchain

ScanTrust is an enterprise that provides cloud based (SaaS) platform that helps products to achieve digital unique identity in the cloud. Cambio Coffee, one of their clients, wants to attain more transparency and product traceability for their product and its supply chain. To achieve this goal ScanTrust implemented the supply chain management system in blockchain. Using the blockchain technology it can easily trace

the journey of their product details, so it records the actions of the product at every single halt. Thus, by simply scanning a QR code on the final product, the blockchain is parsed and the supply chain details are clearly available to the user at any given time.

[5] Walmart brought unprecedented transparency to the food supply chain using Blockchain

Walmart Inc is one of the world's largest retail corporations, a few years ago this large industry faced a main issue of bad quality of food materials, during this time the supply chains of Walmart products were manually handled. So, it took time to trace the complete defect batch and to identify to which all branches these batches have been shipped. It nearly took 7 days work to go through the file system to trace the defective food products. After this issue, Walmart thought of increasing the traceability and transparency of their products supply chain using blockchain. They opted for the Hyperledger framework because it best met their needs and it is an enterprise-grade blockchain technology, which is permissioned. After implementation of this decentralized food supply ecosystem using Hyperledger framework, the time taken by Walmart to trace the source of their products went down from 7 days to 2.2 seconds!

4. TECHNOLOGY

Blockchain

A blockchain is a time-stamped series of immutable records of data that is managed by a cluster of computers not owned by any single entity. Each of these blocks of data are secured and bound to each other using cryptographic principles. Since it is a shared and immutable ledger, the information in it is open for anyone and everyone to see. Hence, anything that is built on the blockchain is by its very nature transparent and everyone involved is accountable for their actions.

Blockchain Frameworks

Frameworks offer a structure that enables developers to build apps quickly. Frameworks offer the building blocks which act as an accelerator for enterprises, and they can focus on implementing their requirements, rather than re-inventing ideas. Different blockchain frameworks and development platforms bring with them varying benefits, leading frameworks include: Hyperledger Fabric, Hyperledger Sawtooth, Etherium, R3 Corda etc.

Why Hyperledger Sawtooth ?

Hyperledger Sawtooth is an enterprise blockchain platform for building distributed ledger applications and networks. Hyperledger Sawtooth separates the application level from the core level, so that an application's business logic is independent from the core Sawtooth functions.Sawtooth includes applications (called "transaction families") to serve as models for low-level functions, such as maintaining chain-wide settings and storing on-chain permissions, and for specific applications, such as performance analysis and storing block information.
A Sawtooth application includes these components:

A **data model** to define valid operations and specify the transaction payload (data for the application).A **transaction processor** to define the business logic for your application. The transaction processor validates batches of transactions and updates state based on the rules defined by the application. The transaction processor runs on each validator node in the Sawtooth network.A **client** to handle the client logic for your application. The client generates and sends transactions (changes for the blockchain) to the validator; the client also displays data. A client can run on a separate system or on the validator node. For example, Sawtooth includes a set of commands that run as a client on each validator node.A **REST API**

to communicate between the client and the transaction processor.Sawtooth provides a REST API that simplifies client development by adapting client-validator communication to standard HTTP/JSON. The REST API runs as a service on the validator node or a separate system.

5. PROPOSED IDEA

In the current public distribution system (PDS), the chances of corruption are quite high since each transaction is recorded using traditional methods like by using pen and paper. So to avoid these flaws in the system , a digital record for each transaction is needed and proper supervision of the system should be carried out in a timely manner.To provide a digital record for the system and for transparency , we use the emerging technology blockchain in the Public Distribution System.
As we have seen that there are mainly two situations where corruption can happen ,namely , at the distribution center and at the fair shops. Corruption at the fair shops can be controlled to an extent with the help of an E-Pos machine which records a transaction when made by a consumer using the authentication through his/her fingerprint [3]. But the main problem is that there are still flaws in the system even after implementing the E-PoS machine. Corruption can occur when the collected foodgrains are accumulated at a godown for transporting each load to different fair shops.So to prevent this corruption from happening, we plan to make the entire system transparent to the public as well as to the parties involved in the system. In order to provide transparency [8], a decentralized mechanism needs to be used which will provide secure transactions, a durable system, we use blockchain technology.

Our idea is to deploy a blockchain application that could connect various users in the supply chain network in the public distribution system. Users are the supervisors at each distribution center. Each user has their own login credentials which are private address and public address, which is used to connect the blockchain using a web interface we developed. These public addresses are visible to other participants in the network ,but the private address is hidden from them. The user at the starting point of the supply chain registers the commodity details such as commodity name,quantity,weight along with the location of the commodity. During each checkpoint, the ownership of the commodity is transferred among the supervisors through public address and these respective supervisor's update the details such as quantity, weight and location.

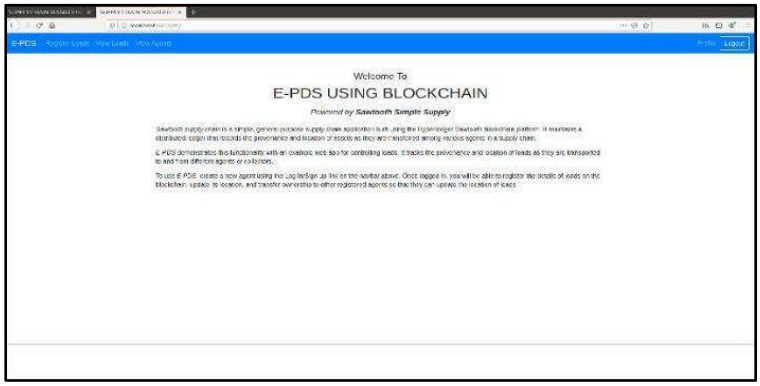

Figure 2: E-PDS Web app

6. PROTOTYPE

6.1 Registering the Load

Each user registers a commodity with its information such as name,weight,location,temperature and humidity from different sensors attached.

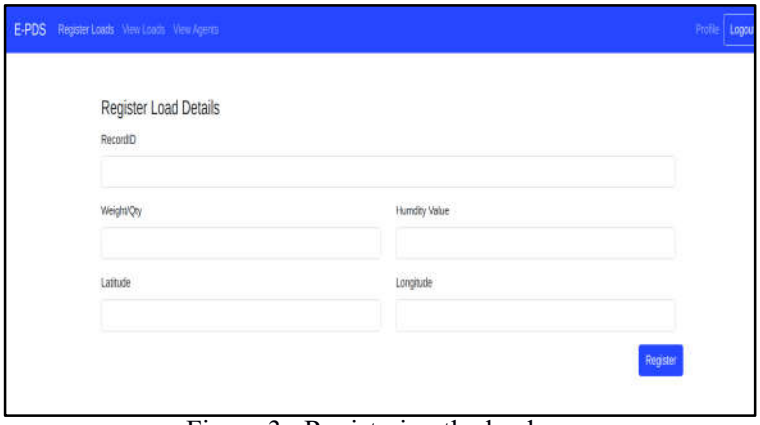

Figure 3: Registering the load

6.2 Tracking the Load

Each user on receiving the commodity updates the location of the load. Figure below shows the commodity that travels through three warehouses.

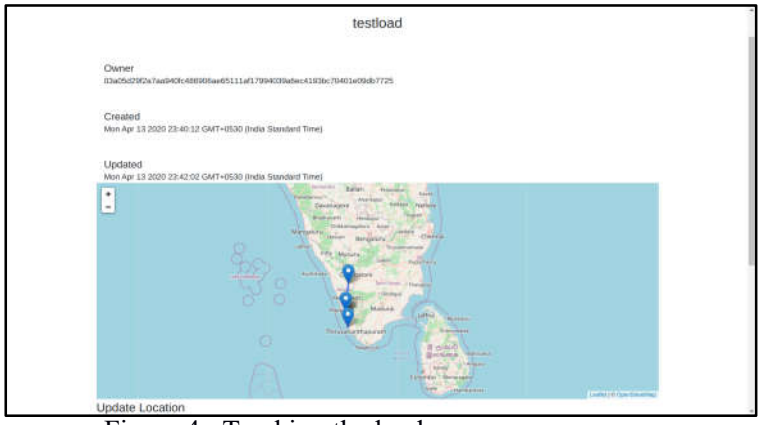

Figure 4: Tracking the load

6.3 Updating and Transferring Ownership

Each agent on receiving the ownership of a commodity updates the current location along with the quantity they are having.The owner can transfer the ownership of a commodity to another agent using their public key. Along with the public key the current owner passes the quantity of commodity that is being transferred.

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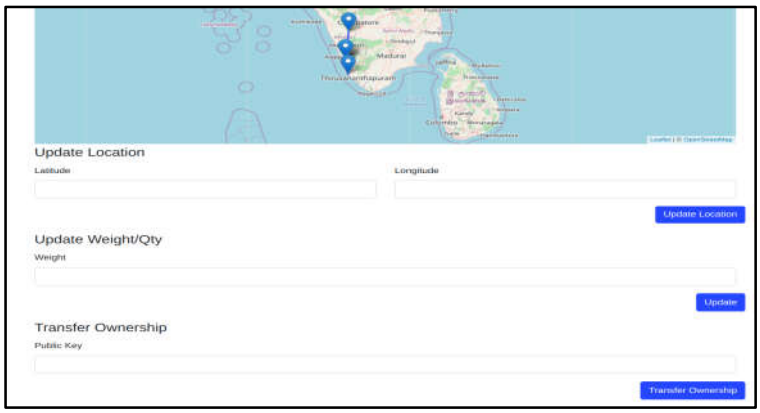

Figure 5: Updating and transferring ownership

7. CONCLUSION AND FUTURE WORK

The Proposed system focuses on improving the transparency of the public distribution system. This is possible by providing a map containing the geographical route covered by a commodity.Each agent on receiving a load, update the location of the commodities to the current location. As each user updates on receiving ,the complete path covered by the commodity can be obtained. E-PDS web application uses the concepts of blockchain that is,for each update of a commodity,a new block is created with the necessary information being hidden and each block is linked to each other cryptographically. As a future scope, we can implement IOT features [9] on the elements and use live tracking of commodities to ensure quality of each has never adulterated, but the public distribution system architecture is currently not able to support these features.

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