Food Tracking System

A Project report submitted in partial fulfillment of 7th semester in degree of

BACHELOR OF ENGINEERING IN **COMPUTER SCIENCE AND ENGINEERING**

Submitted by

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Team id	NM2023TMID03914
Project Name	Food Tracking System

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ANNA UNIVERSITY:CHENNAI-600025

INTRODUCTION

1.1 Project Overview:

Food Tracking System:

The food industry is currently experiencing a profound transformation, marked by a surge in consumer demands for enhanced transparency and safety throughout the supply chain. This transformation is driven by a collective concern for food safety, authenticity, and sustainability. In response to these pressing issues, we propose a forward-looking solution that harnesses the power of blockchain technology, specifically Ethereum, to create an innovative food tracking system. The ultimate objective of this project is to establish an immutable, decentralized ledger that delivers real-time access to critical data, such as the origin, processing, and transportation details of food products.

Enhanced Transparency: The central aim of this project is to develop a blockchain-powered solution that provides end-to-end transparency in the food supply chain. Through this system, customers can seamlessly track the journey of their food products, from their source to their own tables.

Safety Assurance: By utilizing smart contracts on the Ethereum blockchain, we seek to automate safety alerts and recalls. This ensures that customers receive immediate notifications in the event of any safety concerns or product recalls.

Sustainability Focus: As part of our commitment to sustainability, we aim to promote eco-friendly packaging and transportation methods. This empowers customers to make environmentally conscious choices and minimize their carbon footprint.

Health-Conscious Recommendations: In line with growing health-conscious consumer trends, we will offer personalized dietary and health recommendations based on individual customer preferences and dietary restrictions. This empowers customers to make healthier and more satisfying food choices.

Nutritional Information: We are dedicated to ensuring that comprehensive nutritional information is readily available on food labels and online platforms. This supports customers in making informed and health-conscious decisions regarding their food.

Customer Engagement: An integral component of this project is the establishment of a customer engagement platform. Through this platform, customers can actively participate, provide feedback, and report concerns related to the food products they encounter, thus playing a direct role in enhancing the food supply chain.

Authenticity and Third-Party Verification: The project will employ blockchain technology to

guarantee authenticity and accurate labeling. In addition, it will integrate third-party verification systems to independently validate the authenticity of premium and organic food products.

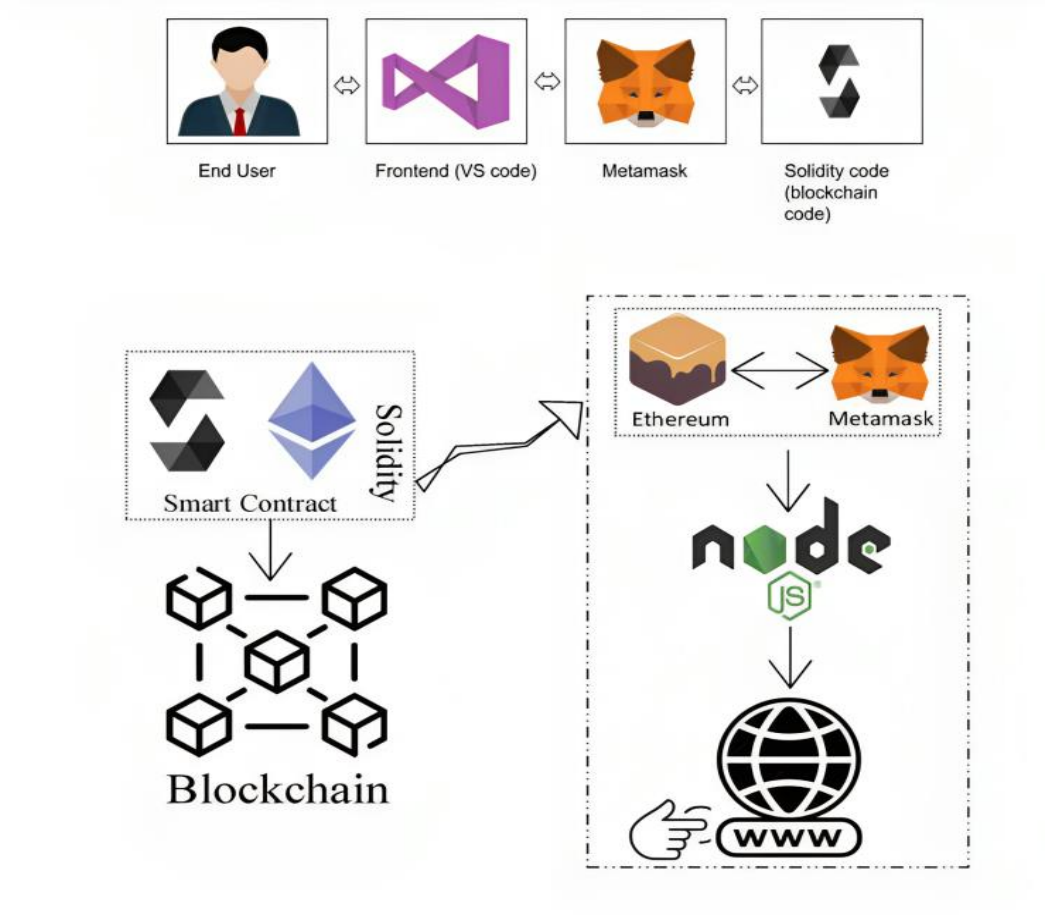


Fig:Solution Architecture Diagram

1.2 Purpose:

The purpose of implementing a food tracking system using smart contracts on the Ethereum blockchain in the food industry can be summarized as follows:

Enhancing Food Safety: Ensure the safety of food products by creating a transparent and tamper-proof system that records the journey of each food item. This technology helps in quickly identifying and addressing potential food safety issues, thereby safeguarding public health.

Ensuring Authenticity: Combat food fraud and ensure product authenticity by using blockchain to track the origin and production processes of food items. Consumers can have confidence in the accuracy of product labeling, preventing deceptive practices within the industry.

Improving Supply Chain Transparency: Increase transparency throughout the entire food

supply chain, allowing consumers and stakeholders to access real-time information about the origin, processing, and transportation of food products. This transparency helps build trust and accountability.

Addressing Consumer Concerns: Address the growing consumer demand for knowing where their food comes from, how it is produced, and its environmental impact. This system provides consumers with the information they need to make informed and ethical food choices.

Facilitating Sustainability: Support sustainability efforts in the food industry by tracking and verifying sustainable practices, such as responsible sourcing, eco-friendly production methods, and reduced waste. This can encourage more environmentally friendly production and consumption patterns.

Compliance with Regulations: Assist food producers and regulators in meeting compliance and reporting requirements, making it easier to adhere to food safety and labeling regulations. This can streamline regulatory processes and reduce the risk of non-compliance.

Preventing Food Waste: Reduce food waste by providing insights into the shelf life and handling of products. With better information, stakeholders can make data-driven decisions to minimize spoilage and waste.

Strengthening Trust: Build trust among consumers, retailers, and producers by demonstrating a commitment to transparency and safety. This can lead to increased customer loyalty and a competitive advantage in the marketplace.

Innovating the Food Industry: Explore the potential of blockchain and smart contracts to revolutionize the food industry, setting a new standard for accountability and traceability. This innovation can drive positive change in the sector.

Educating Stakeholders: Educate all stakeholders, from producers to consumers, about the benefits of blockchain-based food tracking. Increase awareness of the technology's potential to address key concerns and improve the industry.

2. LITERATURE SURVEY

2.1 Existing problem :

Lack of Transparency:

The current food supply chain lacks transparency, making it challenging for consumers, regulators, and producers to access critical information about food products.

Transparency issues include limited access to data related to food origin, processing, and transportation.

Traceability Concerns :

There are concerns regarding the ability to trace the journey of food products from their source to the consumer.

Traditional supply chain systems, including those with technologies like RFID and sensor networks, have not adequately addressed traceability concerns.

Food Safety :

Ensuring food safety is a significant challenge in the food industry supply chain.

Inadequate transparency and traceability can lead to difficulties in identifying and managing potential safety issues.

Food Authenticity :

Verifying the authenticity of food products, such as organic or locally sourced items, is a growing concern.

Current systems do not provide a robust way to confirm the authenticity of food items.

Sustainability :

Sustainability in the food industry, including factors like the environmental impact of transportation and production, is a pressing issue.

The lack of transparency and traceability hampers efforts to assess and improve sustainability.

2.2 Reference

1) Blockchain for Transparency and Traceability:

(Source: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7084604/):

The reference highlights the role of blockchain technology in providing transparency and traceability within the food industry supply chain.

The key emphasis is on the significance of addressing this pressing problem.

"Building a Better Election with Blockchain," by Brookings Institution - This article discusses the potential of blockchain to improve the security and transparency of elections.

2) Concerns of Stakeholders

(Source: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7084604/):

The paper recognizes the concerns of key stakeholders, including consumers, regulators, and producers.

Their worries revolve around food safety, authenticity, and sustainability.

The reference stresses the need for a system offering real-time access to critical information, including food product origin, processing, and transportation details.

3) Inadequacies of Traditional Systems

(Source: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7084604/):

Traditional food supply chain systems have integrated technologies like RFID, sensor networks, and data mining.

However, these systems are deemed inadequate for addressing the challenges presented by the current supply chain market.

2.3 Problem Statement Definition

The problem statement for the described food tracking system using blockchain technology on the Ethereum blockchain can be defined as follows:

Certainly, here's the problem statement structured as requested:

Problem Statement:

1. **Challenges in the Food Industry :**

- The food industry faces significant challenges related to transparency, traceability, food safety, authenticity, and sustainability.
- These challenges raise concerns among consumers, regulators, and producers about the reliability and integrity of food supply chains.

2. **Limitations of Traditional Methods:**

- Traditional methods of tracking and verifying the provenance of food products have limitations.
- These limitations hinder the ability to establish trust and ensure the accuracy of information in the supply chain.

3. **Need for a Novel Food Tracking System :**
- There is a pressing need for a new and innovative food tracking system that addresses the challenges in the food industry.
- This system should leverage advanced technology to establish transparency, security, and traceability.

4. **Blockchain Technology as a Promising Solution :**
- Blockchain technology, with its decentralized and immutable ledger, is identified as a promising solution to the challenges in the food industry.
- Blockchain has the potential to provide the necessary trust and transparency in the supply chain.

5. **Utilizing Smart Contracts on the Ethereum Blockchain :**
- The proposed solution focuses on designing and implementing a robust food tracking system that utilizes smart contracts on the Ethereum blockchain.
- Smart contracts offer automation and trust, enhancing the effectiveness of the system.

Key Components of the Problem Statement:

1. **Transparency and Traceability**: The food industry lacks a transparent and traceable system to provide consumers, regulators, and producers with real-time access to essential information about food products' origin, processing, and transportation.

2. **Trust and Security**: Ensuring the integrity and authenticity of the data in the food supply chain is critical. The current system may be vulnerable to fraud, inaccuracies, and unauthorized changes.

3. **Blockchain Technology**: Blockchain technology is a potential solution due to its decentralized and immutable ledger, which can secure data and provide a transparent record of each food product's journey.

4. **Smart Contracts**: The proposed system should leverage the capabilities of smart contracts on the Ethereum blockchain to automate and streamline various processes within the supply chain, ensuring reliability and efficiency.

5. **Unique Digital Identity**: Each food item must be assigned a unique digital identity to track its movement and activities in the supply chain.

6. **Real-time Access to Information:** Consumers, regulators, and producers should have real-

time access to critical information about food products, enhancing safety and decision-making.

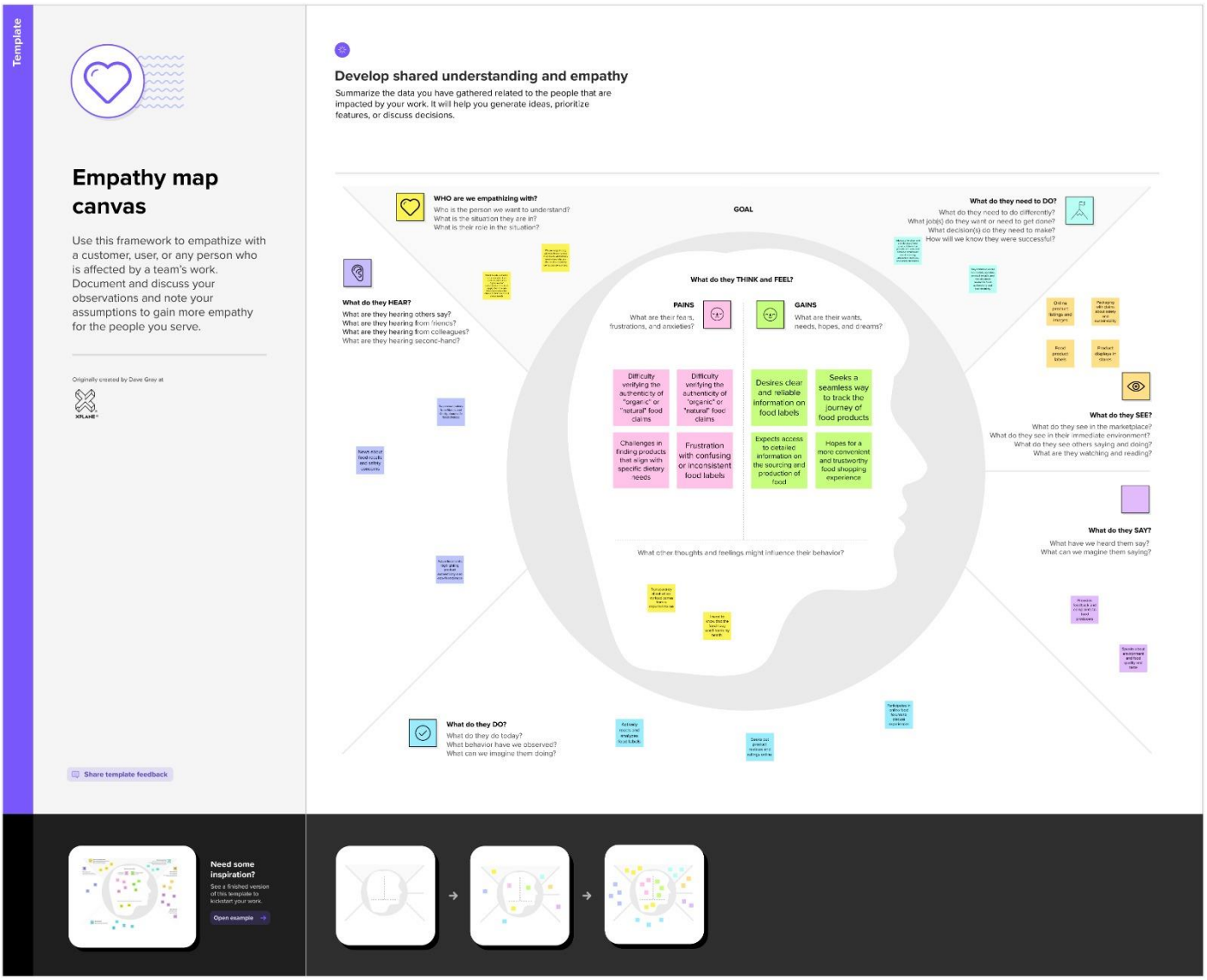
3 . IDEATION& PROPOSED SOLUTION

3.1 Empthay MapCanvas

An empathy map is a simple, easy-to-digest visual that captures knowledge about a user's behaviors and attitudes.

It is a useful tool to help teams better understand their users.

Creating an effective solution requires understanding the true problem and the person who is experiencing it. The exercise of creating the map helps participants consider things from the user's perspective along with his or her goals and challenges.



3,2 Ideation& Brainstorming:

Brainstorm & Idea Prioritization Template:

Brainstorming provides a free and open environment that encourages everyone within a team to participate in the creative thinking process that leads to problem solving. Prioritizing volume over value, out-of-the-box ideas are welcome and built upon, and all participants are encouraged to collaborate, helping each other develop a rich amount of creative solutions.

Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.

Step-1: Team Gathering, Collaboration and Select the Problem Statement:

Step-2: Brainstorm, Idea Listing and Grouping

2

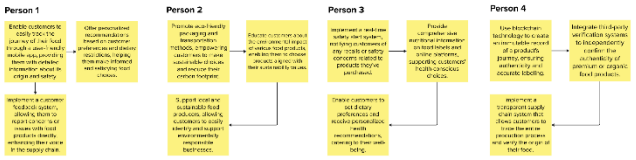
Brainstorm

Write down any ideas that come to mind that address your problem statement.

10 minutes

TIP

You can select a sticky note and hit the pencil [switch to sketch] icon to start drawing!



3

Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. Once all sticky notes have been grouped, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you and break it up into smaller sub-groups.

20 minutes

TIP

Add customizable tags to sticky notes to make it easier to find, browse, organize, and categorize important ideas as themes within your mural.

Enable customers to easily track the journey of their food through a user-friendly mobile app, providing them with detailed information about its origin and safety.

Use blockchain technology to create an immutable record of a product's journey, ensuring authenticity and accurate labeling.

Step-3: Idea Prioritization

4

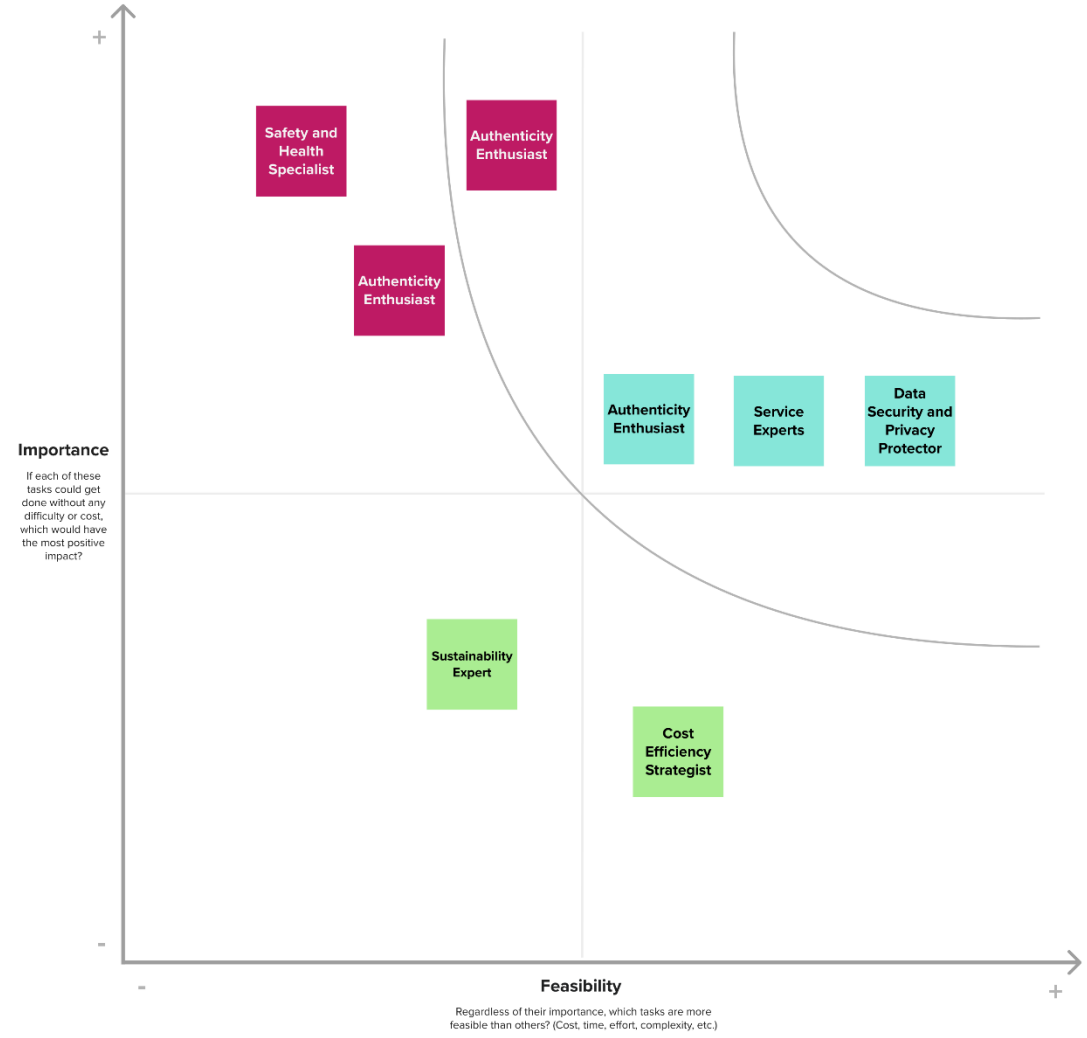
Prioritize

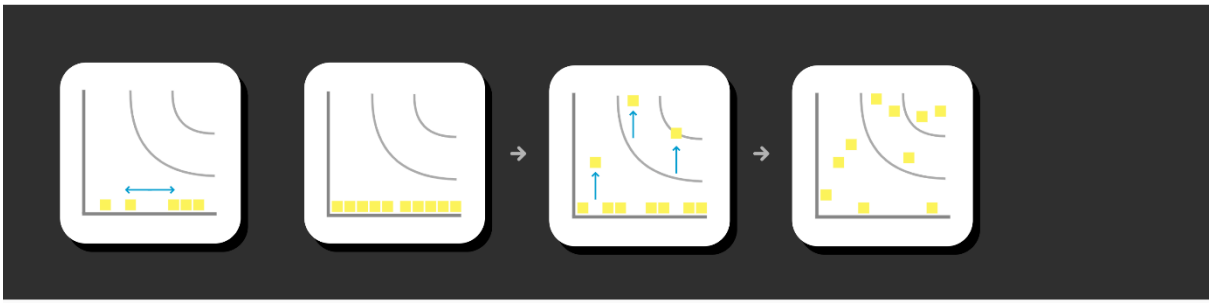
Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

20 minutes

TIP

Participants can use their cursors to point at where sticky notes should go on the grid. The facilitator can confirm the spot by using the laser pointer holding the **H key** on the keyboard.





4 . REQUIREMENT ANALYSIS:

4.1 Functional Requirements:

Requirement ID	Requirement Description	Priority	Notes
FR-001	Adding Food Items	High	Allow the owner to add food items, a core functionality with high priority.
FR-002	Verifying Food Items	Medium	Permit the owner to verify food items, confirming their authenticity.
FR-003	Consuming Food Items	Medium	Enable marking food items as "Consumed".
FR-004	Retrieving Food Item Details	Low	Provide a function to retrieve food item details.
FR-005	User Authentication	High	Ensure that only the owner can access the system, providing top-level security.

4.2 Non-functional Requirements:

The following are the non-functional requirements of the proposed solutions:

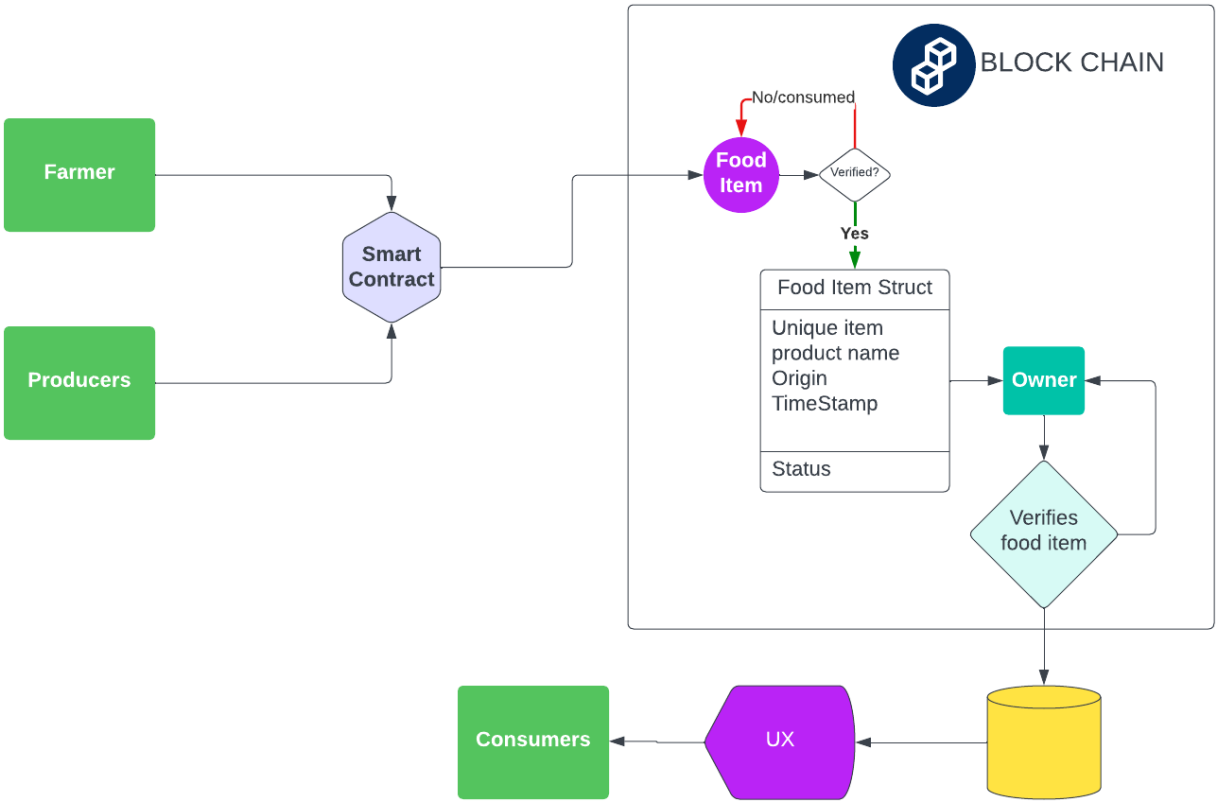
Requirement ID	Requirement Description	Priority	Notes
NFR-001	Security	High	Secure the system to allow only authorized access.
NFR-002	Usability	Medium	Ensure user-friendly interface for the owner
NFR-003	Performance	Medium	Optimize system performance.
NFR-004	Reliability	Medium	Prioritize system reliability and data security.
NFR-005	Scalability	Medium	Design for potential growth.

5 . PROJECT DESIGN:

5.1 Data Flow Diagram:

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat DFD can depict the right amount of the system requirement graphically. It shows data entering and leaving the system, what changes the information, and where data is stored.

Example:DFDLevel0(Industry Standard)



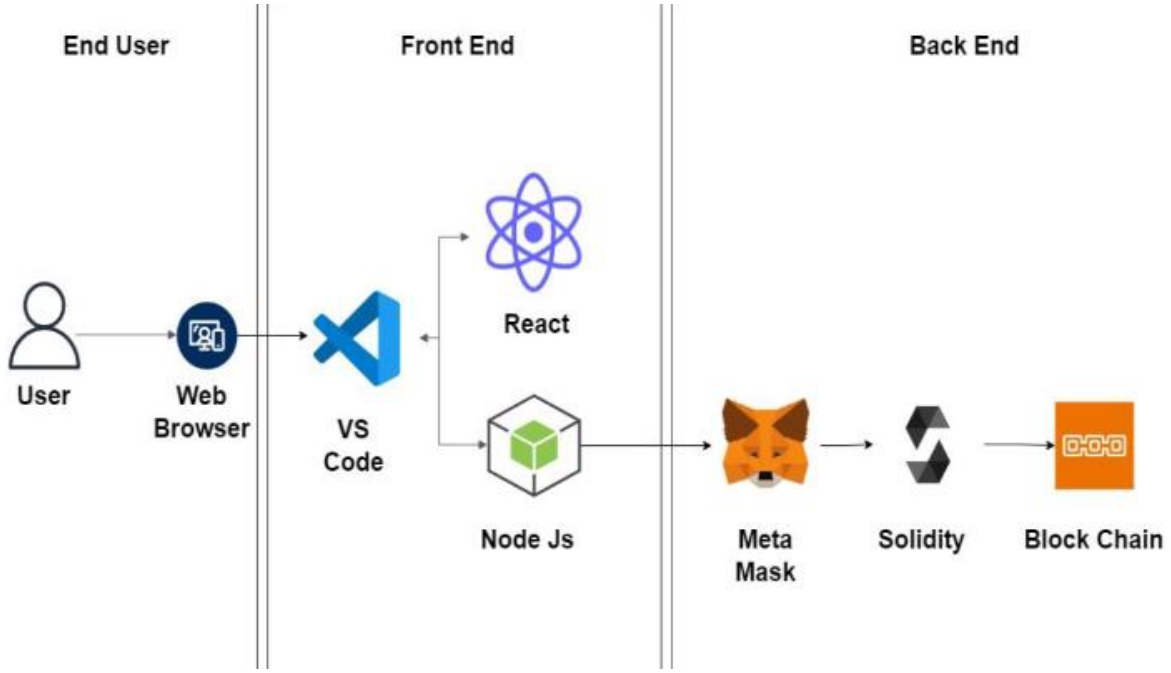
5.2 Solution Architecture

Solution Architecture:

Solution architecture is a complex process – with many sub-processes – thatbridgesthegapbetweenbusinessproblemsandtechnologysolutions.Itsgoalsare to:

- Find the best tech solution to solve existing business problems.
- Describe the structure, characteristics, behaviour, and other aspects of the software to project stakeholders.

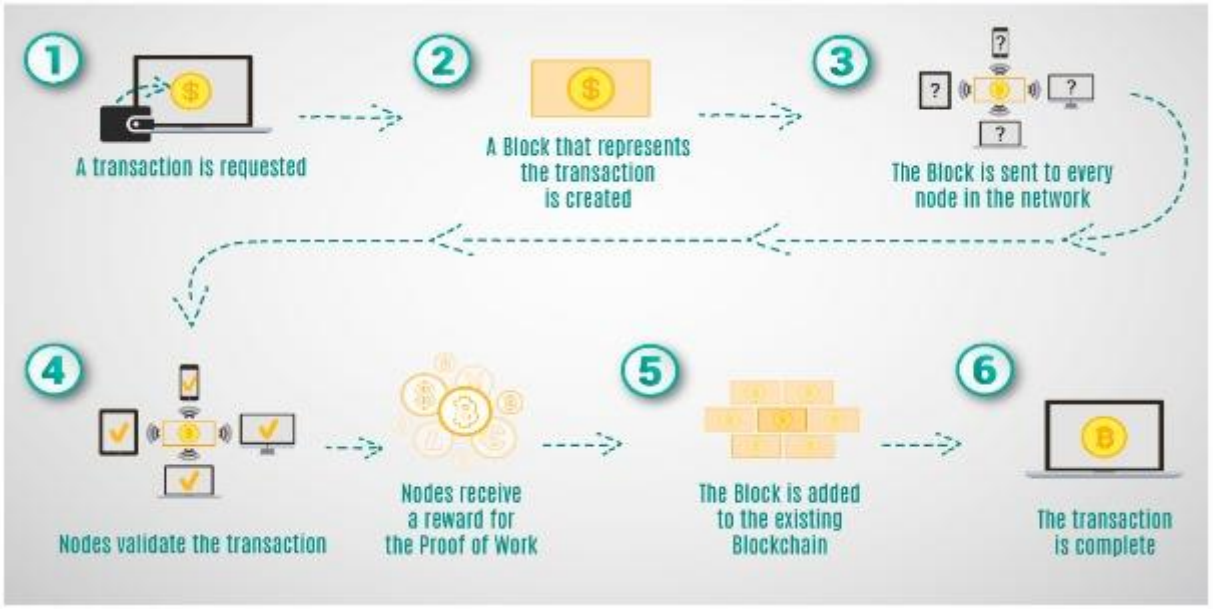
- Define features, development phases ,and solution requirements.



6 . PROJECTPLANNING AND SCHEDULING:

6.1 Technical Architecture:

Technical Architecture (TA) is a form of IT architecture that is used to design computer systems. It involves the development of a technical blueprint with regard to the arrangement, interaction, and interdependence of all elements so that system-relevant requirements are met.



6.2 Sprint Planning & Estimation:

Sprint planning is typically a collaborative effort between the development team, product owner, and stakeholders. It involves selecting a set of user stories or tasks to be completed during the upcoming sprint. For your project, which aims to design and implement a robust food-tracking system using blockchain technology, here's a simplified sprint planning example:

Sprint Duration: 2 weeks (You can adjust the duration as per your project's needs).

Sprint Goal: To lay the foundation for the food tracking system by setting up the Ethereum smart contract and creating a basic user interface for adding and tracking food items.

User Stories and Tasks:

User Story 1: Smart Contract Setup:

- Task 1: Set up the Ethereum development environment.

- Task 2: Create the Food-Tracking smart contract.

- Task 3: Implement the structure for FoodItem and its state variables.

- Task 4: Implement the constructor to set the contract owner.

User Story 2: Adding Food Items

- Task 5: Design the user interface for adding food items.

- Task 6: Implement the function to add food items to the blockchain**.**

- Task 7: Write unit tests for adding food items.

User Story 3: Verifying Food Items

- Task 8: Design the user interface for verifying food items.

- Task 9: Implement the function to verify food items.

- Task 10: Write unit tests for verifying food items.

User Story 4: Retrieving Food Item Details

- Task 11: Design the user interface for retrieving food item details.

- Task 12: Implement the function to retrieve food item details.

- Task 13: Write unit tests for retrieving food item details.

User Story 5: Smart Contract Deployment

- Task 14: Deploy the Food-Tracking smart contract on a testnet.

- Task 15: Interact with the deployed contract and validate basic functionality.

User Story 6: Documentation and Testing

- Task 16: Create user and developer documentation.

- Task 17: Conduct unit testing of all implemented features.

- Task 18: Review and document the test results.

6.3 Spring Delivery Schedule:

Day 1-2 (Task 1): Set up the Ethereum development environment (6 hours)

- The team will set up the Ethereum development environment, ensuring that everyone is ready to start working on smart contracts.

Day 3-4 (Task 2, 3, 4): Create the Food-Tracking smart contract and its structure (18 hours)

- Develop the core structure of the Food-Tracking smart contract and its state variables.

- Implement the constructor to set the contract owner.

Day 5-6 (Task 5): Design the user interface for adding food items (6 hours)

- Begin designing the user interface for adding food items to the blockchain.

Day 7-8 (Task 6, 7): Implement the function to add food items and write unit tests (12 hours)

- Code the function to add food items to the blockchain.

- Write unit tests to ensure the functionality is correct.

Day 9-10 (Task 8): Design the user interface for verifying food items (6 hours)

- Start designing the user interface for verifying food items on the blockchain.

Day 11-12 (Task 9, 10): Implement the function to verify food items and write unit tests (12 hours)

- Code the function to verify food items.

- Write unit tests to validate the verification process.

Day 13-14 (Task 11): Design the user interface for retrieving food item details (6 hours)

- Begin designing the user interface for retrieving detailed information about food items.

Day 15-16 (Task 12, 13): Implement the function to retrieve food item details and write unit

tests (12 hours)

- Code the function to retrieve food item details.

- Write unit tests to ensure the data retrieval works correctly.

Day 17-18 (Task 14): Deploy the Food-Tracking smart contract on a test-net (6 hours)

- Deploy the smart contract on a test-net for testing and validation.

Day 19-20 (Task 15): Interact with the deployed contract and validate basic functionality (6 hours)

- Verify that the deployed smart contract functions as expected and test its basic features.

Day 21-22 (Task 16): Create user and developer documentation (6 hours)

- Begin creating user and developer documentation for the system.

Day 23-24 (Task 17): Conduct unit testing of all implemented features (6 hours)

- Perform unit testing to ensure all features are functioning as intended.

Day 25-26 (Task 18): Review and document the test results (6 hours)

- Review the test results, document any issues or improvements, and prepare for the sprint review.

7. CODING & SOLUTIONS:

CODE:

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

contract FoodTracking {
   address public owner;

   enum FoodStatus {
      Unverified,
      Verified,
      Consumed
   }

   struct FoodItem {
      string itemId;
      string productName;
      string origin;
```

```
    uint256 sentTimestamp;
    FoodStatus status;
}

mapping(string => FoodItem) public foodItems;

event FoodItemSent(
    string indexed itemId,
    string productName,
    string origin,
    uint256 sentTimestamp
);
event FoodItemVerified(string indexed itemId);
event FoodItemConsumed(string indexed itemId);

constructor() {
    owner = msg.sender;
}

modifier onlyOwner() {
    require(msg.sender == owner, "Only contract owner can call this");
    _;
}

modifier onlyUnconsumed(string memory itemId) {
    require(
        foodItems[itemId].status == FoodStatus.Verified,
        "Item is not verified or already consumed"
    );
    _;
}

function sendFoodItem(
    string memory itemId,
    string memory productName,
    string memory origin
) external onlyOwner {
    require(
        bytes(foodItems[itemId].itemId).length == 0,
        "Item already exists"
    );

    foodItems[itemId] = FoodItem({
```

```
        itemId: itemId,
        productName: productName,
        origin: origin,
        sentTimestamp: block.timestamp,
        status: FoodStatus.Unverified
    });

    emit FoodItemSent(itemId, productName, origin, block.timestamp);
}

function verifyFoodItem(string memory itemId) external onlyOwner {
    require(
        bytes(foodItems[itemId].itemId).length > 0,
        "Item does not exist"
    );
    require(
        foodItems[itemId].status == FoodStatus.Unverified,
        "Item is already verified or consumed"
    );

    foodItems[itemId].status = FoodStatus.Verified;

    emit FoodItemVerified(itemId);
}

function consumeFoodItem(
    string memory itemId
) external onlyUnconsumed(itemId) {
    foodItems[itemId].status = FoodStatus.Consumed;

    emit FoodItemConsumed(itemId);
}

function getFoodItemDetails(
    string memory itemId
)
    external
    view
    returns (string memory, string memory, uint256, FoodStatus)
{
    FoodItem memory item = foodItems[itemId];
    return (item.productName, item.origin, item.sentTimestamp, item.status);
}
```

}

7.1. Ownership Management:
The contract has an owner address, which represents the owner of the contract. The owner can be set during contract deployment.

7.2. Food Status Enumeration:
The contract defines an enumeration called FoodStatus with three possible values: Unverified, Verified, and Consumed. This enum is used to track the status of food items.

7.3. Data Structure – Food Item:
The contract defines a FoodItem struct, which is used to represent individual food items. It includes the following attributes:

- itemId: A unique identifier for the food item.
- productName: The name or description of the food product.
- origin: Information about the origin of the food item.
- sentTimestamp: A timestamp indicating when the food item was sent or added to the system.
- status: The status of the food item, which can be one of the values from the FoodStatus enumeration.

7.4. Data Storage - foodItems Mapping:
The contract uses a mapping named foodItems to store food items. Food items are indexed by their unique itemId, and the corresponding FoodItem struct represents the stored data for each item.

7.5. Events:
The contract defines several events, including FoodItemSent, FoodItemVerified, and FoodItemConsumed. These events are emitted when specific actions occur in the contract, providing a way to log and track these events on the blockchain.

7.6. Constructor and Modifiers:
The contract's constructor sets the owner address to the address of the sender (the deployer of the contract).
It includes two modifiers:

- onlyOwner: Ensures that only the contract owner can execute specific functions.
- onlyUnconsumed: Ensures that a food item can be marked as "Consumed" only if it has been previously verified and is not already consumed.

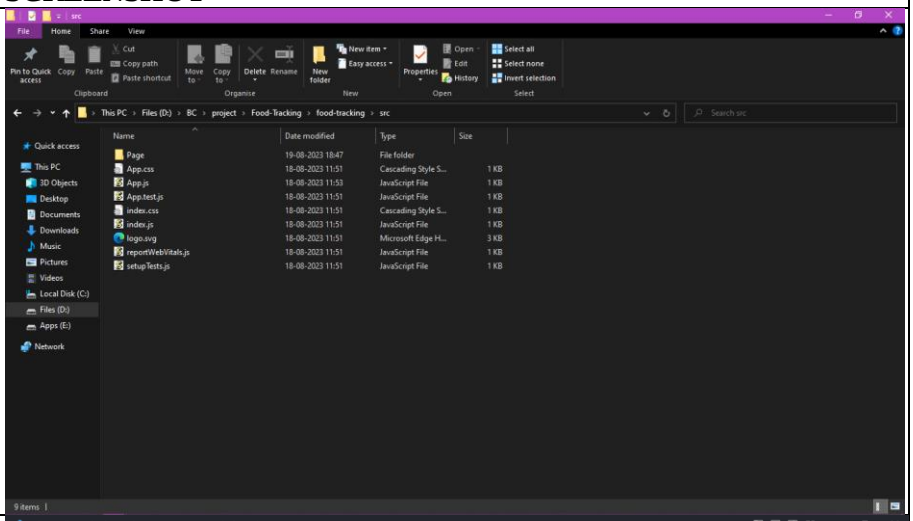
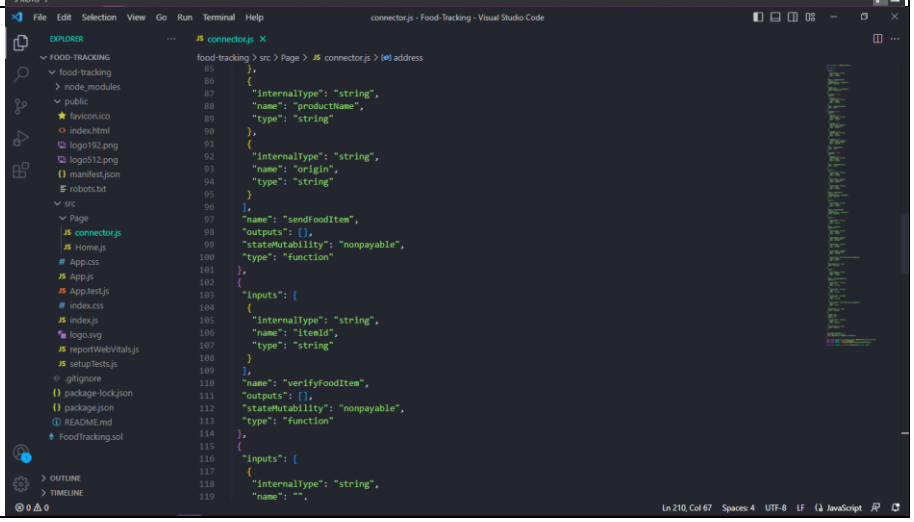
7.7. Functions:

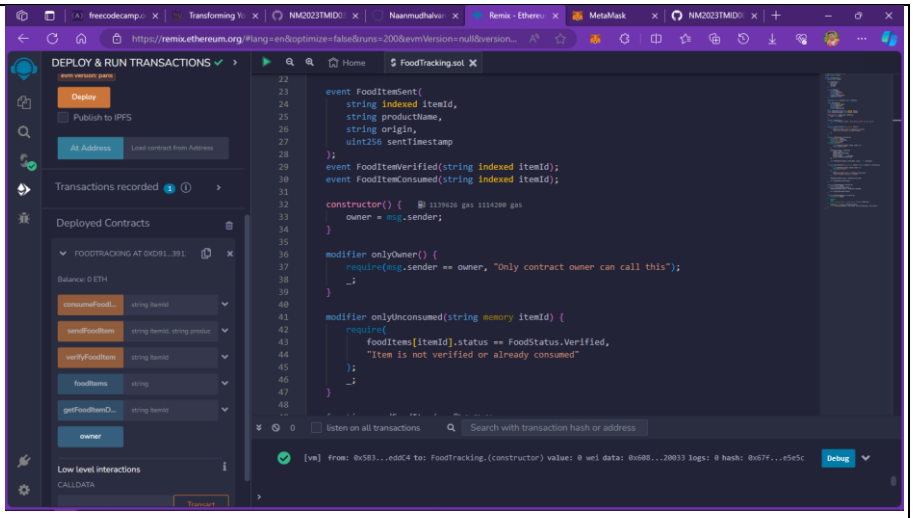
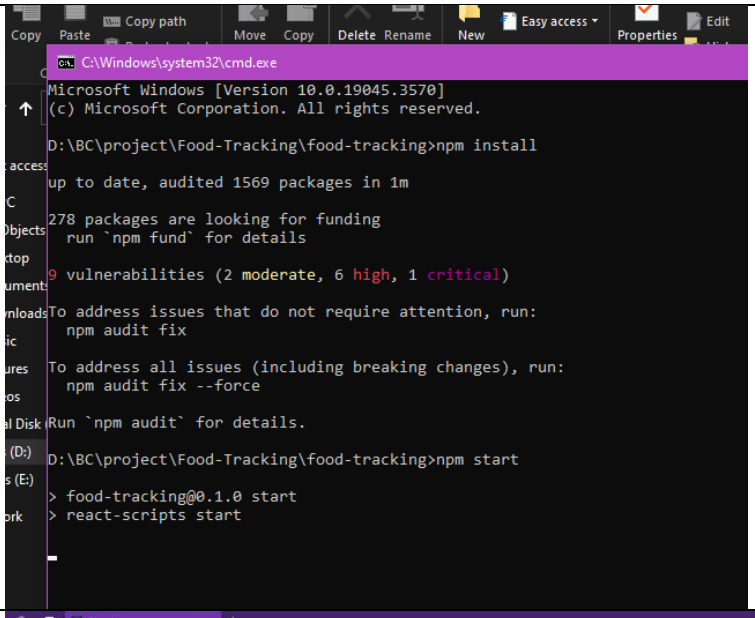
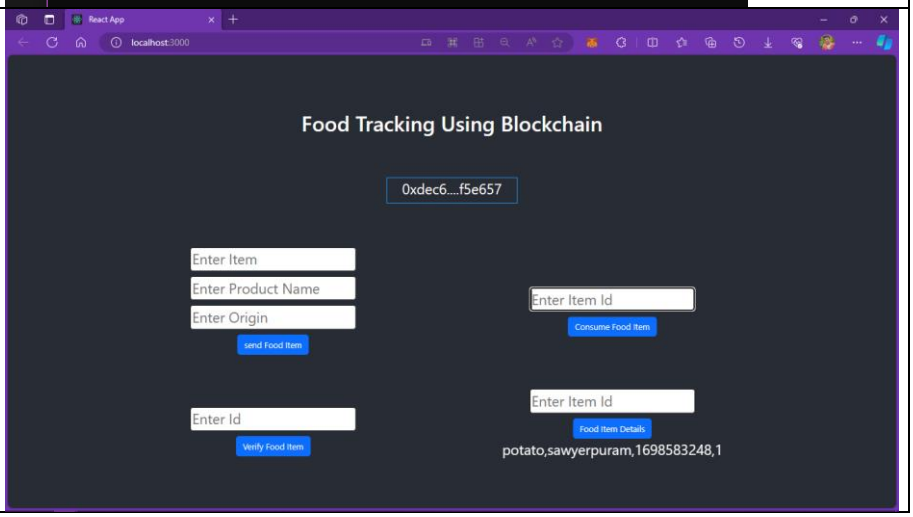
- sendFoodItem: This function allows the contract owner to send a new food item to the contract. It checks whether the item already exists and records it with a status of Unverified.

- verifyFoodItem: This function enables the contract owner to verify a food item, changing its status to Verified.
- consumeFoodItem: This function allows consumers to mark a food item as "Consumed," provided it is in a "Verified" state.
- getFoodItemDetails: This function allows anyone to retrieve details about a food item based on its itemId. It provides information such as the product name, origin, timestamp, and status.

8. PERFORMANCE TESTING:

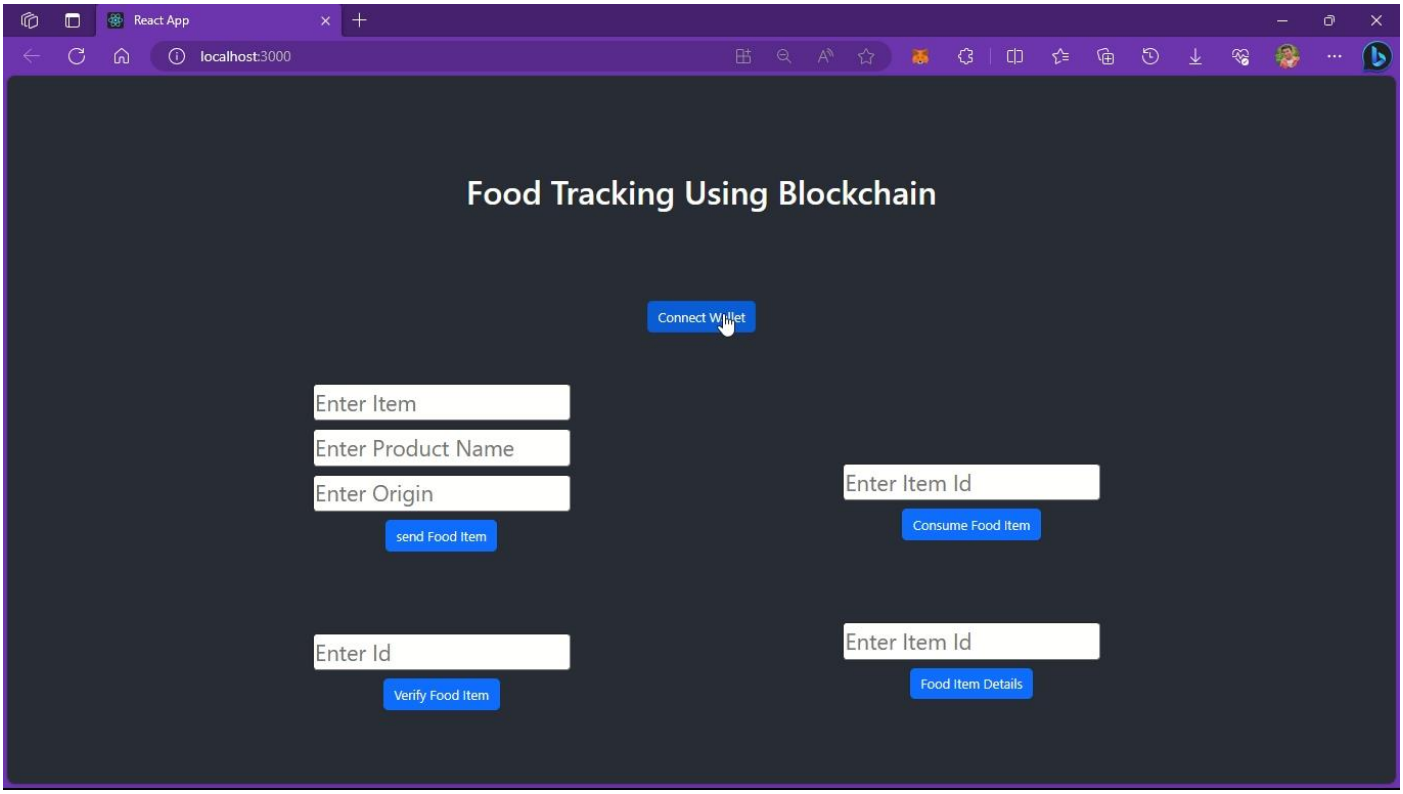
Performance Metrics:

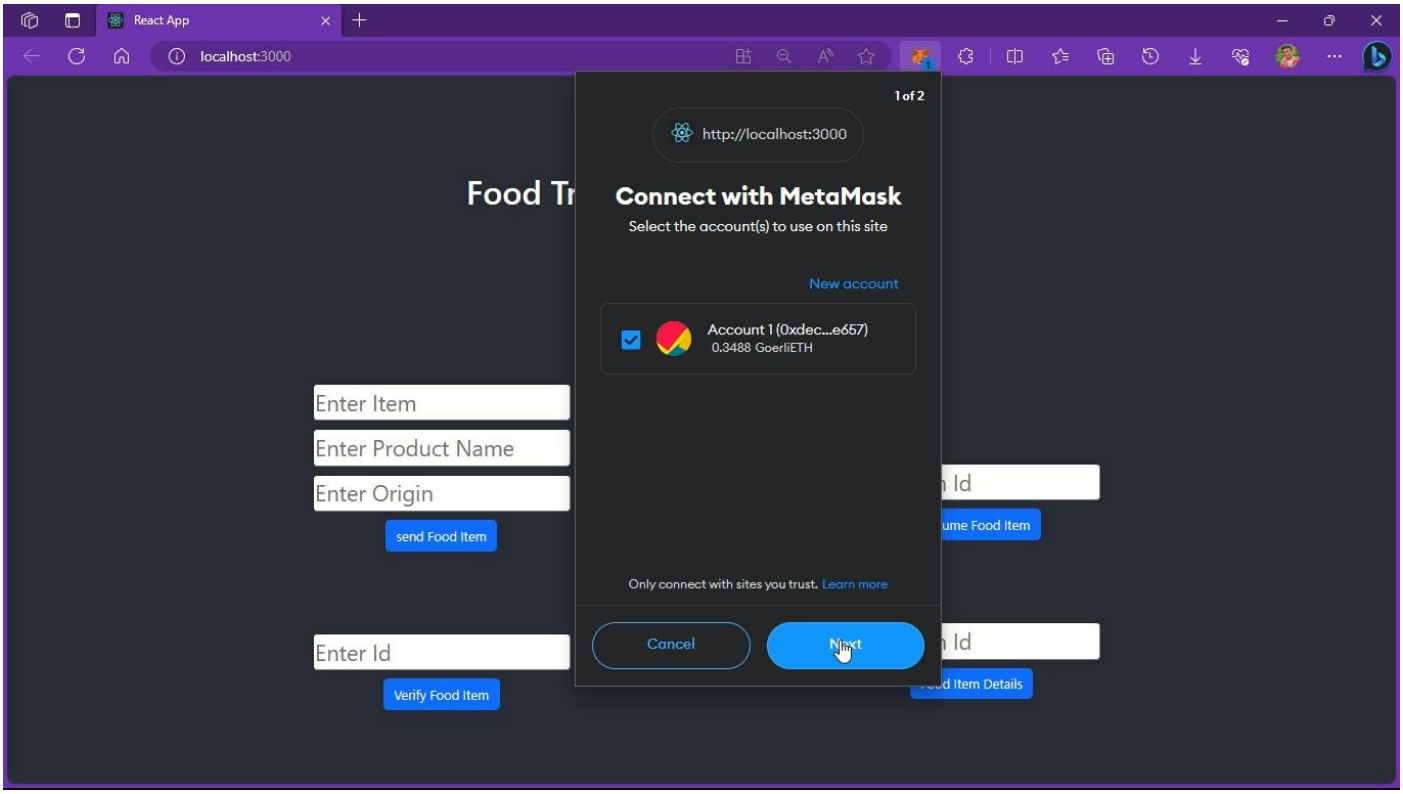
S.No	PARAMETER	VALUES	SCREENSHOT
1	Information Gathering	Setup all the Prerequisite	
2	Extract the zip files	Open to vs code	

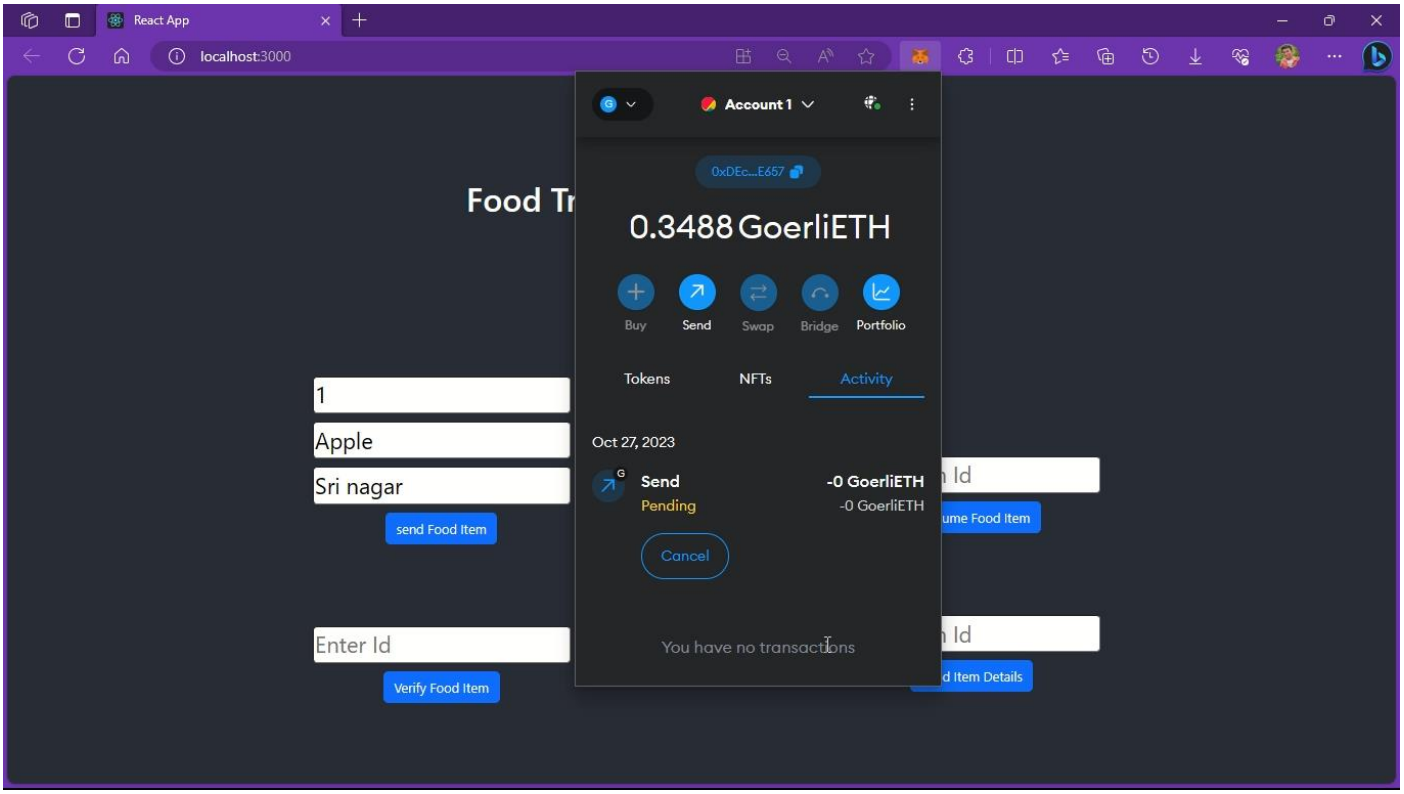
3	Remix Ide platform explorting	Deploy the smart contract code Deploy and run the transactio n. By selecting the environme nt - inject the MetaMask .	
4	Open file explorer	Open the extracted file and click on the folder. Open src, and search for utiles. Open cmd enter commands 1.npm install 2.npm bootstrap 3. npm start	
5	LOCALHOST IP ADDRESS	copy the address and open it to chrome so you can see the front end of your project.	

9. RESULTS

9.1 Output Screenshots


React App
localhost:3000
Food Tracking Using Blockchain
Connect Wallet
Enter Item
Enter Product Name
Enter Origin
send Food Item
Enter Item Id
Consume Food Item
Enter Id
Verify Food Item
Enter Item Id
Food Item Details


React App
localhost:3000
1 of 2
http://localhost:3000
Connect with MetaMask
Select the account(s) to use on this site
New account
Account 1 (0xdec...e657)
0.3488 GoerliETH
Only connect with sites you trust. Learn more
Cancel
Next
Enter Item
Enter Product Name
Enter Origin
send Food Item
Enter Id
Verify Food Item


React App
localhost:3000
Account 1
0xDEc...E657
0.3488 GoerliETH
Buy
Send
Swap
Bridge
Portfolio
Tokens
NFTs
Activity
Oct 27, 2023
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You have no transactions
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send Food Item
Enter Id
Verify Food Item
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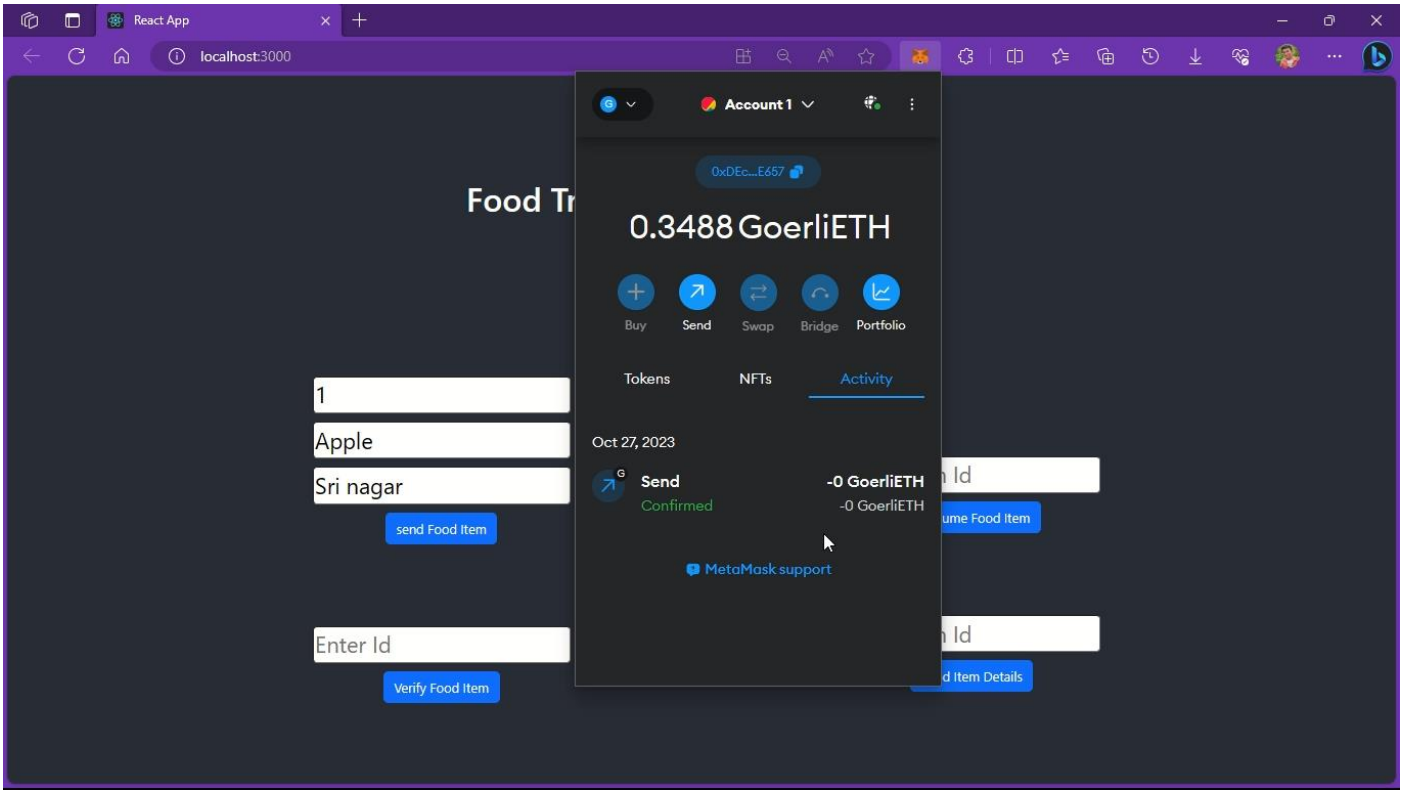
React App
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Oct 27, 2023
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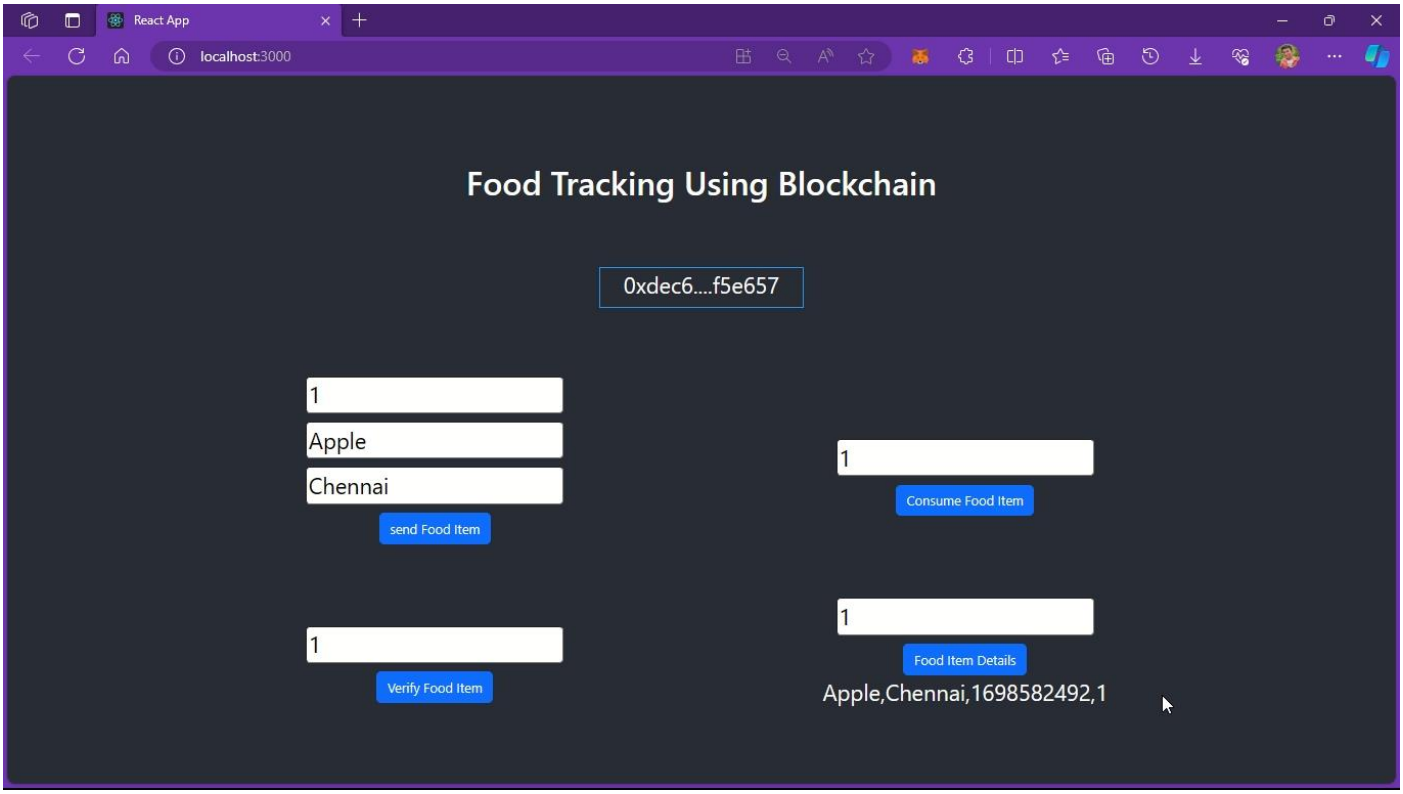

10 . ADVANTAGES & DISADVANTAGES :

Advantages:

Implementing a food tracking system using blockchain technology offers several advantages, which can benefit various stakeholders in the food supply chain. Here are some of the key advantages:

1. **Transparency and Traceability (for Consumers and Regulators):**
   - **Enhanced Transparency:**

Blockchain provides an immutable and transparent ledger, allowing consumers and regulators to trace the origin and journey of food products from farm to fork.

   - **Real-Time Access:**

Users can access real-time data on food items, including their source, processing, and transportation details, fostering trust in the supply chain.

2. **Improved Food Safety** (for Consumers and Producers):
   - **Enhanced Safety Measures**:

Blockchain enables the implementation of real-time monitoring of food products, helping to identify safety issues promptly.

   - **Faster Recalls**:

In the event of food safety concerns, blockchain can facilitate faster and more accurate recalls, reducing the impact of potential outbreaks.

3. **Food Authenticity (for Consumers and Producers):**

- **Verified Authenticity**:

Producers can use blockchain to prove the authenticity of their food products, such as organic or locally sourced items.

- **Consumer Confidence**:

Consumers gain confidence that the products they purchase are as advertised, promoting brand trust.

4. **Sustainability Tracking (for Regulators and Producers):**

- **Environmental Impact:**

Blockchain can record and track the environmental impact of food production and transportation, helping regulators and producers assess sustainability efforts.

- **Efficient Resource Management:**

Producers can optimize resource usage, contributing to sustainable agriculture and responsible sourcing.

5. **Efficiency and Reduced Costs (for All Stakeholders):**

- **Streamlined Processes:**

Smart contracts automate various supply chain processes, reducing administrative overhead and paperwork.

- **Cost Reduction**:

Automation, increased trust, and reduced inefficiencies lead to cost savings for all stakeholders.

Disadvantages:

While food tracking systems using blockchain technology offer many advantages, they also come with certain disadvantages and challenges:

1. **Complexity and Learning Curve**: Implementing and managing blockchain-based food tracking systems can be complex. It may require specialized knowledge and expertise, both in blockchain technology and the food supply chain.

2. **High Initial Costs**: Setting up a blockchain infrastructure, including smart contracts, can be costly. Smaller businesses and organizations may find it financially burdensome to adopt this technology.

3. **Scalability Issues:**

Blockchain networks, especially public ones like Ethereum, may encounter scalability issues as the number of transactions and data on the network grows. This can result in slower transaction processing times and increased costs.

4. **Interoperability Challenges**:
Different blockchain platforms may not be compatible with each other. This can hinder data sharing and collaboration between various stakeholders in the food supply chain.

5. **Data Privacy Concerns**:

While blockchain is known for its security, data stored on a public blockchain is immutable and visible to all participants. This could raise privacy concerns, especially when it comes to sensitive information.

11.CONCLUSION:

The food industry is experiencing a substantial transformation driven by the increasing demand for transparency and traceability throughout the supply chain. Concerns about food safety, authenticity, and sustainability are at the forefront for consumers, regulators, and producers. To address these challenges, blockchain technology, with its decentralized and immutable ledger, offers a promising solution. The proposed food tracking system, discussed in this paper, leverages smart contracts on the Ethereum blockchain to create a transparent and secure platform for tracking food products from their origin to the consumer's table.

In conclusion, the system offers an innovative solution to the food industry's demands for transparency, traceability, safety, authenticity, and sustainability. It uses blockchain technology and smart contracts to create a secure, reliable, and consumer-centric supply chain, benefiting consumers, producers, and regulators alike. As the food industry continues to evolve, such technological solutions will be integral to meeting and exceeding industry standards.

12.FUTURE SCOPE:

Wider Adoption of Blockchain: The adoption of blockchain technology in the food industry is likely to grow. This could extend to various sectors within the industry, including agriculture, processing, distribution, and retail.

Interoperability: Future developments may focus on achieving interoperability between different blockchain networks and platforms. This would enable seamless data sharing and traceability across the entire supply chain.

IoT Integration: Integrating Internet of Things (IoT) devices for real-time data collection and monitoring could become more prevalent. These devices can provide valuable information

about temperature, humidity, and other conditions that affect food safety and quality.

Data Analytics: Enhanced data analytics and machine learning could be applied to the vast amount of data collected through the blockchain. This can lead to predictive analytics for quality control and supply chain optimization.

Smart Contracts Advancements: The use of smart contracts might evolve to automate more complex processes within the food supply chain, such as automatically triggering payments upon delivery or adjusting pricing based on market conditions.

Regulatory Compliance: Future developments may involve closer integration with food safety and regulatory bodies. This could lead to standardized data formats and reporting to ensure compliance with food safety regulations.

Consumer Engagement: Improving consumer engagement and transparency through mobile apps and web platforms is likely to remain a focus. Apps could offer additional features, such as QR code scanning to retrieve food product information or even augmented reality experiences to learn more about the product's journey.

Sustainability Tracking: Expanding the blockchain's use to track sustainability practices, such as carbon footprint reduction or fair trade certifications, can become an important aspect of the future food supply chain.

Global Supply Chain Integration: Expanding the blockchain's use for global food supply chains, ensuring that food products are sourced and transported internationally while maintaining transparency and traceability.

Supply Chain Resilience: The food industry may invest in blockchain technology to enhance supply chain resilience, as seen during crises such as pandemics, ensuring the continuity of essential food supplies.

Decentralization: Decentralized applications (DApps) built on blockchain networks might offer innovative solutions for food supply chain management, allowing stakeholders to collaborate directly without intermediaries.

PROJECT DEMONSTRATION:

Demo Video Link :
https://drive.google.com/file/d/1q5YkVT8pUL29lj4K8kfb06yJtPa06z_b/view?usp=sharing
Source Code Link:
https://drive.google.com/file/d/1Mrn_D7rZK5sAvoEGhq9kp0w-Zj_3jy8P/view?usp=sharing