# FOOD TRACKING SYSTEM

# Project Report

***Submitted by:***


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# CHAPTER – 1

## 1.INTRODUCTION

### 1.1 Project Overview

**Food Tracking System**

The Food Tracking System Using Blockchain Technologyproject is a cutting-edge solution aimed at revolutionizing the food supply chain. Leveraging blockchain's transparency and security, this project seeks to enhance traceability, product information access, and food safety. It involves creating an immutable blockchain ledger to record the journey of food products from source to consumer, implementing smart contracts for automating various processes, and integrating IoT devices for real-time monitoring of environmental conditions during transportation and storage. This system benefits all stakeholders, including food producers, regulatory agencies, retailers, and consumers, by ensuring data accuracy, reducing operational costs, and ultimately empowering consumers to make informed choices about the food they purchase.

With a timeline spanning research, development, testing, and pilot implementation, this project addresses potential risks such as stakeholder adoption and regulatory compliance. The ultimate goal is to significantly enhance food safety, quality, and transparency, while improving operational efficiency and reducing food waste, making it a transformative endeavor in the food industry.

### 1.2 Purpose

The purpose of the Food Tracking System Using Blockchain Technology project is to enhance food supply chain transparency, traceability, and security while empowering consumers to make informed decisions about the food they consume.

Furthermore, this system empowers consumers to make informed choices, fosters trust in the food supply chain, and improves food safety by quickly identifying the source of any contamination or issues. This project not only benefits consumers but also all stakeholders, including food producers, distributors, and regulatory agencies, by ensuring data integrity, reducing

operational costs, and ultimately making the food supply chain more secure and efficient.

# CHAPTER-2

# 2.LITERAURE SURVEY

## 2.1 Existing Problem

Implementing a food tracking system using blockchain technology offers benefits like transparency and trust in the food supply chain, but it comes with challenges. These include complexities in scaling, integration with existing systems, ensuring data quality and consistency, addressing privacy concerns, standardization issues, stakeholder adoption, regulatory complexities, costs, security risks, and the need for a user-friendly experience. Additionally, the environmental impact of energy-intensive blockchain systems is a growing concern. To overcome these challenges, project teams must meticulously plan, collaborate with stakeholders, and stay updated on evolving best practices and regulations in the blockchain and food safety domain.

In summary, while blockchain technology holds promise for revolutionizing food tracking, it requires a strategic approach to address these challenges effectively and realize its potential in enhancing the food supply chain's transparency and efficiency.

## 2.2 References


- Processed Food Traceability using Blockchain Technology

**Published in:** 2023 IEEE 8th International Conference for Convergence in Technology (I2CT).

https://ieeexplore.ieee.org/document/10126385/

- Food Traceability and Prevention of Location Fraud using Blockchain

**Published in:** 2020 IEEE 8th R10 Humanitarian Technology Conference (R10-HTC)

https://ieeexplore.ieee.org/document/9356999/

- Blockchain in Food Traceability: A Systematic Literature Review

**Published in:** 2021 32nd Irish Signals and Systems Conference (ISSC)

https://ieeexplore.ieee.org/document/9467848/

**https://www.mdpi.com/2079-9292/11/16/2491**

**https://www.researchgate.net/publication/352908332_Blockchain_in_Food_Traceability_A_Systematic_Literature_Review**

**https://www.sciencedirect.com/science/article/pii/S2405844023037337**

### 2.3 Problem Statement Definition:

The existing food supply chain is fraught with issues related to transparency, traceability, and trust. Food products often travel through complex and convoluted supply chains, making it challenging to verify their origin, quality, and safety. Instances of food fraud, contamination, and inefficiencies persist, eroding consumer confidence and posing health risks.

To address these pressing challenges, our project aims to develop a food tracking system that leverages blockchain technology. This system will establish a secure, immutable ledger to trace the entire journey of food products, from production to consumption, ensuring transparency, enhancing food safety, and reducing fraudulent activities in the food supply chain.

## CHAPTER-3

## 3.IDEATION & PROPOSED SOLUTION

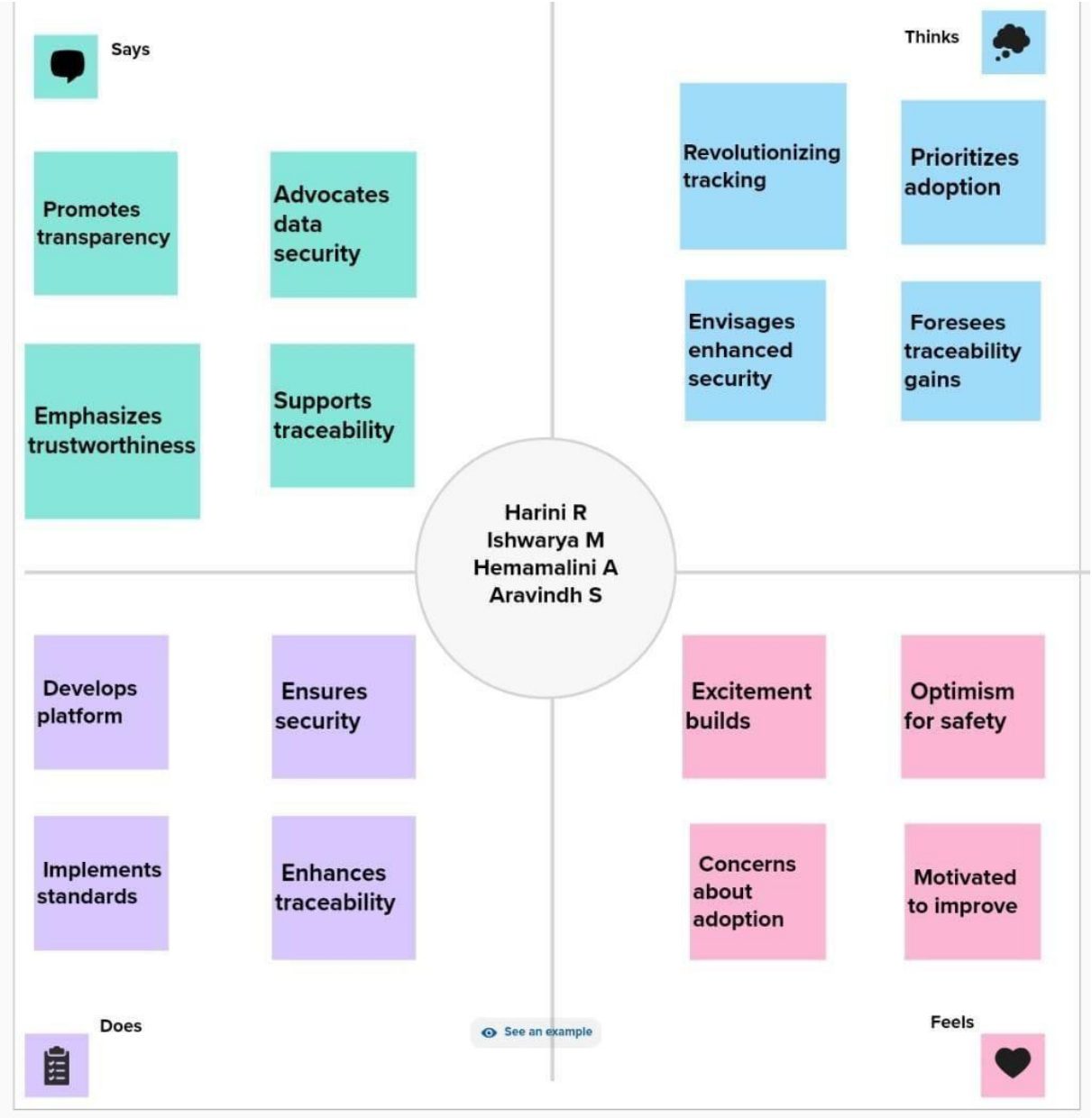
### 3.1 Empathy Map Canvas :

In the context of the “Food Tracking System Using Blockchain Technology” project, understanding the perspectives of various stakeholders is paramount. Consumers, driven by concerns over food safety and authenticity, actively seek clear product information through apps, QR codes, and certifications, underscoring their need for trust and transparency. Food producers grapple with maintaining product quality and compliance, seeking streamlined supply chain solutions and traceability tools. Regulators and inspectors strive for more

efficient ways to ensure food safety and compliance, while retailers face challenges in managing inventory and maintaining customer trust, emphasizing the need for accurate information and supply chain efficiency.

In parallel, blockchain developers are integral to the project's success, emphasizing the importance of scalability and security in their work on tailored blockchain solutions. They require detailed project requirements and effective collaboration with stakeholders.

By recognizing these diverse perspectives, the project can be designed to cater to the distinct needs and concerns of these stakeholders, ultimately leading to a successful food tracking system that enhances transparency and trust in the food supply chain.

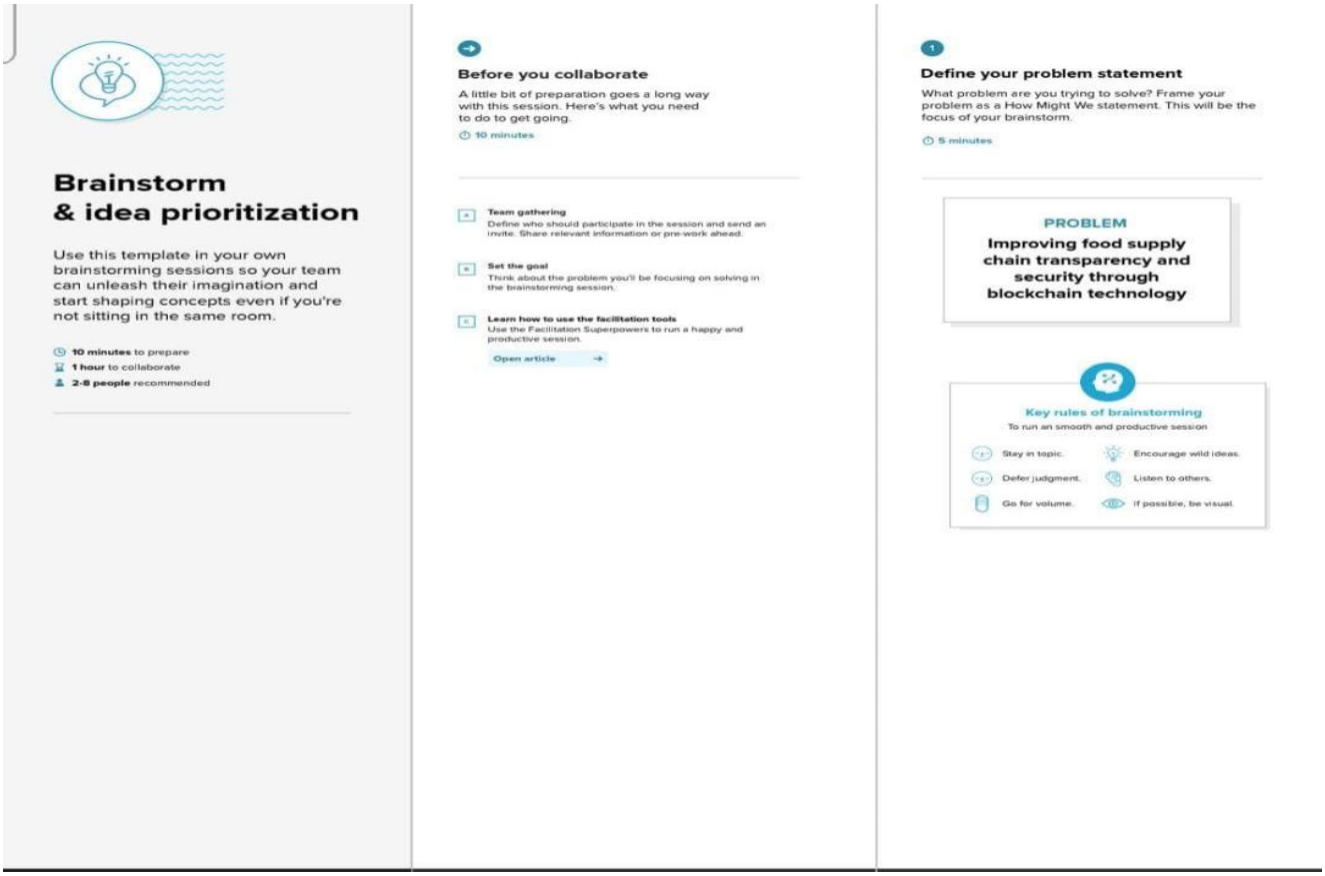



### 3.2 Ideation & Brainstorming:

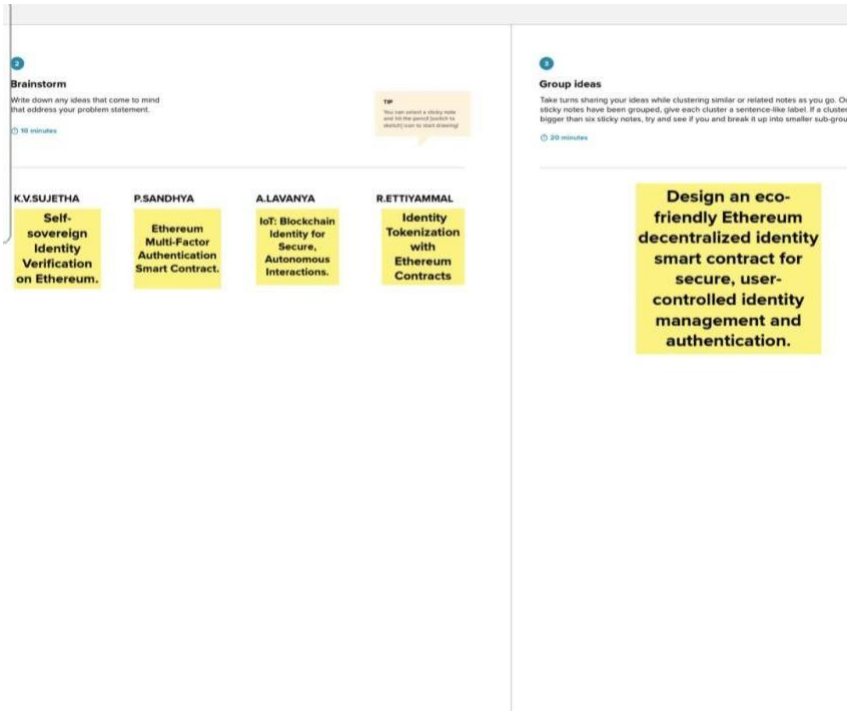
During the ideation and brainstorming phase of the Food Tracking System project, we explored ways to leverage blockchain for enhancing the food supply chain. We envisioned a user-friendly mobile app for consumers to scan QR codes on food items, accessing instant information about their origin, quality, and safety. Integrating smart sensors in the supply chain to capture real-time data for quality assurance during transit was another key concept. For producers, we considered automating compliance and quality control through blockchain-based smart contracts. Additionally, we discussed the potential to reduce the workload of regulators by automating auditing and compliance

verification. Our vision encompassed a holistic ecosystem involving consumers, producers, regulators, retailers, and blockchain developers, emphasizing the need for flexibility, scalability, and adaptability to address supply chain complexities while enhancing transparency and trust. This project aspires to revolutionize the food industry by improving food safety, combating fraud, and empowering consumers with the transparency they seek in their food consumption.

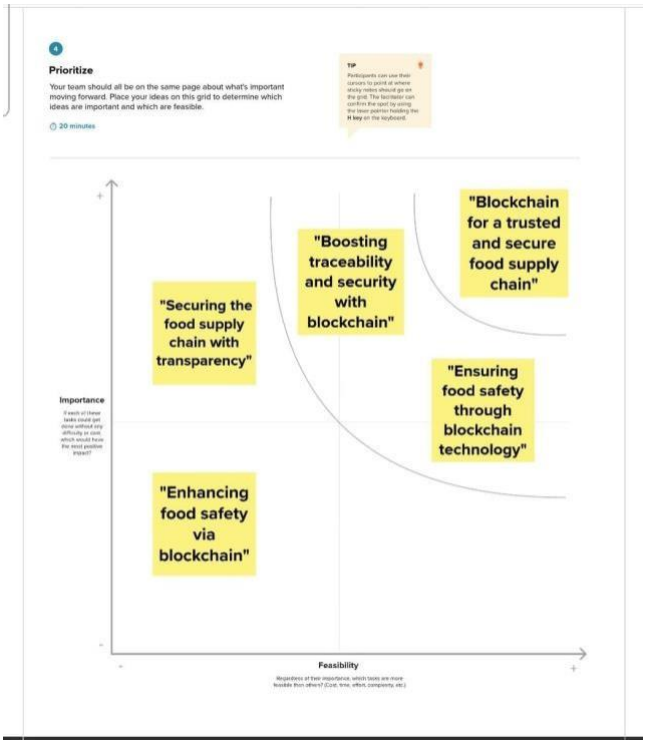
**Step-1: Team Gathering, Collaboration and Select the**



## Step-2: Brainstorm, Idea Listing and Grouping




## Step-3: Idea Prioritization




# CHAPTER-4

# 4.REQUIREMENT ANALYSIS

## 4.1 Functional Requirements

The functional requirement analysis outlines the core features and capabilities required for a food tracking system using blockchain technology, facilitating secure, transparent, and traceable food supply chains.

- User Management - The system should allow users to register, log in, and manage their profiles securely, with roles defined for producers, consumers, and regulators.
- Product Registration- Producers should be able to register food products on the blockchain, providing essential product details such as name, production date, origin, and certification information.
- Blockchain Integration - Utilize blockchain technology to create a transparent and immutable ledger for tracking all food-related transactions, ensuring data integrity and security.
- Smart Contracts- Implement smart contracts to automate processes like product verification, certification, and payment, with predefined rules and conditions.
- Certification and Verification- Food safety and quality certification authorities should have the capability to verify and certify products, which can be checked by consumers.
- Traceability and Transparency - Enable users to trace the complete history of a food product, from its origin to the end consumer, ensuring complete transparency.
- Real-Time Updates and Alerts - The system should provide real-time updates on product status, location, and any critical events, with alerts generated for recalls or suspicious activities.
- Integration with Stakeholders- Integrate the system with all relevant stakeholders in the food supply chain, including producers, distributors, retailers, and regulators, to ensure a seamless flow of information.
- Privacy and Compliance - Implement strong data security measures to protect user information, including compliance with data privacy regulations such as GDPR.
- Reporting and Analytics - Provide reporting and analytics tools for stakeholders to monitor supply chain data, generate reports on product quality and compliance, and gather insights for continuous improvement.

### 4.2 Non-Functional Requirements

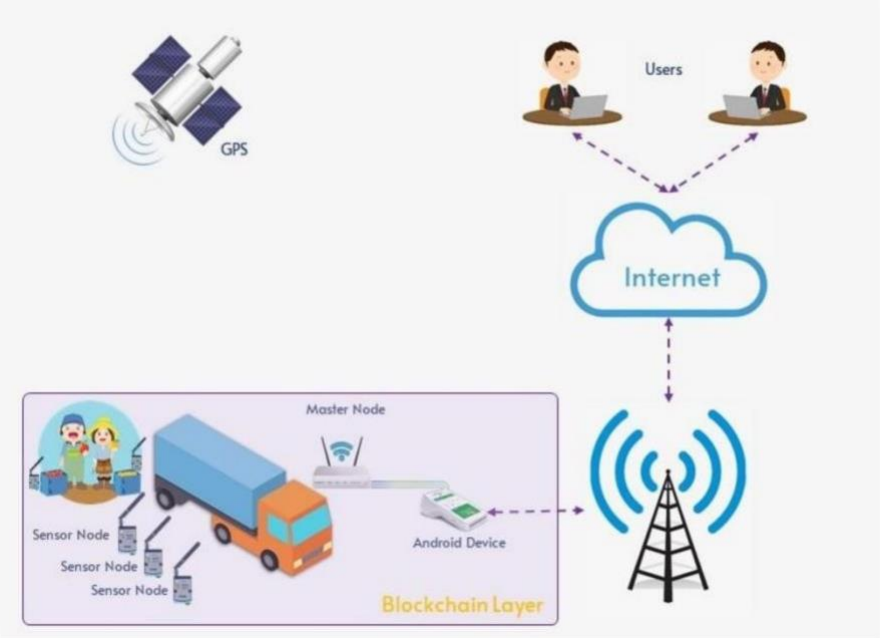
The non-functional requirements are essential to ensure that the food tracking system not only works but also works efficiently, securely, and reliably while meeting the industry's compliance and privacy standards.

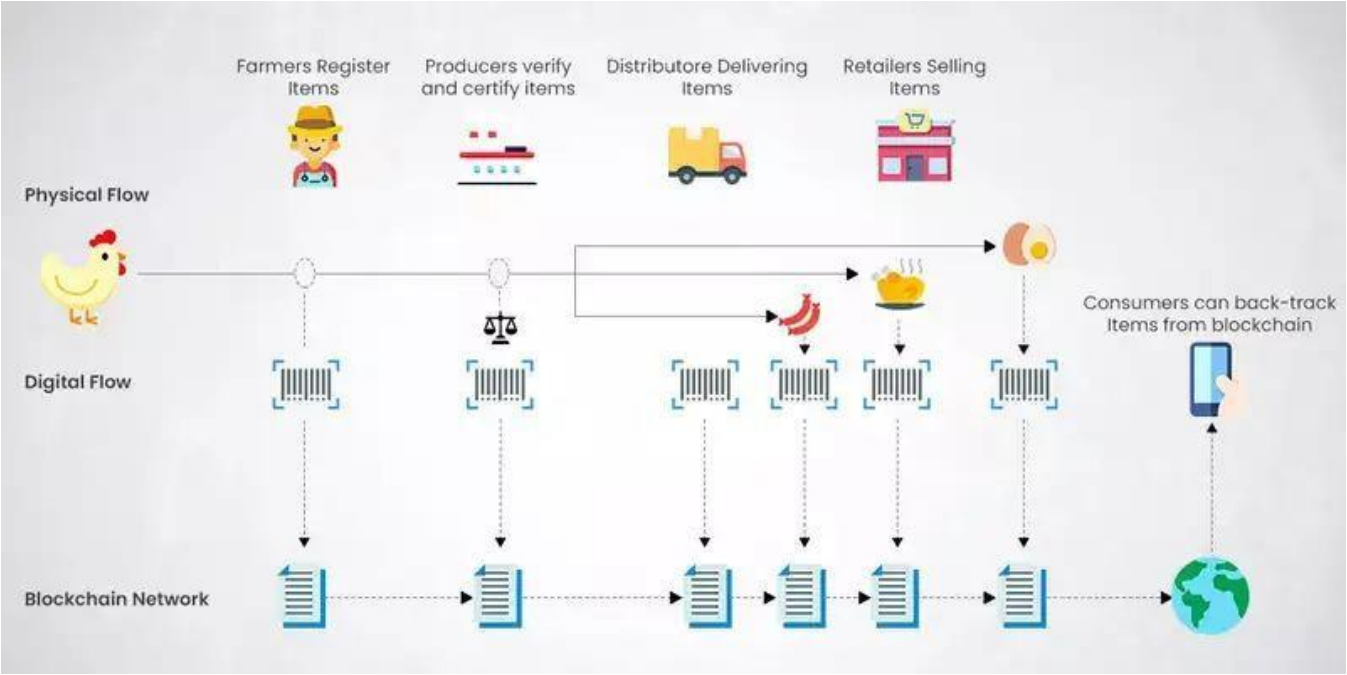
- Performance-The system should support a high throughput of transactions to accommodate a large volume of data generated by the food supply chain.
- Scalability-It should be designed to scale both vertically and horizontally to handle increased data and user loads as the system grows.
- Security- Ensure data security by using encryption, access controls, and secure communication protocols to protect sensitive information stored on the blockchain.
- Availability - The system should be highly available, with minimal downtime, as it deals with critical data for food safety and quality.
- Reliability - Ensure that the system is reliable and resilient, capable of recovering from failures to maintain continuous service.
- Data Privacy - Implement data anonymization and privacy features to protect the personal information of users and other sensitive data.
- Compliance - Ensure that the system complies with relevant regulations and standards, especially in the food industry, to avoid legal and operational issues.
- User Experience (UX) - The system should have an intuitive and user-friendly interface to enhance the user experience, especially for consumers and regulators.
- Interoperability - Ensure that the system can integrate with various existing systems and technologies used by different stakeholders in the food supply chain.
- Auditability - Maintain comprehensive audit logs to track changes and transactions on the blockchain, facilitating traceability and accountability.

# CHAPTER-5

# 5 .PROJECT DESIGN

## 5.1 Data Flow Diagram &User Stories



## 5.2 User Stories

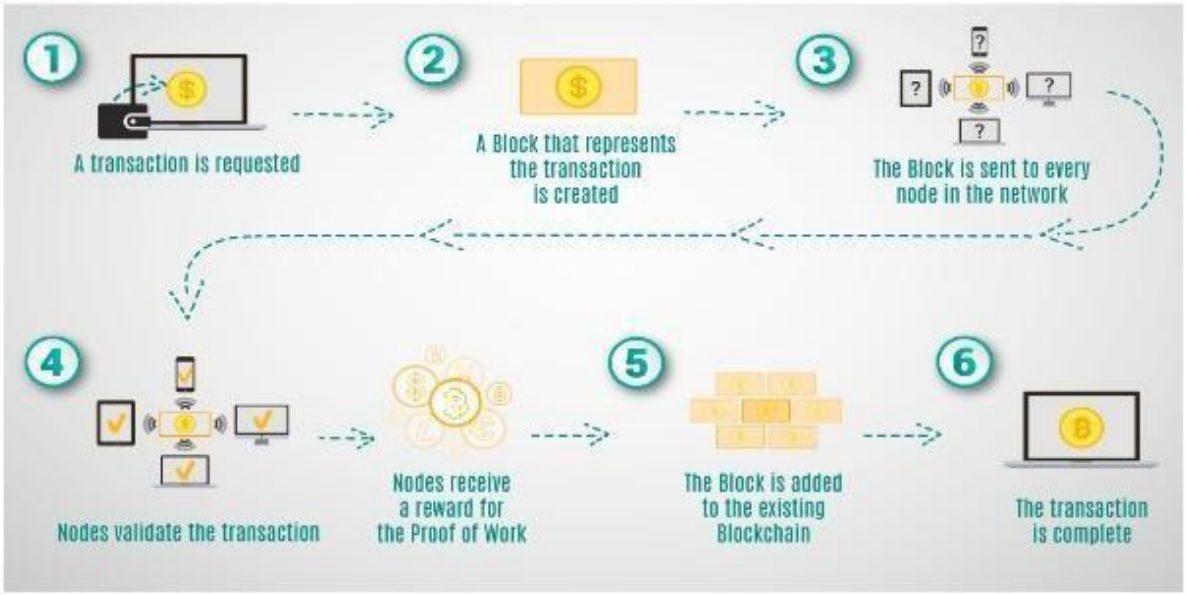
The User Stories can serve as a starting point for the development of a food tracking system using blockchain technology. They can be refined further, and their implementation prioritized according to the needs of the project and its stakeholders.

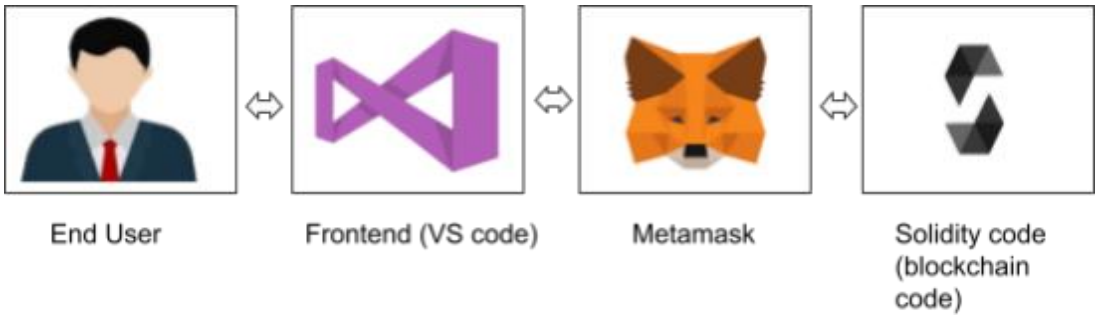
- **As a consumer,** I want to scan a QR code on a food product to access detailed information about its origin, ingredients, and production process.
- **As a restaurant owner,** I want to record the sources of all the ingredients I use in my dishes on a blockchain to provide transparency to my customers.
- **As a food distributor,** I want to track the temperature and humidity conditions during the transportation of perishable goods to ensure food safety and quality.
- **As a health-conscious individual,** I want to receive alerts and notifications about food recalls or safety concerns for products I've purchased.
- **As a government regulator,** I want access to a secure and immutable ledger of food production and distribution to monitor and ensure compliance with safety regulations.
- **As a farmer,** I want to record information about the seeds, pesticides, and fertilizers used in my crop production process to demonstrate the quality and sustainability of my products.
- **As a food retailer,** I want to validate the authenticity of organic or specialty food products by accessing blockchain records of their certifications.
- **As a consumer with dietary restrictions,** I want to easily filter and search for products that meet my specific dietary requirements.
- **As a food producer,** I want to streamline the process of obtaining organic or fair trade certifications by sharing relevant data directly on the blockchain.
- **As a restaurant manager,** I want to efficiently manage inventory levels by monitoring real-time data on the availability and freshness of ingredients.
- **As a blockchain administrator,** I want to ensure the security and integrity of the blockchain network, protecting it against unauthorized access or tampering.

# CHAPTER-6

# 6.PROJECT PLANNING AND SCHEDULING

## 6.1 Technical Architecture



## CHAPTER-7

## 7.CODING AND SOLUTIONING

```
// 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(
```

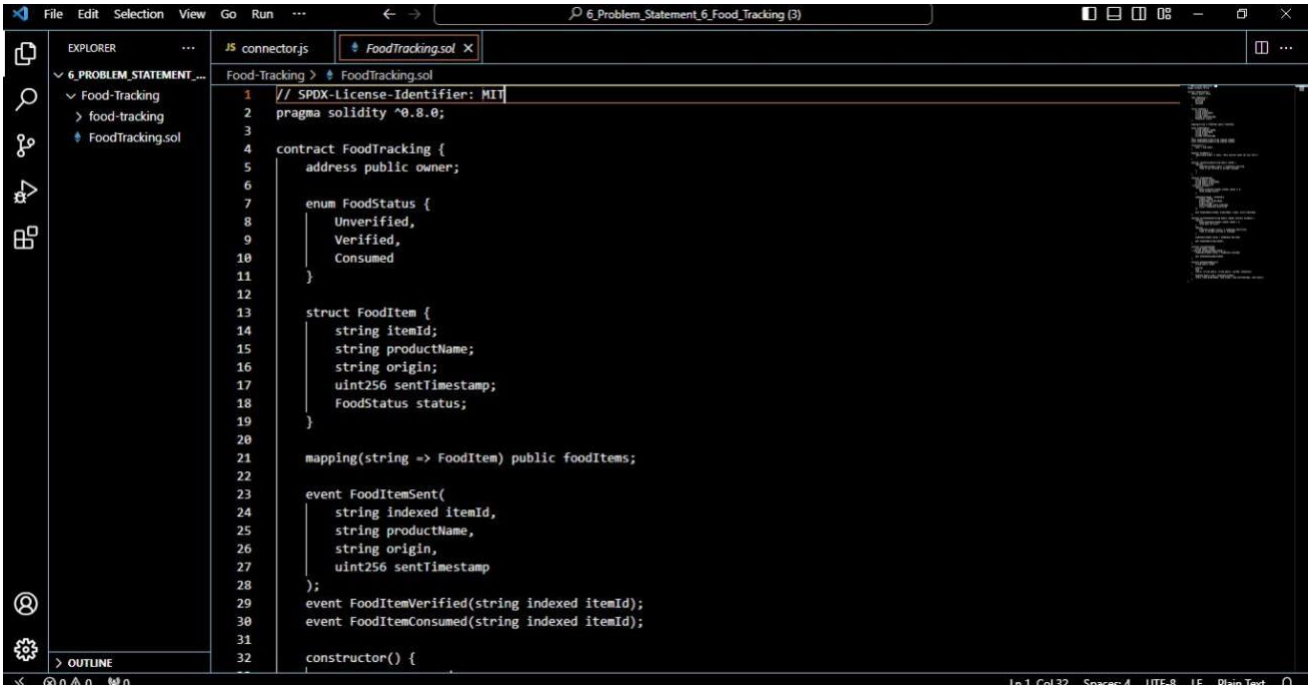
```
    String indexed itemId,
    String productName,
    String origin,
    Uint256 sentTimestamp
);
Event FoodItemVerified(string indexed itemId);
Event FoodItemConsumed(string indexed itemId);

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,
```

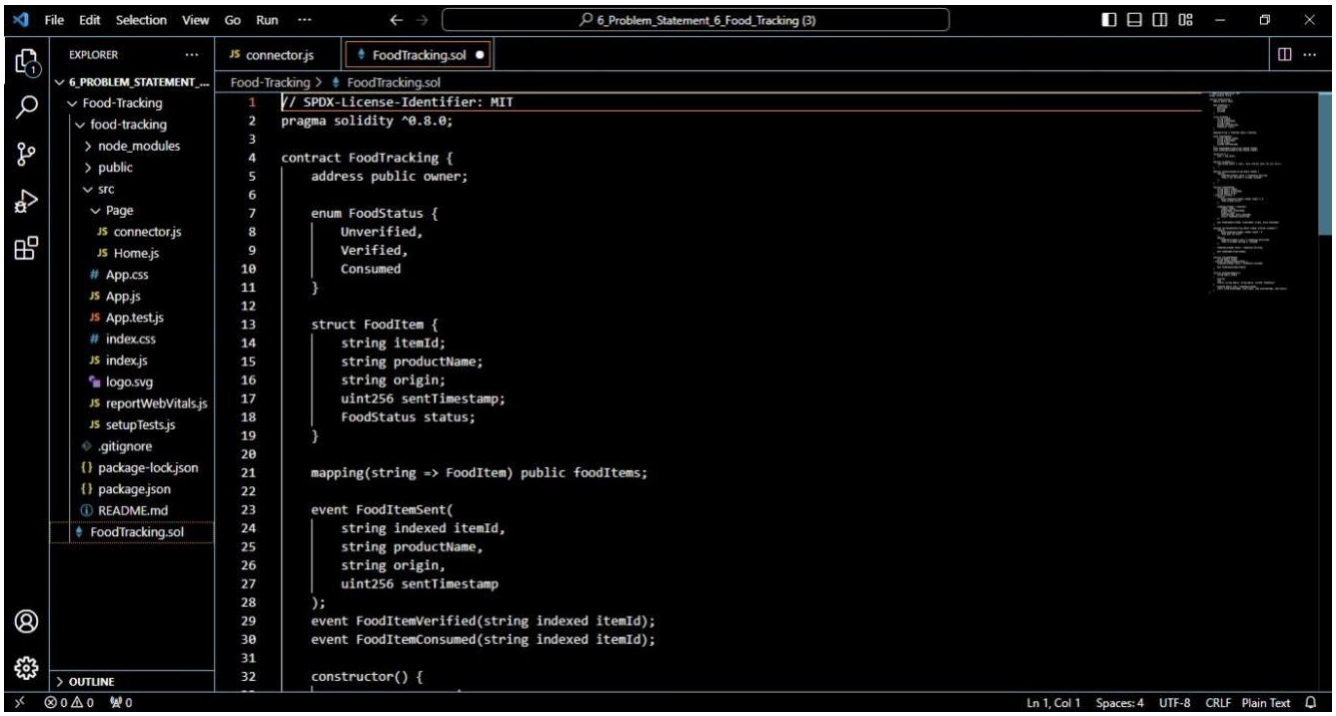
```
    String memory productName,
    String memory origin
) external onlyOwner {
    Require(
        Bytes(foodItems[itemId].itemId).length == 0,
        “Item already exists”
    );

    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”
```

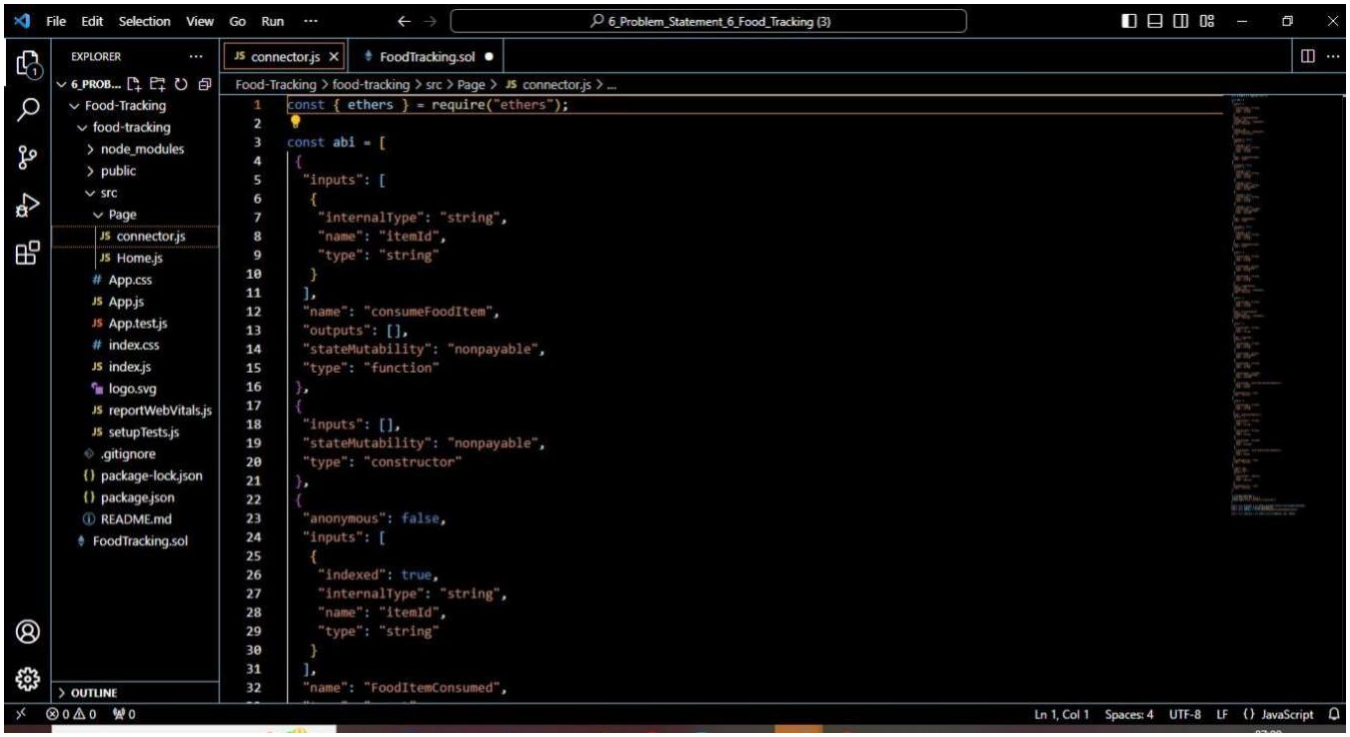
```
        );

        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);
    }
}
```

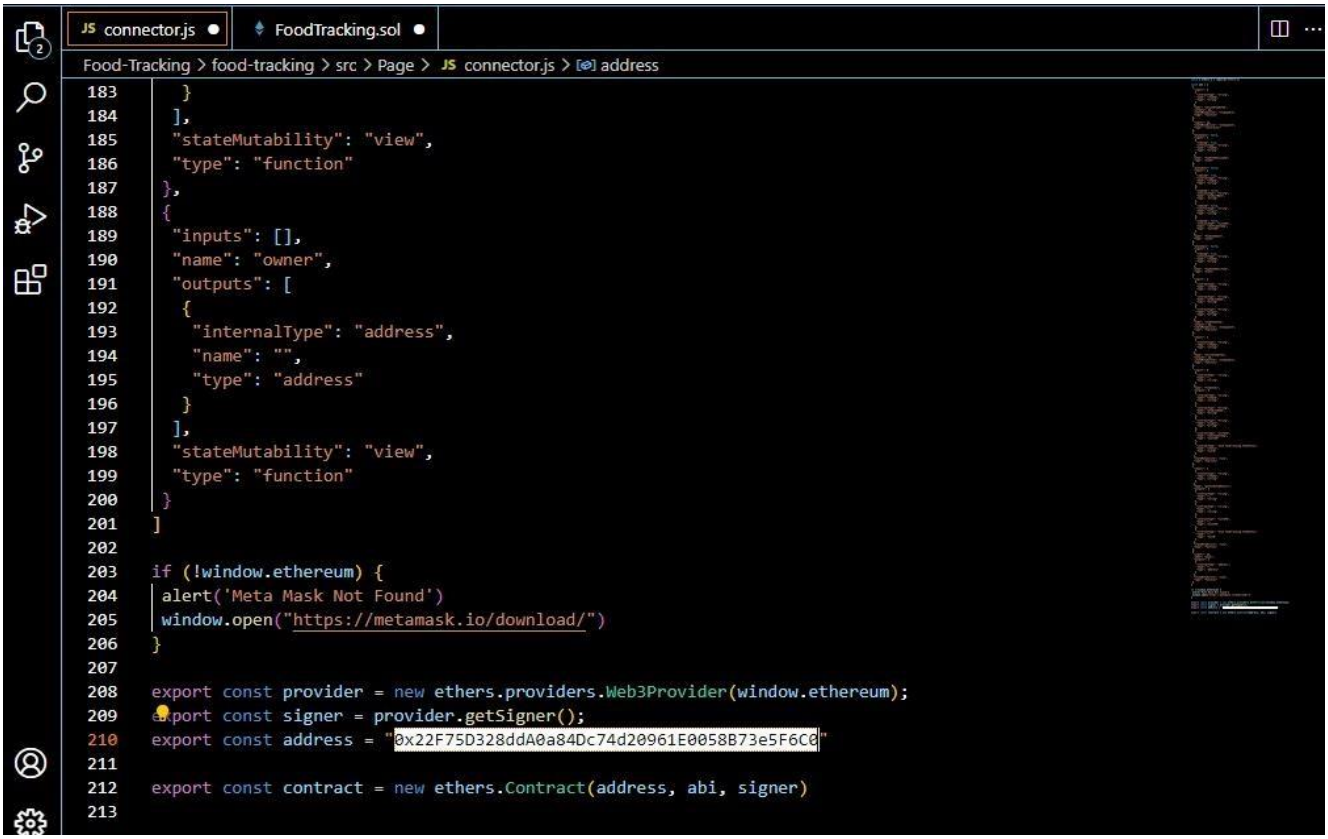
## 7.1Feature 1

### Visual Studio Coding




File Edit Selection View Go Run ···
6_Problem_Statement_6_Food_Tracking (3)
EXPLORER
6_PROBLEM_STATEMENT_...
Food-Tracking
food-tracking
node_modules
public
src
Page
connector.js
Home.js
App.css
App.js
App.test.js
index.css
index.js
logo.svg
reportWebVitals.js
setupTests.js
.gitignore
package-lock.json
package.json
README.md
FoodTracking.sol
OUTLINE
connector.js
FoodTracking.sol
Food-Tracking > FoodTracking.sol
// 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() {
0 0 0
Ln 1, Col 1 Spaces: 4 UTF-8 CRLF Plain Text

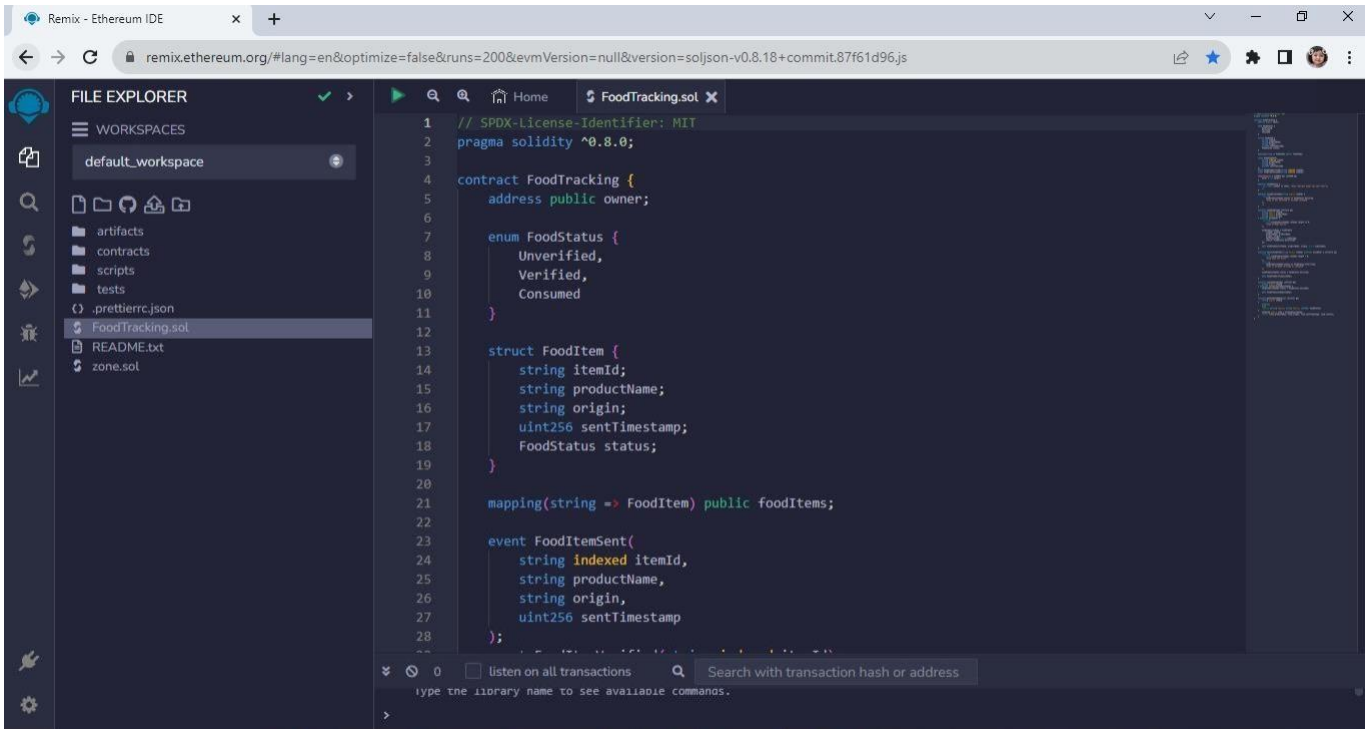

File Edit Selection View Go Run
6_Problem_Statement_6_Food_Tracking (3)
EXPLORER
connector.js
FoodTracking.sol
Food-Tracking > food-tracking > src > Page > connector.js > ...
const { ethers } = require("ethers");
const abi = [
{
"inputs": [
{
"internalType": "string",
"name": "itemId",
"type": "string"
}
],
"name": "consumeFoodItem",
"outputs": [],
"stateMutability": "nonpayable",
"type": "function"
},
{
"inputs": [],
"stateMutability": "nonpayable",
"type": "constructor"
},
{
"anonymous": false,
"inputs": [
{
"indexed": true,
"internalType": "string",
"name": "itemId",
"type": "string"
}
],
"name": "FoodItemConsumed",
OUTLINE
Ln 1, Col 1 Spaces: 4 UTF-8 LF JavaScript

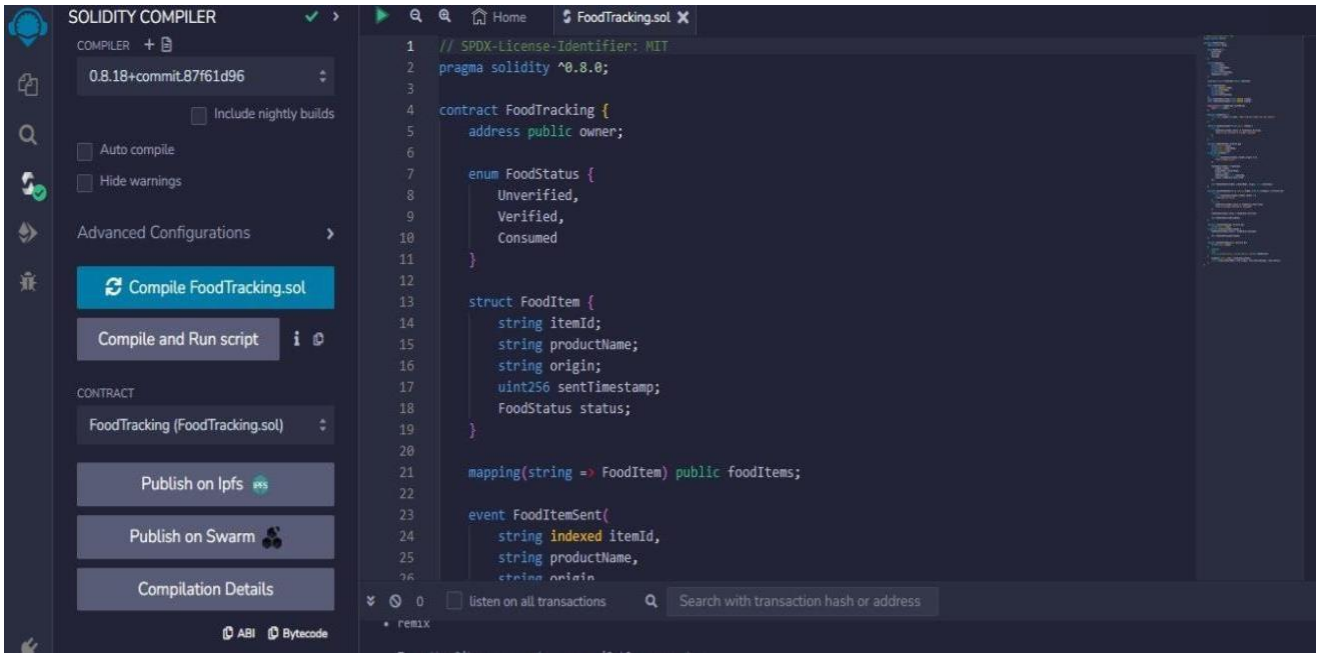

connector.js
FoodTracking.sol
Food-Tracking > food-tracking > src > Page > connector.js > address
},
],
"stateMutability": "view",
"type": "function"
},
{
"inputs": [],
"name": "owner",
"outputs": [
{
"internalType": "address",
"name": "",
"type": "address"
}
],
"stateMutability": "view",
"type": "function"
}
]
if (!window.ethereum) {
alert('Meta Mask Not Found')
window.open("https://metamask.io/download/")
}
export const provider = new ethers.providers.Web3Provider(window.ethereum);
export const signer = provider.getSigner();
export const address = "0x22F75D328ddA0a84Dc74d20961E0058B73e5F6C0"
export const contract = new ethers.Contract(address, abi, signer)

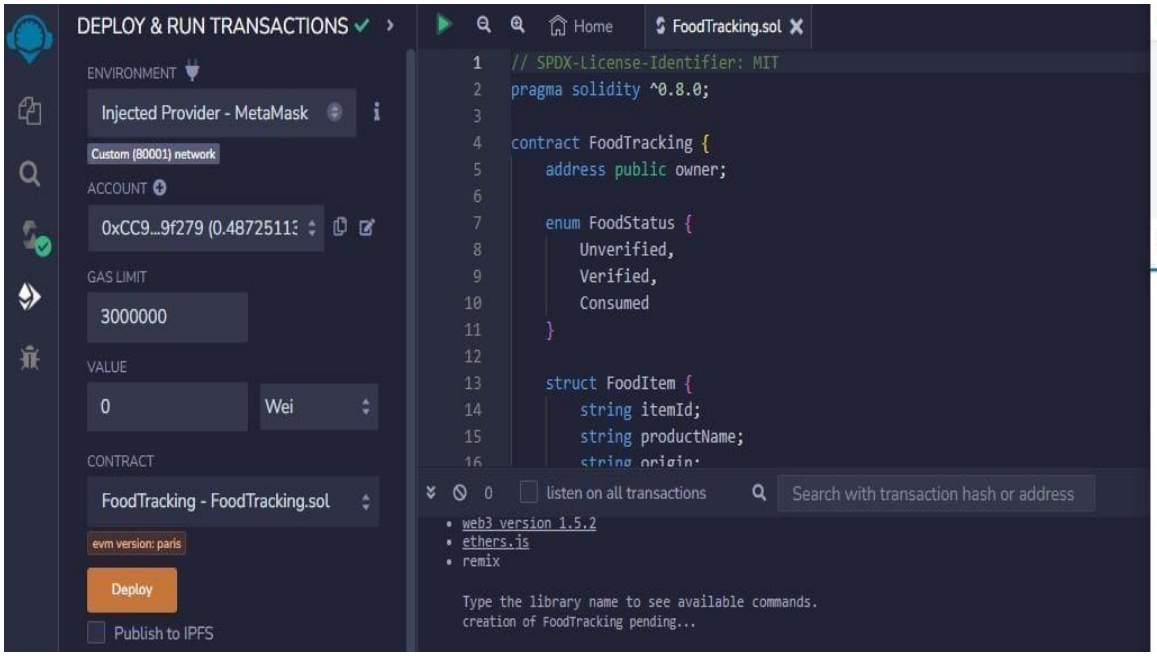
## 7.2Feature 2

### Remix

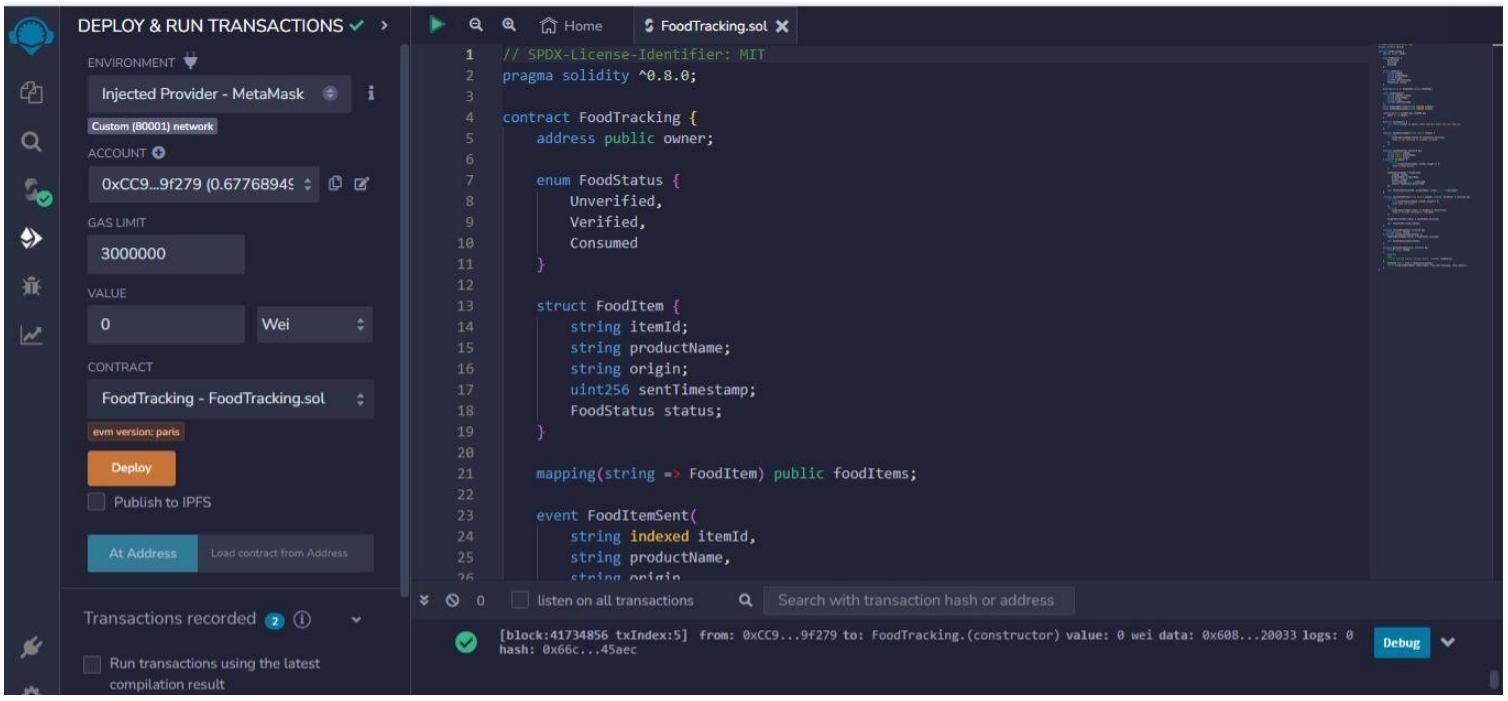
### Coding




DEPLOY & RUN TRANSACTIONS
ENVIRONMENT
Injected Provider - MetaMask
Custom (80001) network
ACCOUNT
0xCC9...9f279 (0.4872511
GAS LIMIT
3000000
VALUE
0
Wei
CONTRACT
FoodTracking - FoodTracking.sol
evm version: paris
Deploy
Publish to IPFS
Home
FoodTracking.sol
// 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;
listen on all transactions
Search with transaction hash or address
web3 version 1.5.2
ethers.js
remix
Type the library name to see available commands.
creation of FoodTracking pending...
Account 1
New contract
https://remix.ethereum.org
CONTRACT DEPLOYMENT
$0.00
DETAILS
DATA
Site suggested
Gas (estimated)
$0.00
0.00318721 MATIC
Very likely in < 15 seconds
Max fee: 0.00318721 MATIC
Total
$0.00
0.00318721 MATIC
Amount + gas
Max amount:

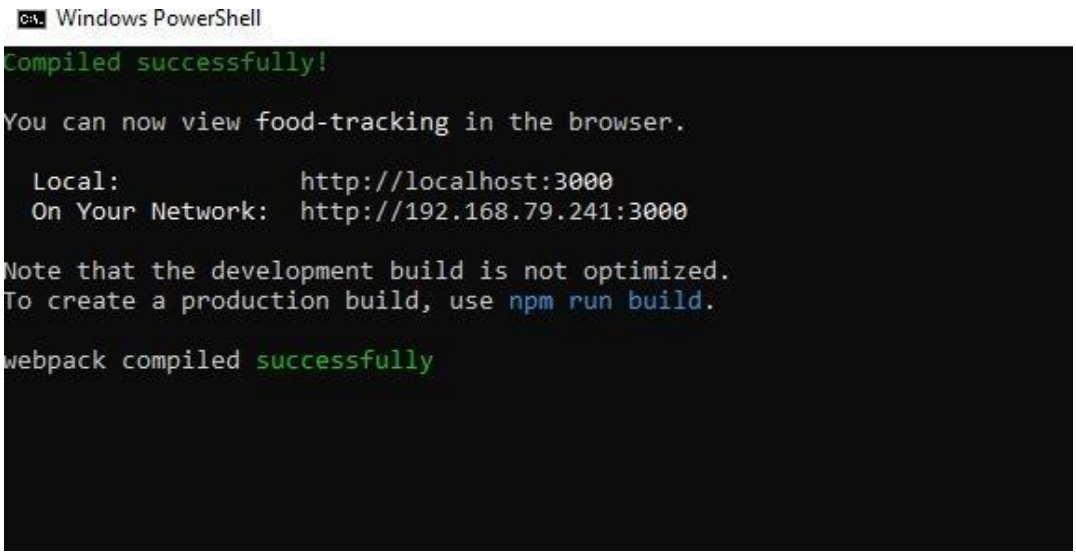
9

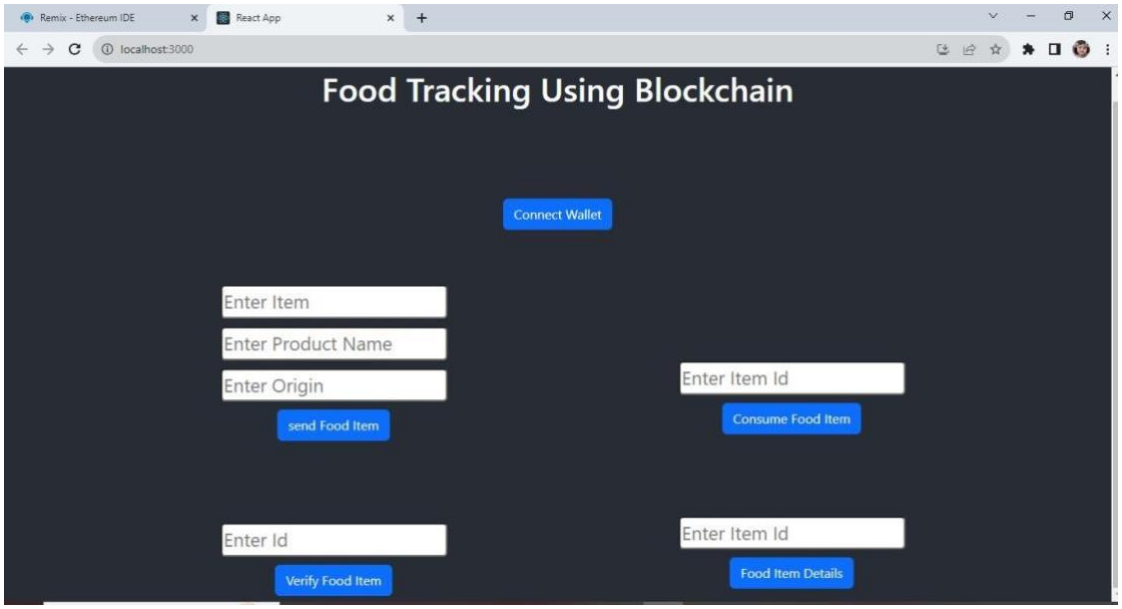

DEPLOY & RUN TRANSACTIONS
ENVIRONMENT
Injected Provider - MetaMask
Custom (80001) network
ACCOUNT
0xCC9...9f279 (0.6776894
GAS LIMIT
3000000
VALUE
0
Wei
CONTRACT
FoodTracking - FoodTracking.sol
evm version: paris
Deploy
Publish to IPFS
At Address
Load contract from Address
Transactions recorded 2
Run transactions using the latest compilation result
Home
FoodTracking.sol
// 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,
listen on all transactions
Search with transaction hash or address
[block:41734856 txIndex:5] from: 0xCC9...9f279 to: FoodTracking.(constructor) value: 0 wei data: 0x608...20033 logs: 0 hash: 0x66c...45aec
Debug

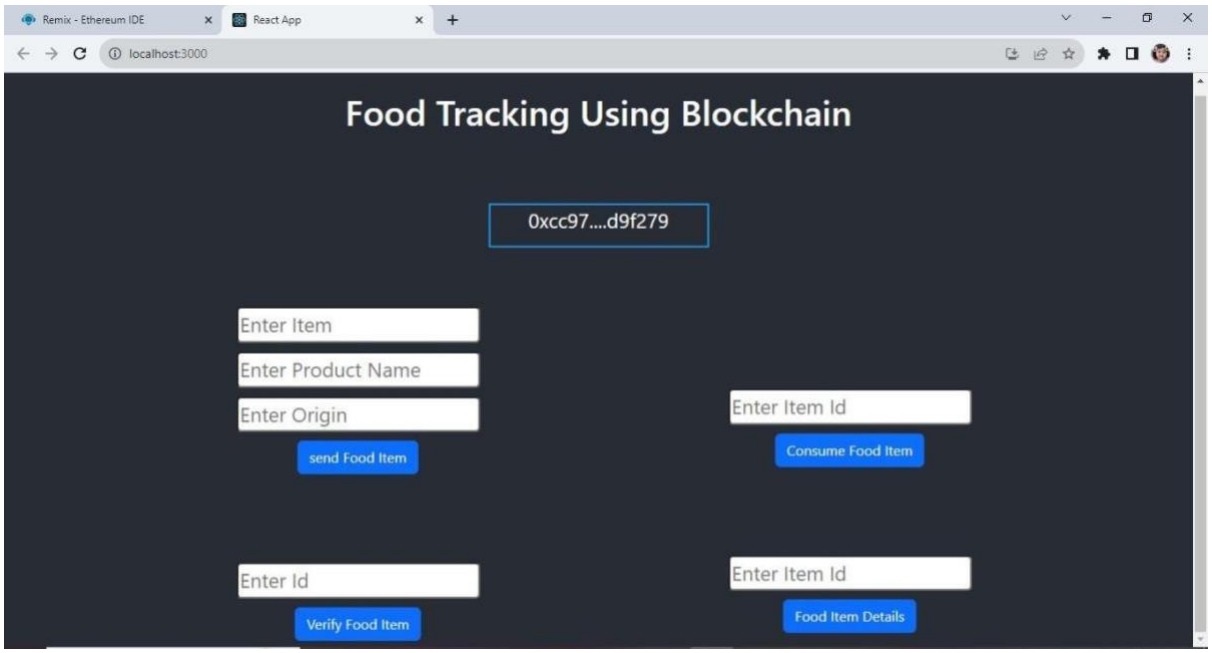
# CHAPTER-9

# 9.RESULTS

## 9.1 Output






# CHAPTER-10

# 10. ADVANTAGES AND DISADVANTAGES

## ADVANTAGES

- Transparency and Traceability: Blockchain provides a tamper-proof, immutable ledger of all transactions and data, making it possible to trace the entire journey of food products from farm to table. This transparency can help in identifying the source of contamination or spoilage quickly and efficiently.
- Enhanced Food Safety: By tracing the origin and history of food products, it becomes easier to identify and recall contaminated or unsafe food items. This can help in preventing foodborne illnesses and ensuring food safety.
- Reduced Food Fraud: Blockchain can make it difficult for bad actors to introduce counterfeit or substandard food products into the supply chain, as each step is recorded and verified.

- Efficiency and Cost Savings: By automating processes such as verification, certification, and record-keeping, blockchain can reduce administrative overhead and streamline the supply chain. This can lead to cost savings and improved efficiency.

- Trust and Consumer Confidence: Consumers can access information about the products they purchase, such as the origin, handling, and quality of the food. This transparency can increase consumer confidence in the food supply chain.
- Smart Contracts: Smart contracts can automate certain processes in the supply chain, such as payment upon delivery or the release of certifications once conditions are met. This reduces the need for intermediaries and accelerates transactions.

**DISADVANTAGES :**

- Implementation Challenges: Implementing a blockchain-based food tracking system can be complex and costly. It requires collaboration and consensus among various stakeholders in the food supply chain.
- Scalability: Blockchain technology, particularly public blockchains, can face scalability issues as the number of transactions and data volume increases. This may limit its effectiveness in handling a high volume of food transactions.
- Privacy Concerns: While blockchain provides transparency, there are concerns about the privacy of sensitive data in a public blockchain. Special considerations and privacy measures need to be taken to protect confidential information.
- Education and Adoption:Users and stakeholders in the food supply chain may require training to understand and use blockchain technology effectively. The learning curve can slow down adoption.
- Data Accuracy: The accuracy of data recorded on the blockchain depends on the quality of data input. Garbage in, garbage out is a concern, and there should be mechanisms for verifying data accuracy.

- Regulatory Challenges: Different countries and regions may have varying regulations related to food tracking and blockchain technology. Compliance with these regulations can be challenging.

## CHAPTER-11

## 11. CONCLUSION

In conclusion, implementing a food tracking system using blockchain technology offers the potential for improved transparency, traceability, food safety, and trust in the supply chain. However, it comes with challenges such as complex implementation, scalability issues, privacy concerns, and regulatory compliance. Successful deployment of such a system requires careful consideration of these factors and collaboration among stakeholders to maximize its benefits

## CHAPTER-12

## 12. FUTURE SCOPE

The future scope of a food tracking system using blockchain technology is highly promising. It presents opportunities for enhancing food safety, transparency, and efficiency in the global food supply chain. As blockchain technology matures and becomes more widely adopted, we can expect increased integration with emerging technologies such as Internet of Things (IoT), Artificial Intelligence (AI), and machine learning. This will enable real-time monitoring of food products, predictive analytics for quality control, and proactive measures against fraud. Additionally, as consumer demand for traceable and sustainable food products grows, blockchain can empower consumers to make informed choices about the products they purchase, contributing to a more ethical and environmentally friendly food industry. The future will likely see the establishment of global standards and greater collaboration among stakeholders to ensure interoperability and consistency in food tracking systems, improving the overall integrity of the supply chain.

In summary, the future scope of a blockchain-based food tracking system extends to other sectors like pharmaceuticals and luxury goods, as it can serve as a model for traceability. Expect increased collaboration with regulatory bodies and the potential to revolutionize how we track, verify, and consume products, all driven by innovation and wider adoption.

# CHAPTER-13

# 13.APPENDIX

**Source Code GitHub: https://github.com/HARINIRAMAN20/blockchain-nm**

**Project Demo Link: https://drive.google.com/file/d/1ZjZ34LFLIbnQZiTUYNZI0kfp-cbIitDU/view?usp=drivesdk**