Project Report Format

1. **INTRODUCTION**

1.1 Project Overview

The project aims to revolutionize the food industry by leveraging blockchain technology to ensure transparency and traceability throughout the food supply chain. It addresses the growing concerns related to food safety, authenticity, and sustainability. This innovative project presents a novel approach to implementing a food tracking system using smart contracts on the Ethereum blockchain.

1.2 Purpose

The purpose of this project is to provide a secure and transparent platform for tracking food products from their origin to consumers' tables. By utilizing Ethereum's smart contract capabilities, it ensures the authenticity and safety of food items, enhances consumer trust, and addresses critical concerns in the food industry.

2. **LITERATURE SURVEY**

2.1 Existing problem

The food industry faces significant challenges related to transparency, traceability, and food safety. Traditional supply chains often lack the mechanisms to provide real-time information about the origin and journey of food products. This opacity results in inefficiencies, safety concerns, and potential risks for consumers and businesses.

2.2 References

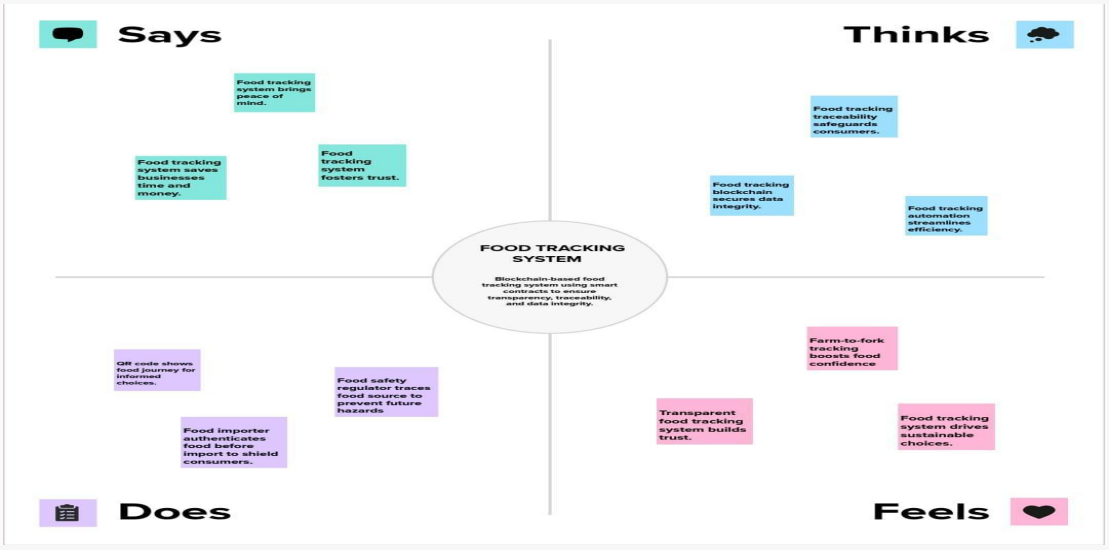
2.3 Problem Statement Definition

The problem addressed in this project is the lack of transparency and accountability in the food supply chain. This project aims to solve this problem by implementing a food tracking system that utilizes blockchain technology to ensure data integrity, real-time access to critical information, and traceability of food products.

3. **IDEATION & PROPOSED SOLUTION**

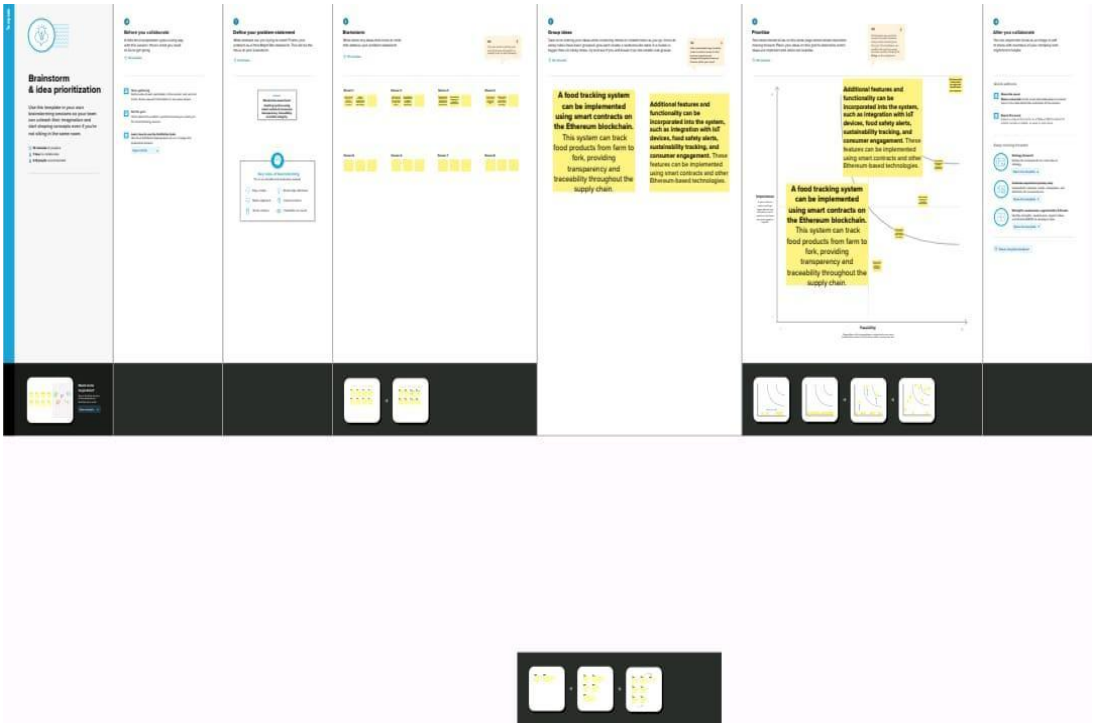
3.1 Empathy Map Canvas

During the ideation phase, an empathy map canvas was used to gain insights into the needs and concerns of consumers, regulators, and producers in the food industry.



3.2 Ideation & Brainstorming

Ideation and brainstorming sessions led to the proposed solution. The solution leverages blockchain technology to create a transparent and secure platform for tracking food products, ensuring their authenticity and safety.



4. REQUIREMENT ANALYSIS

4.1 Functional requirement

Functional requirements for the project include:

Creation of unique digital identities for food products.

Recording the journey of food items on the blockchain.

Real-time access to critical information for consumers and stakeholders.

4.2 Non-Functional requirements

Non-functional requirements include data integrity, security, and scalability to handle a large volume of food product data.

5. PROJECT DESIGN

5.1 Data Flow Diagrams & User Stories

Processes:

- Process 1: Blockchain Network
  - Manages and maintains the blockchain network.

  Process 2: Smart Contract
  - Executes smart contract functions.
- Process 3: User Interface
  - Provides the user interface for interacting with the system.
- Process 4: Supply Chain
  - Manages the flow of food products through the supply chain.

Data Stores:

- Data Store 1: Blockchain Ledger
    - Stores transaction data.
- Data Store 2: User Accounts
    - Contains user account information.
- Data Store 3: Food Product Database
    - Stores food product information.
- Data Store 4: Supply Chain Records
    - Records the journey of food products.
- Data Store 5: Regulatory Requirements
    - Contains relevant regulations and standards.

Data Flows:

- Data Flow 1: Record Food Product Data
    - From Supply Chain to Smart Contract.
- Data Flow 2: Verify Food Product
    - From Smart Contract to User Interface.
- Data Flow 3: Update Supply Chain Record
    - From Smart Contract to Supply Chain.
- Data Flow 4: View Food Product History
    - From User Interface to Blockchain Ledger.
- Data Flow 5: Check Regulatory Compliance
    - From Smart Contract to Regulatory Requirements.

User Stories:

- As a consumer, I want to scan a QR code on a food product to view its origin and journey through the supply chain to ensure its authenticity.
- As a food producer, I want to record the details of food products at each stage of the supply chain to maintain transparency and traceability.
- As a regulator, I want to validate compliance with food safety regulations and standards by checking the smart contract records.
- As a warehouse manager, I want to update the supply chain records when food products arrive or leave my facility to maintain an accurate trail.
- As a retailer, I want to verify the authenticity of food products before selling them to consumers by accessing the blockchain ledger.
- As a consumer, I want to know the source of my food products, including their origin and processing details, to make informed choices.
- As a smart contract developer, I want to design and implement smart contracts that automate quality control and compliance checks in the supply chain.

5.2 Solution Architecture

The solution architecture outlines the use of Ethereum's smart contract capabilities to create a transparent and secure food tracking system.

6. PROJECT PLANNING & SCHEDULING

6.1 Technical Architecture

The technical architecture includes the selection of Ethereum blockchain as the underlying technology and the design of smart contracts

6.2 Sprint Planning & Estimation

Sprint planning involves breaking the project into manageable sprints, and estimations are based on user stories and functional requirements.

6.3 Sprint Delivery Schedule

The sprint delivery schedule defines the timeline for completing each sprint

7. CODING & SOLUTIONING (Explain the features added in the project along with code)

Solidity 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(
```

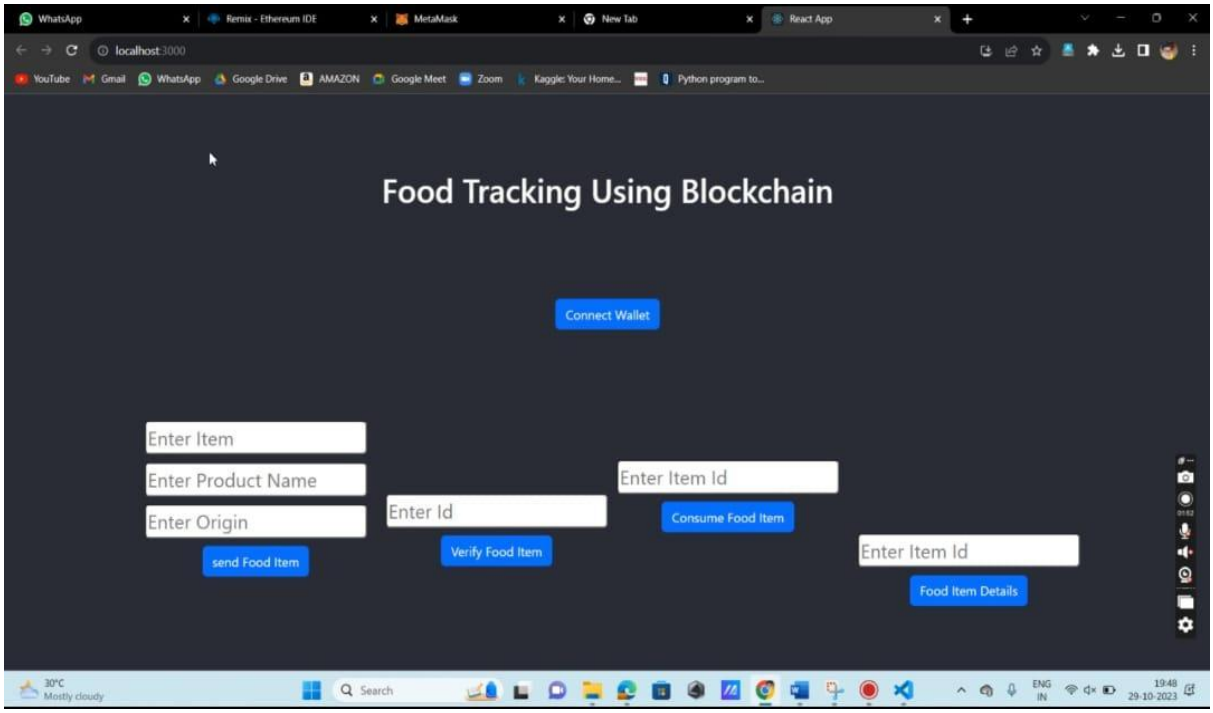
```
        bytes(foodItems[itemId].itemId).length == 0,
        "Item already exists"
    );
        foodItems[itemId] = FoodItem({
        itemId: itemId,
        productName: productName,
        origin: origin,
        sentTimestamp: block.timestamp,
        status: FoodStatus.Unverified
    });
        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);
}
}
```

8. PERFORMANCE TESTING

9. RESULTS

9.1 Output Screenshots



10. ADVANTAGES & DISADVANTAGES

Enhanced Transparency: Blockchain technology provides a transparent and immutable ledger, allowing consumers, regulators, and producers to have real-time access to critical information about food products' journey through the supply chain. This transparency builds trust and confidence.

Improved Food Safety: Smart contracts can be programmed to execute quality control checks automatically, reducing the risk of human errors and ensuring food safety. In case of issues, stakeholders can quickly identify the source and take appropriate actions.

Authentication and Anti-Fraud: Each food item is assigned a unique digital identity, making it difficult for counterfeit or fraudulent products to enter the supply chain. This ensures the authenticity of products.

Sustainability Monitoring: Blockchain can track the environmental and social impact of food production and distribution. This supports sustainable practices and enables consumers to make informed choices.

11. CONCLUSION

In summary, the food industry's changing landscape—which is marked by shifting customer expectations, strict regulations, and sustainability imperatives—has spurred research into novel solutions. There has never been a higher need for authenticity, transparency, traceability, food safety, and sustainability. Blockchain technology shows promise as a disruptive solution to these urgent problems because of its decentralized and immutable ledger capabilities.

12. FUTURE SCOPE

- **Global Adoption:** The future scope involves expanding the use of blockchain-based food tracking systems on a global scale. Collaboration among different countries and regions can help ensure consistency in food safety standards and traceability.
- **Interoperability:** Enhancing interoperability between various blockchain platforms will be a major focus. Standardization efforts and the development of protocols for data sharing and communication between different blockchains will promote wider adoption.
- **Integration with Emerging Technologies:** The integration of blockchain with other emerging technologies, such as the Internet of Things (IoT), can provide real-time data on food products' conditions during transportation and storage. This can enhance the quality and safety of food products.
- **Consumer Engagement:** The future of food tracking systems should aim to engage consumers actively. Mobile apps and user-friendly interfaces can empower consumers to scan product QR codes and access detailed information about the food they purchase.
- **Supply Chain Efficiency:** Continued development of smart contracts can further automate supply chain processes. This will not only improve efficiency but also reduce costs and delays.

13. APPENDIX

GitHub & Project Demo Link

https://drive.google.com/file/d/1uaC7FsDojdQwaqsMLJYOmQ6LZ7oRU6X4/view?usp=sharing