SRI RAMACHANDRA
INSTITUTE OF HIGHER EDUCATION AND RESEARCH
(Category - I Deemed to be University) Porur, Chennai
SRI RAMACHANDRA ENGINEERING AND TECHNOLOGY

CSE 345 – BLOCK CHAIN TECHNOLOGIES

CA4-BLOCKCHAIN BASED SUPPLY CHAIN

Submitted to

SRI RAMACHANDRA INSTITUTE OF HIGHER EDUCATION AND RESEARCH
SRI RAMACHANDRA ENGINEERING AND TECHNOLOGY

For the Award of the Degree of

BACHELOR OF TECHNOLOGY
In
COMPUTER SCIENCE AND ENGINEERING
(Cyber Security and Internet of Things)

By

SHRIRAM K.P (E0219007)
UMESH KUMAR M (E0219019)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
SRET, PORUR, CHENNAI- 600116
OCTOBER 2022

SRI RAMACHANDRA
INSTITUTE OF HIGHER EDUCATION AND RESEARCH
(Category - I Deemed to be University) Porur, Chennai
SRI RAMACHANDRA ENGINEERING AND TECHNOLOGY

BONAFIDE CERTIFICATE

This is to certify that the subject report submitted by SHRIRAM KP is a record of original work done and submitted to SRI RAMACHANDRA ENGINEERING AND TECHNOLOGY during the academic year 2022 in partial fulfilment of the requirements for the award of the degree of BACHELOR OF TECHNOLOGY in COMPUTER SCIENCE AND ENGINEERING (Cyber Security and Internet of Things.)

Course Faculty
Prof. Priya
Sri Ramachandra Engineering and Technology
Porur, Chennai-600116

Vice-Principal
Dr. M.Prema
Sri Ramachandra Engineering and Technology
Porur, Chennai-600116

Evaluation Date:

ACKNOWLEDGEMENT

We express our sincere gratitude to our Chancellor, Vice-Chancellor and our sincere gratitude to our Provost Dr.V. Raju and our Vice-Principal Prof.M. Prema for their support and for providing the required facilities for carrying out this study.

We wish to thank our faculty, Prof. Priya, Assistant Professor, Sri Ramachandra Engineering and Technology for extending help and encouragement throughout the project. Without her continuous guidance and persistent help, this project would not have been a success for us.

We are grateful to Department of Computer Science and Engineering, Sri Ramachandra Engineering and Technology, our beloved parents and friends for extending the support, who helped us to overcome obstacles in the study.

TABLE OF CONTENTS

Abstract

We keep track of the path taken by dairy products from producer to consumer in an effort to integrate the digital and physical worlds. IoT sensors may link together. any goods that have been given to a third party for transportation, including Possession, ownership, and measurement data that can be tracked such as place, climate, humidity, and movement; for example, curd, milk, etc. The ultimate consumer has access to the full record. of specifics and has confidence that the data is precise and true. Blockchain, one of the newest technologies, is a fantastic solution for handling the supply chain management's effectiveness since it uses the public universal ledger that is disseminated. The following are some ways that blockchain technology benefits the supply-chain industry: it decreases errors, prevents product delays, eradicates fraud, enhances management, boosts consumer and supplier trust, and so on. Blockchain records data regarding a range of transactions involving commodities and services, which are recorded and tracked in real time, in the event that there is a lack of transparency.

Introduction

Managing a supply chain is challenging, even for small businesses. When viewed from a larger perspective, the supply chain begins to resemble a web rather than a chain due to its high degree of interconnection. Despite the deployment of Enterprise Resource Planning (ERP) solutions and digital shipment tracking tools, there are still numerous complications and product losses. By capturing each and every step, blockchain effectively acts as an incorruptible ledger, making it much simpler to track compliance efforts. Due to record errors, billing issues, fraud, and corruption, the entire supply chain needs to be audited by unbiased third parties, and it should be done frequently. However, envision a scenario in which the entire supply chain could be managed electronically, from the initial phase of raw materials to the final phase of customer delivery, without a single error occurring in the process, without the need to maintain any checkpoints, and without the need for any time-consuming weighs.

Since the creation of Bitcoin, blockchain technology has been at the center of the financial discussion. All transactions are available to all authorized users and may be tracked within the ledger thanks to this open-source technology. The blockchain is a robust technology. The transactions that are processed are unchangeable and irrevocable, and it does not have a single point of failure.

In a blockchain, transactions are processed directly between a single peer and the end user peer, with little to no middlemen.

One advantage of a blockchain ledger is that it updates automatically, requiring less time and labor.

Due to the simultaneous execution of both sides of the transaction. The major resource needed is computing power, which is less expensive than typically employed human resources. The use of blockchain technology would eliminate the need for track reconciliation.

The following are the eight major aspects to consider when developing Hyperledger fabric:

1.**Blockchain Architect:** Creates the blockchain solution from scratch.

2.**Blockchain User:** A business user who works in a business network but is unaware of the Blockchain. To interact with the Blockchain, they use an application.

3.**Blockchain Regulator:** They are the authority in a business network and may require broad access to the ledger's contents.

4.**Blockchain Developer:** They create smart contracts in addition to applications. These contracts interact with the Blockchain and are used by users of the Blockchain.

5.**Blockchain Operator:** A blockchain's operators perform the basic functions of determining who can participate in the blockchain, distributing blocks to participants, and so on.

6.**Membership Services:** These services manage the various types of certificates required to run an authorized Blockchain.

7.**Traditional Processing Platform:** This is an existing computer system that the Blockchain can use to simulate processing.

8.**Traditional Data Coordinator:** A traditional data coordinator is an existing data system that provides data that may influence the characteristics of smart contracts.

Literature review

"RFID-based garment supply chain management system research" [1]: This paper provides a brief overview of RFID's application in the garment supply chain. It provides information about the EPC global network and explains how transparency can be achieved throughout the supply chain.

"Overview of blockchain-related business innovations and research opportunities, as well as an introduction to the special issue" [2]: This paper provides us with an overview of blockchain research and development. It also provides a brief overview of how blockchain is used to implement bitcoins.

"A distributed ledger-based blockchain-ready manufacturing supply chain" [3]: This paper discusses how blockchain can be used to develop global supply networks.

"IoT Blockchain as a Service"[4]: This paper discusses how blockchain can play an important role in IoT.

"A Systematic Literature Review of Blockchain for the Internet of Things" [5]: This paper proposes a number of case studies that demonstrate the use of blockchain in IoT.

"A review and bibliometric analysis of big data and supply chain management." [6] : This paper discusses how big data and analytics can be used to improve supply chain management.

You can record transactions in the hyperledger, and they cannot be changed or deleted without the permission of every peer. [7].

As a result, the Supply Chain becomes more secure and reliable, and data efficiency can be increased. [8].

Technical Background

Our system is a licensed blockchain network established by organizations with the goal of forming an association. The organizations that construct the Hyperledger Fabric network are referred to as "members."

Each member is responsible for arranging for peers to join the blockchain network. The needs of all network peers are met by providing cryptographic material such as Certificate Authorities and related information.

Given the task of providing a supply chain system that would connect many small businesses, we wanted to minimize the need for expensive infrastructure, and because the target sector was dairy products, we also wanted to provide a system that non-technical people could learn and use.

As a result of the ubiquity of mobile devices and people's familiarity with them, we decided to make the system available via a mobile app. We built the app with react-native so that we could target both Android and iOS in a single app, as well as convert it to a desktop webapp with minimal changes. We chose Hyperledger Composer for the server-side blockchain implementation. Its user-friendly interface allowed us to jump right in and get started, and its modeling language mapped well to our problem domain.

The following software is used:

1. **Hyperledger Fabric**: This framework is used to implement blockchains. The primary motivation for creating Hyperledger Fabric was to provide a modular architecture. Fabric's platform is licensed. Fabric's distinguishing feature is that it supports pluggable consensus protocols. In Fabric, a smart contract, also known as chain code, serves as an agreement among peers.

2. **Hyperledger Composer**: Hyperledger is a collection of tools and scripts that make business network development easier and faster. We can develop and deploy the solution in less time by using the hyperledger composer. Javascript was used to create the tools.

3. **Docker**: Docker assists us in developing our application by creating an environment in the form of containers. Because the applications are contained within our mobile phones, they are immune to attacks and difficult to hack. Similarly, various platforms such as MongoDB, MySQL, and others are already present as software packages (containers), and thus Docker has implicit security settings.

4. **Loopback**: As the name implies, loopback is commonly used in troubleshooting or connecting with servers on the same machine because it ECHOs the request and response and 127.0.0.1 routes back to the same machine. This range can be anywhere between 127.0.0.0 and 127.255.255.255.

5. **IPFS**: IPFS is an acronym that stands for Interplanetary File System. It creates a distributed web in which data is stored within nodes and there is no data duplication between nodes. Each file is assigned a distinct cryptic hash. There isn't just one point of failure.

Furthermore, each and every piece of data can be owned by an individual rather than a group. For example, if you have a website hosted on the IPFS and the government shuts down the network, your website will never be unavailable.

Methodology

There are raw material suppliers who send the material to the factory, and this material can be of good or bad quality. Temperature and humidity are important factors in determining the quality of raw materials, particularly milk.

The minimum and maximum temperature criteria, as well as penalties in various scenarios, are included in the smart contract. Temperature and humidity are now checked using sensors prior to receiving the shipment, and this information is compared to the information in the Smart contract, and a penalty (if any) is assigned. The shipment's price and penalty are calculated after it is received. In this manner, the shipper, importer, and exporter will be charged or paid in accordance with the scenario.

This entire data is recorded in the block, and as the raw material is transformed into a product and delivered, the entire information is stored in the chain of blocks. This blockchain data cannot be modified or deleted.

System flow Architecture

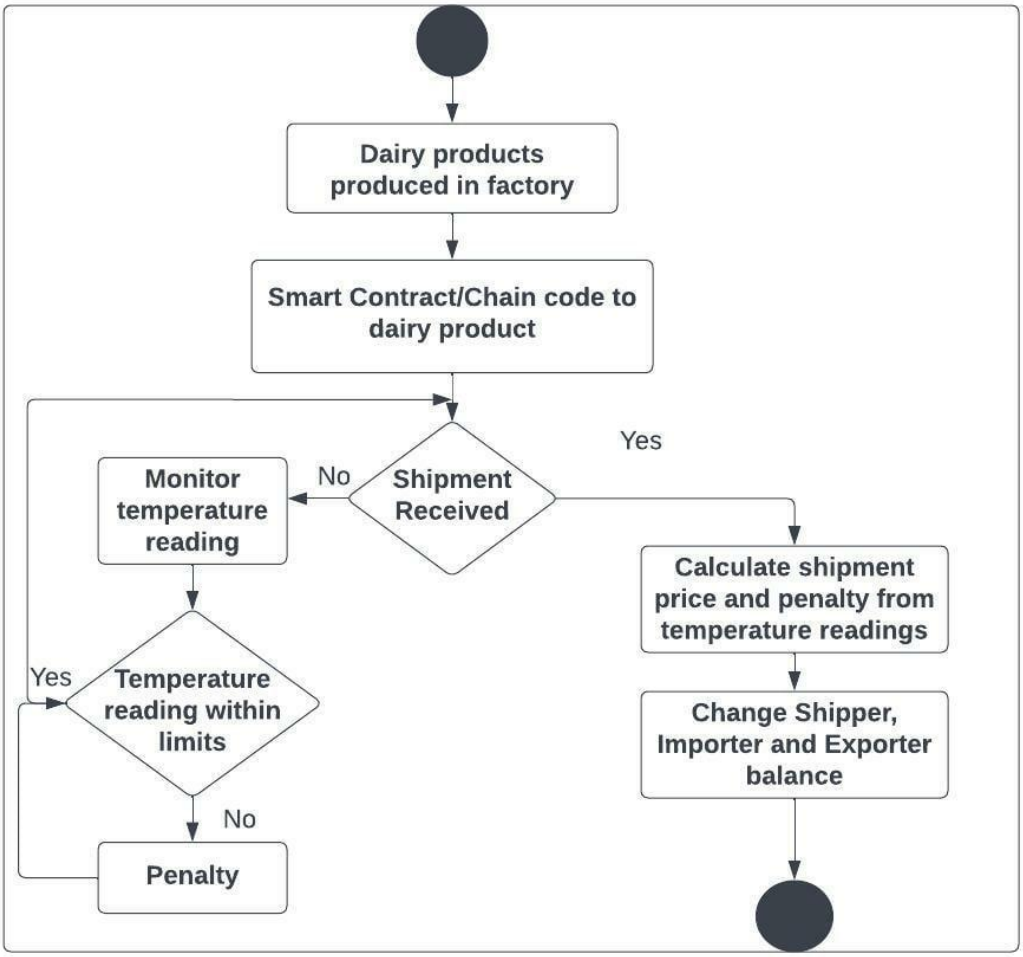

Fig. 1 Activity Diagram

Implementation

1. When a dairy product is manufactured, a smart contract code for that product is created and updated in blockchain.

2. The smart contract will specify how the goods should be processed and distributed in the market.

3. If the shipment is not received, check the temperature to see if it is within acceptable limits.

4. If it is within the limit, proceed to the next process; otherwise, charge a penalty and proceed to the next process.

5. After receiving the shipment, we will calculate the shipment price and penalty based on temperature readings and save it in the json file.

6. Finally, with the addition of a new node to the blockchain, update the values of the Shipper, Importer, and Exporter balances.

7. Based on the flow chart above, these processes will be triggered automatically.

Results

1. Hyperledger fabric is installed with composer tools which will allow us to deploy our smart contract on our own blockchain.

```
===> list out hyperledger docker images
hyperledger/fabric-tools     2.4       d2f5f013cf70   4 months ago   489MB
hyperledger/fabric-tools     2.4.4     d2f5f013cf70   4 months ago   489MB
hyperledger/fabric-tools     latest    d2f5f013cf70   4 months ago   489MB
hyperledger/fabric-peer      2.4       080114f6c98f   4 months ago   64.2MB
hyperledger/fabric-peer      2.4.4     080114f6c98f   4 months ago   64.2MB
hyperledger/fabric-peer      latest    080114f6c98f   4 months ago   64.2MB
hyperledger/fabric-orderer   2.4       9e5c2bd3cd99   4 months ago   36.7MB
hyperledger/fabric-orderer   2.4.4     9e5c2bd3cd99   4 months ago   36.7MB
hyperledger/fabric-orderer   latest    9e5c2bd3cd99   4 months ago   36.7MB
hyperledger/fabric-ccenv     2.4       b01eeb054e4c   4 months ago   520MB
hyperledger/fabric-ccenv     2.4.4     b01eeb054e4c   4 months ago   520MB
hyperledger/fabric-ccenv     latest    b01eeb054e4c   4 months ago   520MB
hyperledger/fabric-baseos    2.4       1c37de9bc07b   4 months ago   6.86MB
hyperledger/fabric-baseos    2.4.4     1c37de9bc07b   4 months ago   6.86MB
hyperledger/fabric-baseos    latest    1c37de9bc07b   4 months ago   6.86MB
hyperledger/fabric-ca        1.5       b2aed5002b3d   6 months ago   68.1MB
hyperledger/fabric-ca        1.5.3     b2aed5002b3d   6 months ago   68.1MB
hyperledger/fabric-ca        latest    b2aed5002b3d   6 months ago   68.1MB
```

Fig. 2

2. Docker is installed with CouchDB for data handling and docker will manage separate IDs in separate containers

```
CONTRIBUTING.md                                token-utxo
root@ubuntu:/home/kp/Desktop/fabric-network/fabric-samples# cd fabric-samples/t
est-network
./network.sh up createChannel -ca -c mychannel -s couchdb
bash: cd: fabric-samples/test-network: No such file or directory
bash: ./network.sh: No such file or directory
root@ubuntu:/home/kp/Desktop/fabric-network/fabric-samples# cd ..
root@ubuntu:/home/kp/Desktop/fabric-network# cd fabric-samples/test-network
./network.sh up createChannel -ca -c mychannel -s couchdb
Using docker and docker-compose
Creating channel 'mychannel'.
If network is not up, starting nodes with CLI timeout of '5' tries and CLI dela
y of '3' seconds and using database 'couchdb with crypto from 'Certificate Auth
orities'
Bringing up network
LOCAL_VERSION=2.4.4
DOCKER_IMAGE_VERSION=2.4.4
CA_LOCAL_VERSION=1.5.3
CA_DOCKER_IMAGE_VERSION=1.5.3
Generating certificates using Fabric CA
Creating network "fabric_test" with the default driver
Creating ca_org1    ... done
Creating ca_orderer ... done
Creating ca_org2    ... done
```

Fig. 3

3. Smart contract code and the main function is established in solidity language for flexibilty and penalty constraints will be added to it.

```
pragma solidity 0.5.1;
contract mintYourCoins {
    address public minter;
    mapping (address => uint) public balance;
    event send(address from, address to, uint amount);

    constructor() public {
        minter = msg.sender;
    }
    function mint (address receiver, uint amount) public {
        require(msg.sender == minter);
        require(amount < 1e60);
        balance[receiver] += amount;
    }
    function sent (address receiver, uint amount) public {
        require(amount <= balance[msg.sender], "Insufficient Balance");
        balance[msg.sender] -= amount;
        balance[receiver] += amount;
        emit send(msg.sender, receiver, amount);
    }

    function balances(address _account) external view returns (uint) {
        return balance[_account];
    }
}
```

Fig. 4

4. Container IDs can be viewed using “docker ps -a” command and it lists the IDs

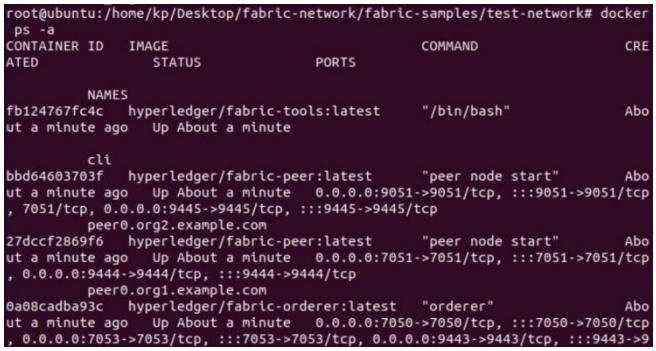

Fig. 5

5. Testing of the Smart contract by sending and receiving the money based on penalty

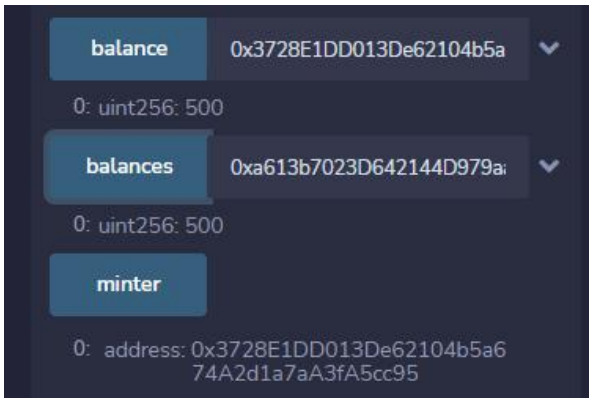

Fig. 6

Discussion

The smart contract with key elements stored in a json file for temperature reading factor and determining the penalty value to the total cost in smart contract code format. These values will be verified and updated in the blockchain blocks. The contract is then automatically invoked in accordance with the constraints, and a penalty is added to the goods received. The implementations described above make the supply chain more reliable and secure. It will also keep the goods' authenticity. The supply chain will be improved and successfully maintained as a result of this.

Conclusion

Thus, blockchain assisted us in overcoming supply chain issues such as eliminating expired food from consumption. It would also aid in the equitable distribution of revenue generated. Among those involved in the food supply chain Transparency and security throughout the supply chain is possible thanks to the undertaking Furthermore, smart contracts can aid in the elimination of costly. Delays and waste are currently occurring as a result of manual handling of paperwork.

Reference

[1] Bo Yan, Bo Du; “Research on garment supply chain management system based on RFID”, 2009 ISECS International Colloquium on Computing, Communication, Control, and Management [29 September 2009] ISBN978-14244-4247-8 978-1-4244-4247-8.

[2] J. Leon Zhao Shaokun Fan, Jiaqi Yan; “Overview of business innovations and research opportunities in blockchain and introduction to the special issue”. [15 December 2016].

[3] Abey Ratne, Saveen A., Monfared, Radmehr P., “Blockchain ready manufacturing supply chain using distributed ledger”. eSAT; 2321-7308.

[4] Mayra Samaniego,Ralph Deters,”Blockchain as a Service for IoT”, 2016 IEEE International Conference on Internet of Things (iThings) and IEEE Green Computing and Communications (GreenCom) and IEEE Cyber, Physical and Social Computing (CPSCom) and IEEE Smart Data (SmartData)[04 May 2017]

[5] Marco Conoscenti, Antonio Vetrò, Juan Carlos De Martin,” Blockchain for the Internet of Things: A systematic literature review”, : 2016 IEEE/ACS 13th International Conference of Computer Systems and Applications (AICCSA)[12 June 2017].

[6] Deepa Mishra, Angappa Gunasekaran, Thanos Papadopoulos, Stephen J. Childe, “Big Data and supply chain management: a review and bibliometric analysis”.

[7] Schatsky, David, and Craig Muraskin. "Beyond bitcoin."

[8] A.J., Dweekat, G., Hwang, and J. Park, “A supply chain performance measurement approach using the internet of things: toward more practical SCPMS,” Industrial Management & Data Systems, 117(2), pp. 267-286, 2017.