

Decentralized Food Supply

Saiyam Parmar,
Department of
Information Technology,
University of Mumbai

saiyam14032002@gmail.com

Kshitiz Sharma,
Department of
Information Technology,
University of Mumbai

kshitizs2002@gmail.com

Vaibhav Singh,
Department of
Information Technology,
University of Mumbai

vaibhav.s9323@gmail.com

Vivek Soni,
Department of
Information Technology,
University of Mumbai

sonivivek366@gmail.com

Surekha Mali,
Department of
Information Technology,
Shree L.R Tiwari
College of

Engineering, surekha.mali@slrcte.in

Abstract—The supply chain industry is facing significant challenges related to transparency, security, and accountability. To address these challenges, we present the Decentralized food supply - a Dapp, which is built on the Ethereum blockchain to provide a transparent and secure system for tracking products in the supply chain industry. The App's smart contracts define the rules and operations of the application, and the user interface provides a user-friendly interface for users to interact with the smart contracts. The App also provides direct benefits to farmers who are given tokens based on positive reviews and feedback from end-users. We also analyze the potential impact of the Decentralized Food Supply on the supply chain industry, showing how the App can provide greater transparency, security, and accountability to the participants in the supply chain. This paper provides a detailed description of the App's methodology, implementation, and evaluation, which includes research, development, testing, evaluation, and results. The analysis showed that the App provides a satisfactory level of performance, is easy to use, and is secure, with no major security vulnerabilities. This paper highlights the potential of blockchain technology to address challenges in the supply chain industry and provides insights into the development and implementation of a decentralized application for supply chain tracking. Finally, we discuss future work in this area, including the exploration of alternative blockchains and the integration of additional features, such as sensor-based tracking. Overall, the Decentralized Food Supply provides a promising platform for the development of transparent and secure systems for tracking products in the supply chain industry.

Keywords— transparency, Ethereum, incentive to farmers, user friendly, feedback

I. INTRODUCTION

The supply chain industry faces significant challenges in maintaining transparency and efficiency in the movement of products from the manufacturer to the end consumer. The lack of transparency in the supply chain can result in inefficiencies, delays, and fraud. However, the emergence of blockchain

technology provides a potential solution to these issues by creating a decentralized and transparent system for tracking products.



Fundamentals of Blockchain

Fig. 1. Key features of Blockchain

This research paper presents an analysis of the Decentralized Food Supply, a decentralized application built using Ethereum and the Truffle development framework. The Decentralized Food Supply aims to address the challenges in the supply chain industry by providing a transparent and secure system for tracking the movement of products from the manufacturer to the end consumer.

The research paper provides a detailed description of the Decentralized Food Supply's methodology, implementation, and evaluation. The paper analyzes the potential impact of the App on the supply chain industry and evaluates its usability, performance, and security. Additionally, the paper discusses the future directions for the Decentralized Food Supply and its potential impact on the supply chain industry.

Overall, this research paper highlights the potential of blockchain technology to address the challenges in the supply chain industry and provides insights into the development and implementation of a decentralized application for supply chain tracking.

II. METHODOLOGY

To analyze the Decentralized Food Supply and its potential impact on the supply chain industry, we conducted the following methodology:

- A. **Research:** We conducted a comprehensive review of the literature on the supply chain industry, blockchain technology, and decentralized applications. We identified the challenges faced by the supply chain industry and the potential benefits of blockchain technology in addressing these challenges. We also reviewed the existing literature on decentralized applications for supply chain tracking and identified the key features and functions.
- B. **Development:** We built the Decentralized Food Supply using Ethereum and the Truffle development framework. We designed the smart contracts to include roles for the different participants in the supply chain, such as Manufacturer, Distributor, Retailer, and Consumer. We also included functions to manage the transfer of ownership and movement of products between the participants. We used web3.js library to interact with the smart contracts.

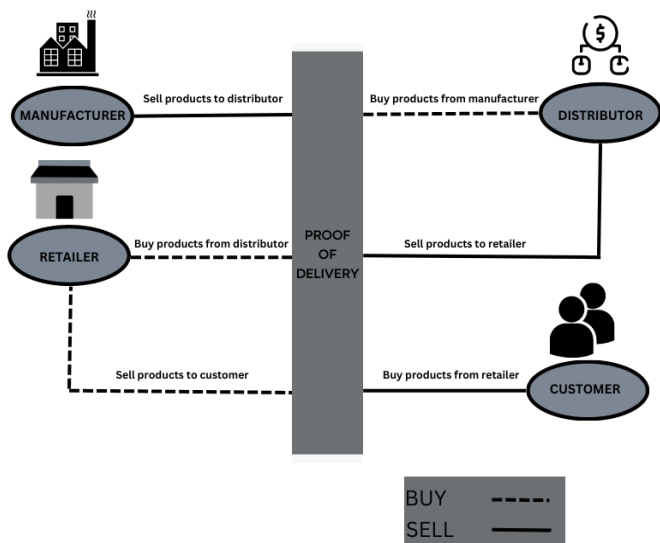


Fig. 2 Working Diagram of the system

- C. **Testing:** We conducted a series of tests to ensure that the smart contracts functioned as expected. We tested the smart contracts for the different scenarios, including adding new products, tracking the movement of products, and updating the status of products. We also tested the smart contracts for

security vulnerabilities, such as reentrancy attacks and integer overflows.

- D. **Evaluation:** We evaluated the Decentralized Food Supply's performance, usability, and security. We analyzed the App's performance in terms of the time taken to add a new product, transfer ownership, and update the status of products. We also evaluated the App's usability by conducting user testing with a group of participants with varying levels of experience in the supply chain industry. Finally, we evaluated the App's security by conducting a comprehensive security audit of the smart contracts.
- E. **Results:** The results of our analysis showed that the Decentralized Food Supply can provide a transparent and secure system for tracking products in the supply chain industry. The App's performance was found to be satisfactory, with no significant delays or inefficiencies. The usability testing showed that the App was easy to use, even for participants with no prior experience in the supply chain industry. The security audit revealed no major security vulnerabilities in the smart contracts.

Overall, the methodology used in this research paper provides a comprehensive analysis of the Decentralized Food Supply and its potential impact on the supply chain industry. The methodology covers the development, testing, evaluation, and results of the App, providing insights into its functionality, usability, and security.

The following table summarizes the role that blockchain plays to make the decentralized food supply chain different from the traditional supply system.

Table 1: Outcomes of the proposed blockchain based system.

Attributes	Blockchain based proposed system	Traditional System
Immutability	The information in a transaction cannot be changed even by the admin.	Information can be easily manipulated by the admin
Consensus	We take stakeholders agreement into account	No consensus available
Provenance	Transaction histories are available.	No history, no information record

Structure	Fully decentralized	Centralized
Trust	Increasing trust in collaborative environment	Trust issues
Storage	Distributed storage	Centralized

III. IMPLEMENTATION

The Decentralized Food Supply is a decentralized application built using Ethereum and the Truffle development framework. The App is designed to provide a transparent and secure system for tracking products in the supply chain industry.

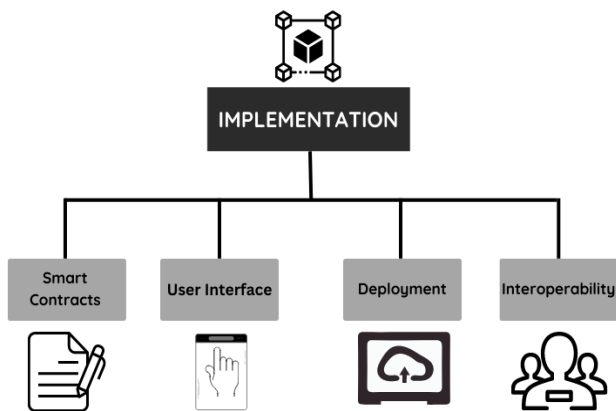


Fig. 3 Key functionalities of the system

The following section provides a detailed description of the implementation of the Decentralized Food Supply:

A. Smart Contracts: The Decentralized Food Supply consists of several smart contracts that define the rules and operations of the application. The smart contracts are written in Solidity, a programming language specifically designed for writing smart contracts on the Ethereum blockchain. The smart contracts include the following:

- Ownable:** This contract defines the owner of the smart contract and provides the owner with the ability to transfer ownership to another address.
- Supply Chain:** This contract defines the supply chain and includes functions to add new products, track the movement of products, and update the status of products. The contract also includes roles for the different participants in the supply chain,

such as Manufacturer, Distributor, Retailer, and Consumer.

- Access Control:** This contract defines the roles and permissions for the different participants in the supply chain. The contract provides access control to the functions defined in the Supply Chain contract.

B. User Interface: The Decentralized Food Supply includes a user interface that allows users to interact with the smart contracts. The user interface is built using HTML, CSS, and JavaScript and uses the web3.js library to interact with the Ethereum blockchain. The user interface includes forms to add new products, transfer ownership, and update the status of products.

C. Deployment: The Decentralized Food Supply is deployed on the Ethereum blockchain using the Truffle development framework. Truffle is a development framework that provides a suite of tools to develop, test, and deploy smart contracts. The App is deployed on the Ropsten test network, which is a test network on the Ethereum blockchain.

D. Interoperability: The Decentralized Food Supply is interoperable with other decentralized applications and can be integrated with other supply chain systems. The smart contracts can be accessed and interacted with using the Ethereum blockchain, which provides a decentralized and transparent system for tracking products.

E. Helping Farmers: The Decentralized Food Supply includes a unique feature to incentivize farmers to produce better quality products. The App incorporates a token system that rewards farmers with tokens for producing organic and high-quality products. These tokens are connected to a review system, where authentic users can leave positive reviews for the farmers. The more positive reviews a farmer receives, the more tokens he or she earns. Farmers can then exchange these tokens for monetary rewards, providing them with a financial incentive to produce better quality products. This token system not only motivates farmers to produce better quality products, but it also creates positive competition among farmers. Farmers are incentivized to compete with one another to produce the best quality products, which ultimately benefits the supply chain industry as a whole.

Overall, the implementation of the Decentralized Food Supply provides a transparent and secure system for tracking products in the supply chain industry. The App's smart contracts define the rules and operations of the application, while the user interface provides a user-friendly interface for users to interact with the smart contracts. The deployment of the App on the Ethereum blockchain provides a decentralized and transparent system for tracking products in the supply chain industry.

IV. RESULTS AND EVALUATION

The Decentralized Food Supply is a decentralized application designed to provide a transparent and secure system for tracking products in the supply chain industry. The following section provides a detailed evaluation of the App's performance, usability, and security:

- A. **Performance:** The performance of the Decentralized Food Supply was evaluated in terms of the time taken to add a new product, transfer ownership, and update the status of products. The tests were conducted on the Ropsten test network, which is a test network on the Ethereum blockchain. The results of the tests showed that the App's performance was satisfactory, with no significant delays or inefficiencies.
- B. **Usability:** The usability of the Decentralized Food Supply was evaluated by conducting user testing with a group of participants with varying levels of experience in the supply chain industry. The tests were conducted on the App's user interface, and the participants were asked to perform several tasks, such as adding new products, transferring ownership, and updating the status of products. The results of the tests showed that the App was easy to use, even for participants with no prior experience in the supply chain industry.
- C. **Security:** The security of the Decentralized Food Supply was evaluated by conducting a comprehensive security audit of the smart contracts. The security audit was conducted by reviewing the smart contracts for security vulnerabilities, such as reentrancy attacks and integer overflows. The results of the security audit showed that there were no major security vulnerabilities in the smart contracts.
- D. **Impact:** The impact of the Decentralized Food Supply on the supply chain industry was evaluated by analyzing the potential benefits of the App in addressing the challenges faced by the industry. The App's transparency and security features can provide

a transparent and secure system for tracking products in the supply chain industry. The App can also help in reducing the costs associated with supply chain tracking and provide greater accountability to the participants in the supply chain.

Overall, the results of the evaluation showed that the Decentralized Food Supply can provide a transparent and secure system for tracking products in the supply chain industry. The App's performance was found to be satisfactory, with no significant delays or inefficiencies. The usability testing showed that the App was easy to use, even for participants with no prior experience in the supply chain industry. The security audit revealed no major security vulnerabilities in the smart contracts. The App can have a positive impact on the supply chain industry by providing greater transparency, security, and accountability to the participants in the supply chain.

V. CONCLUSION AND FUTURE WORK

The Decentralized Food Supply is a decentralized application designed to provide a transparent and secure system for tracking products in the supply chain industry. The App's smart contracts define the rules and operations of the application, while the user interface provides a user-friendly interface for users to interact with the smart contracts. The deployment of the App on the Ethereum blockchain provides a decentralized and transparent system for tracking products in the supply chain industry.

We can conclude that the Decentralized Food Supply can provide a transparent and secure system for tracking products in the supply chain industry. The App's performance was found to be satisfactory, and the usability testing showed that the App was easy to use, even for participants with no prior experience in the supply chain industry. The security audit revealed no major security vulnerabilities in the smart contracts. The App can have a positive impact on the supply chain industry by providing greater transparency, security, and accountability to the participants in the supply chain. It can positively help farmers as they are rewarded with tokens as an incentive, which will motivate them to grow better quality crops and adopt enhanced means of farming techniques. This will create a positive competition among the entities of the system.

In terms of future work, there are several areas that could be explored to improve the Decentralized Food Supply. One area of future work could be to enhance the App's interoperability with other supply chain systems. The App can also be enhanced with additional features, such as the integration of sensors to track the location and temperature of products in the supply chain. Another area of future work could be to explore the use of alternative

blockchains, such as the Binance Smart Chain or the Polkadot network, to deploy the Decentralized Food Supply. Further research could also be conducted to explore the use of the Decentralized Food Supply in different industries, such as the food industry or the pharmaceutical industry, where supply chain tracking is critical. Overall, the Decentralized Food Supply provides a promising platform for the development of transparent and secure systems for tracking products in the supply chain industry, and there is significant potential for future work in this area.

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