PROJECT REPORT

Date	28 Oct 2023
Team ID	NM2023TMID04093
Project Name	Food Tracking System

Food Tracking System

1.Introduction

1.1Project overview

The power of blockchain technology combined with active and passive sensors has existed for some time, especially in retail. However, it is only in recent years that the food industry has begun to pay them serious attention. Blockchain has the potential to radically improve traceability and protect consumers from counterfeit products.

1.1 Purpose

When unsafe food slips through the system and winds up in consumer's stomachs, it can create problems for brands, lead to regulatory action and even force the closure of some businesses. Traceability allows operatives in the food industry to quickly identify the source of an issue and correct it before it causes widespread harm to public health.

2.Literature survey

2.1 Existing problem

One of the biggest challenges with implementing effective traceability systems in food supply chains is the complexity of the supply chains themselves. Food products can pass through multiple intermediaries, including producers, processors, distributors, and retailers, before reaching the end consumer. This makes it difficult to track the movement of food products and identify the source of any contamination or quality issues.

In addition, the global nature of the food industry means that food products may be produced and distributed across multiple countries and regions. This can make it difficult to ensure compliance with regulations and maintain consistent standards across different parts of the supply chain.

2.2 References

1. Adele Peter, Fast Company., 2017. In China, you can track your chicken on-you guessedit-the blockchain. https://www.fastcompany.com/40515999/in-china-you-cantrack-your- chicken-on-you-guessed-it-the-blockchain.

2. Aiello, G., Enea, M., & Muriana, C., 2015. The expected value of the traceability information. European Journal of Operational Research, 244(1), 176-186. https://doi.org/10.1016/j.ejor.2015.01.028.

3. Alharby, M., & van Moorsel, A., 2017. Blockchain-based smart contracts: A systematic mapping study. arXiv preprint arXiv:1710.06372. https://doi.org/10.5121/csit.2017.71011.

4. Alzahrani, N., & Bulusu, N., 2018. Block-supply chain: a new anti-counterfeiting supply chain using NFC and blockchain. In Proceedings of the 1st Workshop on Cryptocurrencies and Blockchains for Distributed Systems (pp. 30-35). ACM. https://doi.org/10.1145/3211933.3211939.

5. Andoni, M., Robu, V., Flynn, D., Abram, S., Geach, D., Jenkins, D., & Peacock, A., 2019. Blockchain technology in the energy sector: A systematic review of challenges and opportunities. Renewable and Sustainable Energy Reviews, 100, 143-174. https://doi.org/10.1016/j.rser.2018.10.014.

6. Aung, M. M., & Chang, Y. S., 2014. Traceability in a food supply chain: Safety and quality perspectives. Food control, 39, 172-184. https://doi.org/10.1016/j.foodcont.2013.11.007.

7. Badia-Melis, R., Mishra, P., & Ruiz-García, L., 2015. Food traceability: New trends and recent advances. A review. Food control, 57, 393-401. https://doi.org/10.1016/j.foodcont.2015.05.005.

8. Bahga, A., & Madisetti, V. K., 2016. Blockchain platform for industrial internet of things. Journal of Software Engineering and Applications, 9(10), 533.

https://doi.org/10.4236/jsea.2016.910036.

2.3 Problem Statement Definition

Blockchain food traceability systems can quickly identify points of contamination with Verifiable Credentials because of the immutable and verifiable data collected over time. With blockchain, when a food disease pathogen (an organism that can cause disease) is identified, the company could quickly locate the origin and batch for immediate recall of that contaminated batch rather than throwing out an entire inventory of the product.

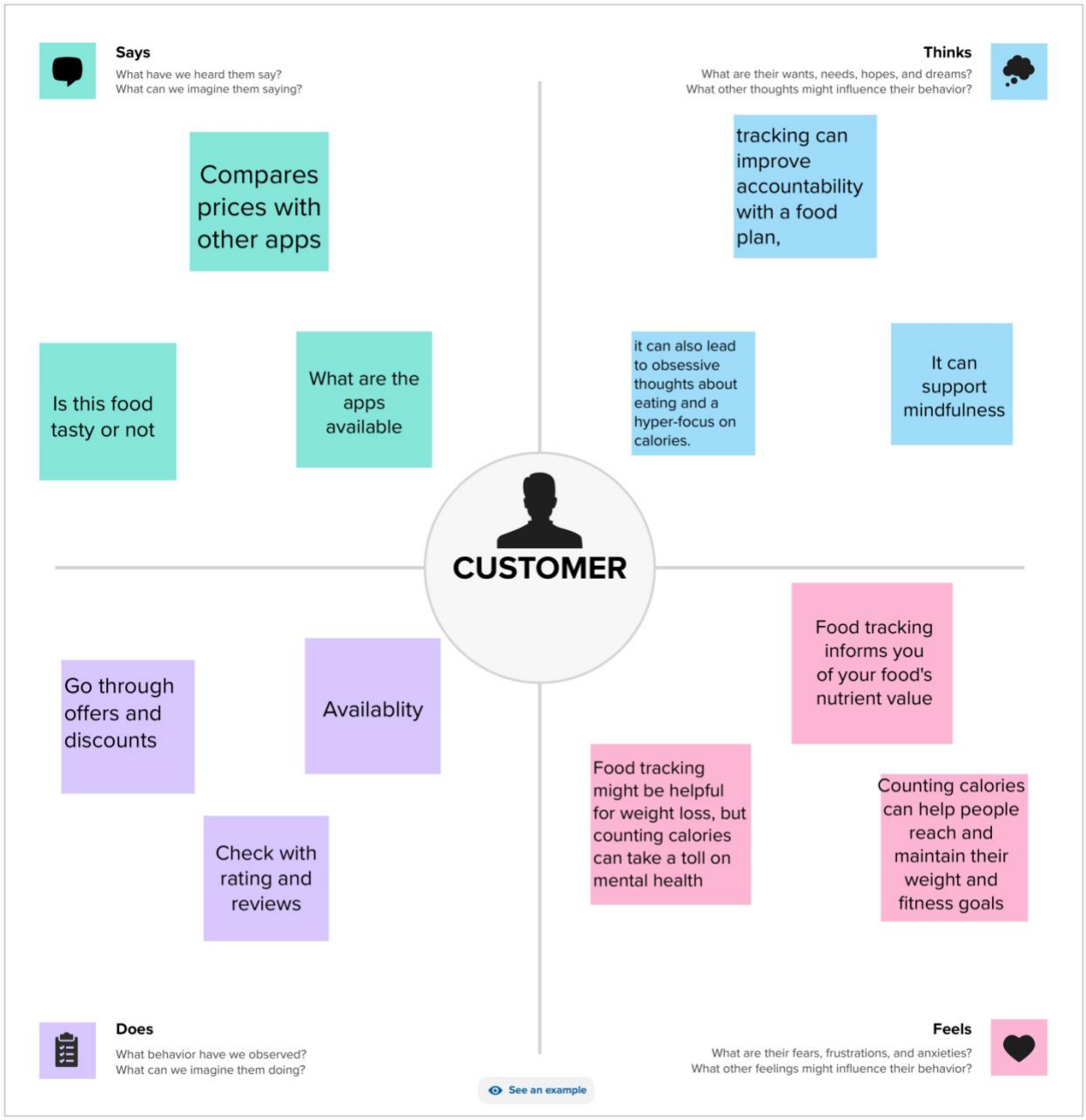
Before, when a food product was contaminated, customers and companies had to throw out the entire inventory resulting in a lot of waste and loss of revenue. An E.coli outbreak in California led to discarding spinach from supermarkets across the US for two weeks and the state's farmers had losses of US$ 74 million. Food-borne illness costs US$ 110 billion per year in low and middle income countries.

Blockchain food traceability systems can help companies comply with food safety regulations. For example in 2020, the Food and Drug Administration (FDA) proposed a New Era of Smarter Food Safety Blueprint to enhance food traceability which motivated trading partners to expand the use of blockchain technology to trace a product back to its origin.

3.Ideation and Proposed Solution

3.1 Empathy Map Canvas

An empathy map is a collaborative tool teams can use to gain a deeper insight into their customers. Much like a user persona, an empathy map can represent a group of users, such as a customer segment. The empathy map was originally created by Dave Gray and has gained much popularity within the agile community.



3.2 Ideation and Brainstroming

A group problem-solving technique that involves the spontaneous contribution of ideas from all members of the group

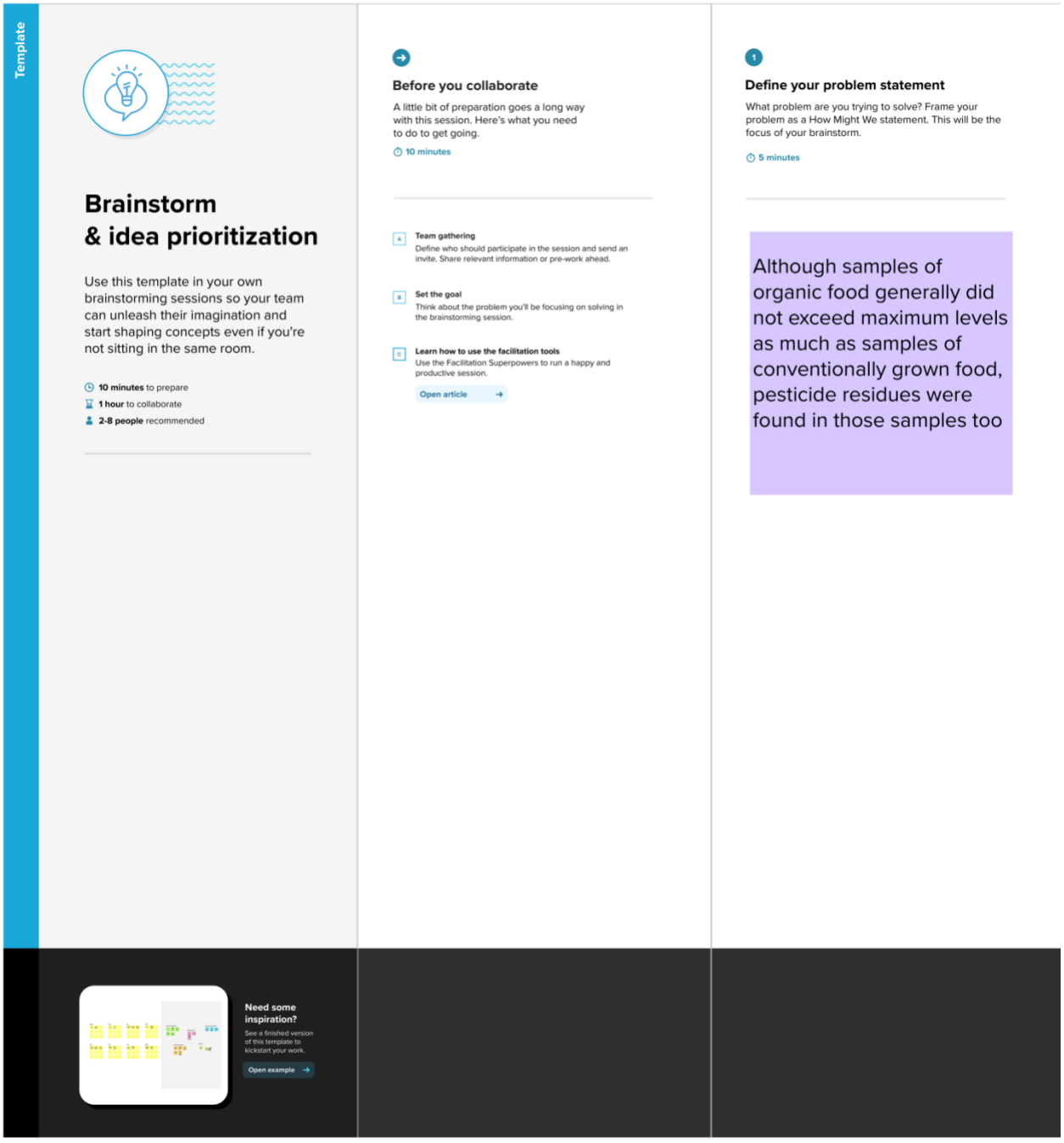
RULES:

1.Lay out the problem you want to solve. ...

2.Identify the objectives of a possible solution. ...

3.Try to generate solutions individually. ...

4.Once you have gotten clear on your problems, your objectives and your personal solutions to the problems, work as a group.



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!

Person 1

Food tracking informs you of your food's nutrient value

Food tracking might be helpful for weight loss, but counting calories can take a toll on mental health

Counting calories can help people reach and maintain their weight and fitness goals

Person 2

tracking can improve accountability with a food plan,

it can also lead to obsessive thoughts about eating and a hyper-focus on calories.

It can help you plan meals

Person 3

Compares prices with other apps

Follow one particular app

What are the apps available

Group ideas

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

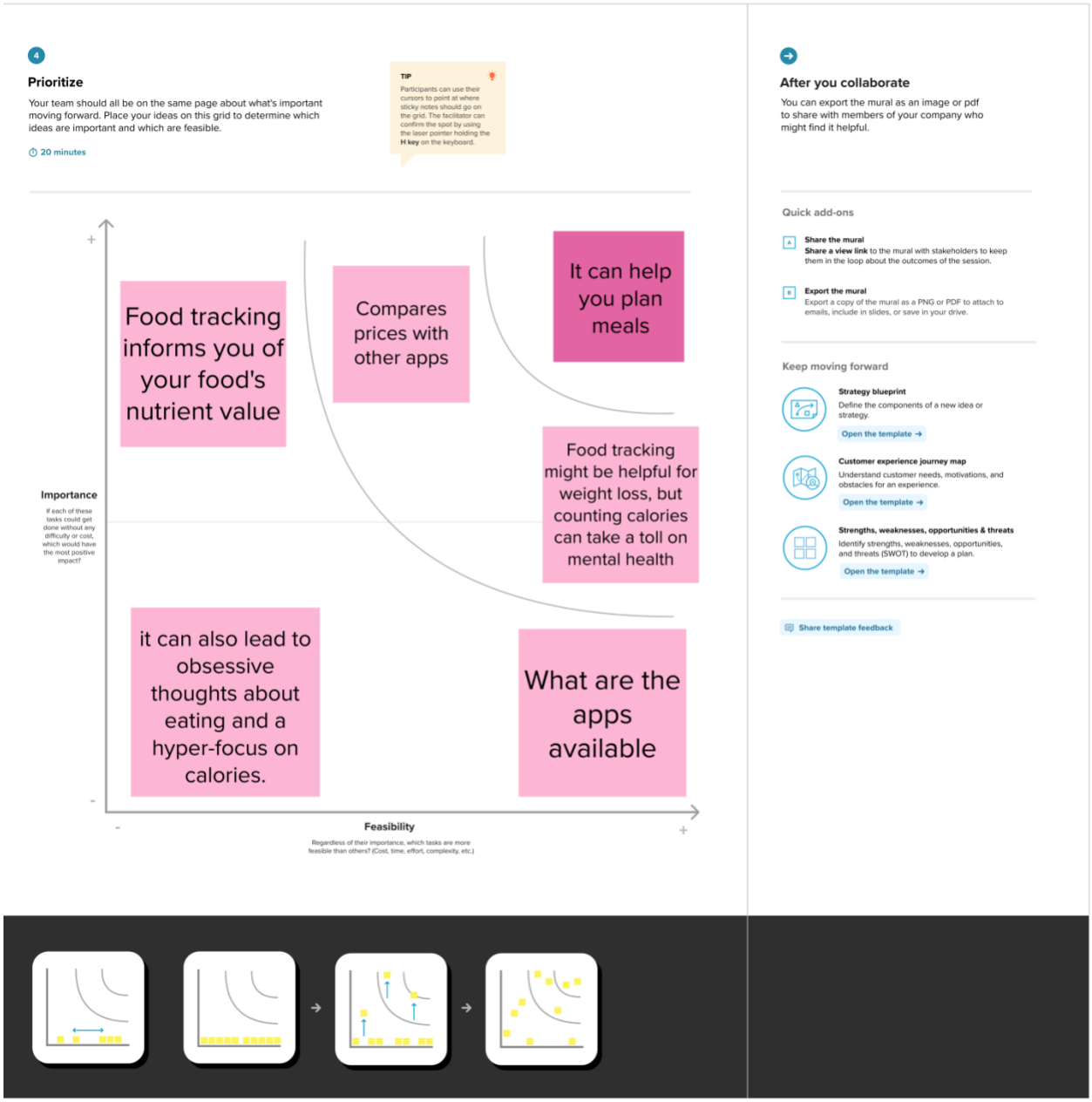
TIP
Add customizable tags to sticky notes to make it easier to find, browse, organize, and categorize important ideas as themes within your mural.

Food tracking might be helpful for weight loss, but counting calories can take a toll on mental health

it can also lead to obsessive thoughts about eating and a hyper-focus on calories.

It can help you plan meals

Compares prices with other apps



4.Requirement Analysis

4.1 Functional Requirements

Requirements are traced forward through other development artifacts, including test cases, test runs, and issues. Requirements are traced backward to the source of the requirement, such as a stakeholder or a regulatory compliance mandate.

The purpose of requirements traceability is to verify that requirements are met. It also accelerates development. That’s because it’s easier to get visibility over your requirements.

Traceability is also important for analysis. If a requirement changes, then you can use traceability to determine the impact of change. You'll see what the requirement is connected to. And you'll be able to see how changing that requirement will impact related issues or tests.

4.2 Non Functional Requirements

For the technical requirements, the results of literature research, workshops and expert interviews are transformed into functional and non-functional user stories and summarized into application-oriented requirements. They contain a short description of the requirement: acceptance criteria describing which conditions the BBTS has to fulfill and other marginal data.

Data collected from the information sources "stakeholders", "documents" and "existing systems" are also systematically analyzed for the interoperability requirements. The analysis aims at an investigation of the systems already in use with regard to data and service interfaces for coupling with a blockchain. The interoperability requirements serve to incorporate all demands for digital frameworks.

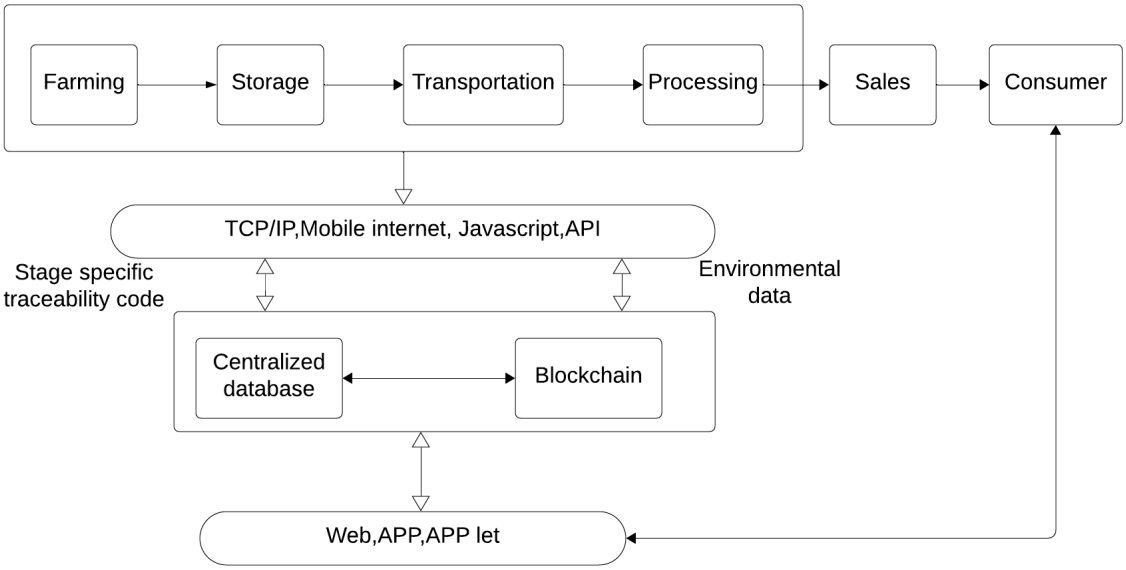
When establishing the requirements, it must be ensured that the named aspects are objectively determined, validated and not contradictory. First, the objectivity of a usage requirement is ensured when several stakeholders / persons / sources formulate the same requirement for a specific usage context. Furthermore, the raised requirements must be traceable to the requirements of the context of use. To ensure that the requirements elicitation is done in the most unbiased way, an aspect is only declared as a fundamental requirement if at least two groups of stakeholders demand for it.

Second, the collected requirements must be valid, i.e. the data must be confirmed or, if necessary, corrected by representatives working in this context. In this paper, workshops with different participants of the supply chain were conducted as well as guideline-based interviews. The results can therefore be considered as valid.

5.Project Design

5.1 Data Flow Diagrams & User Stories

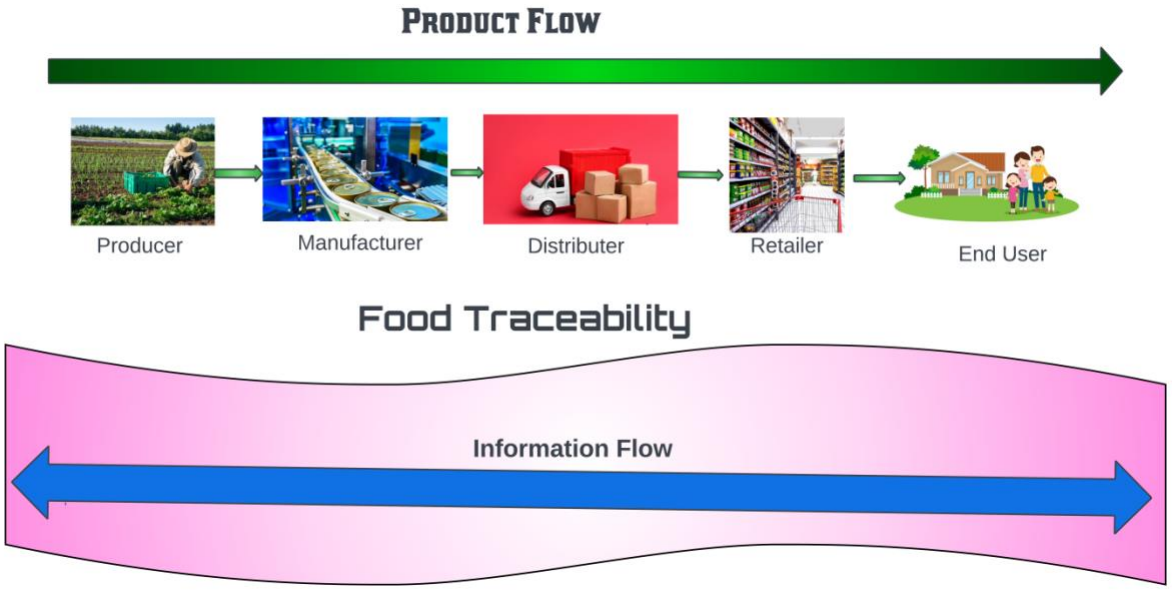
Data flow diagram



User Stories

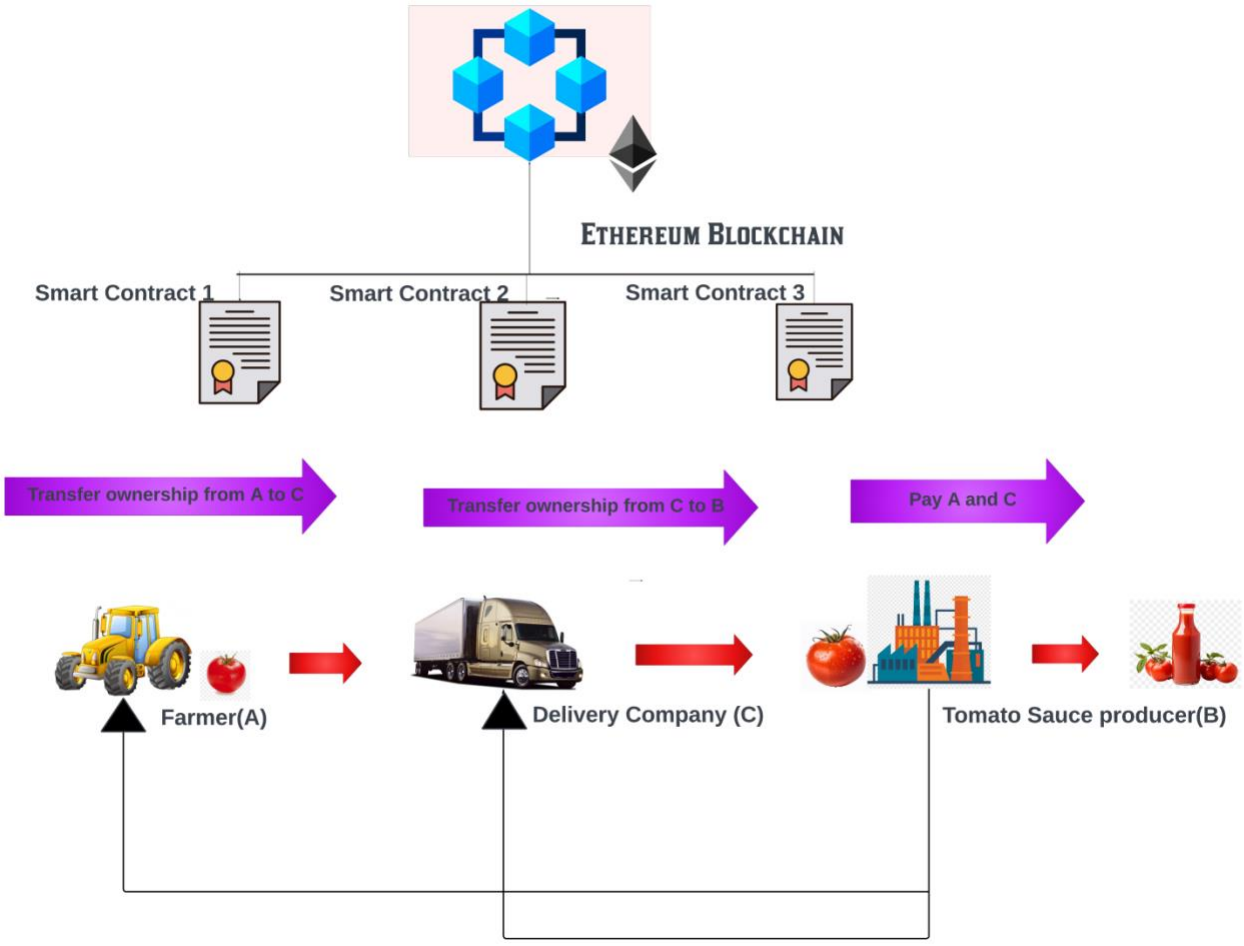
User Type	User Story Number	User type/task	Priority
Food Traceability Industry	USN-1	I want details about the origin of food	High
	USN-2	Want to know about the transportation	High
	USN-3	Detailed description of quality of food	High
	USN-4	Time to reach from farm to table	Medium
	USN-5	To manage the validation of identities	High
Customer	USN-1	I want to track the quality of food by using QR code	High
	USN-2	In all the products QR code want to be attached	High
	USN-3	By scanning the QR code total details about the product will be displayed	Medium
	USN-4	Decreasing foodborne illness risk	High
	USN-5	I want guaranteed food	Medium

5.2 Solution Architecture



6.Project Planning & Scheduling

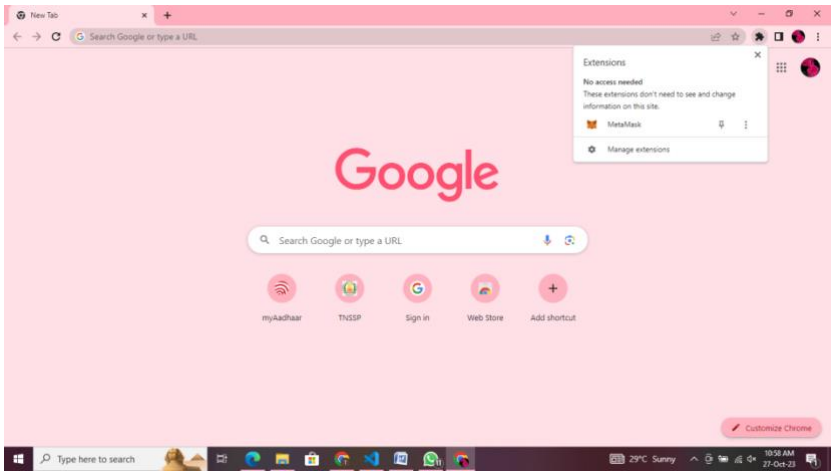
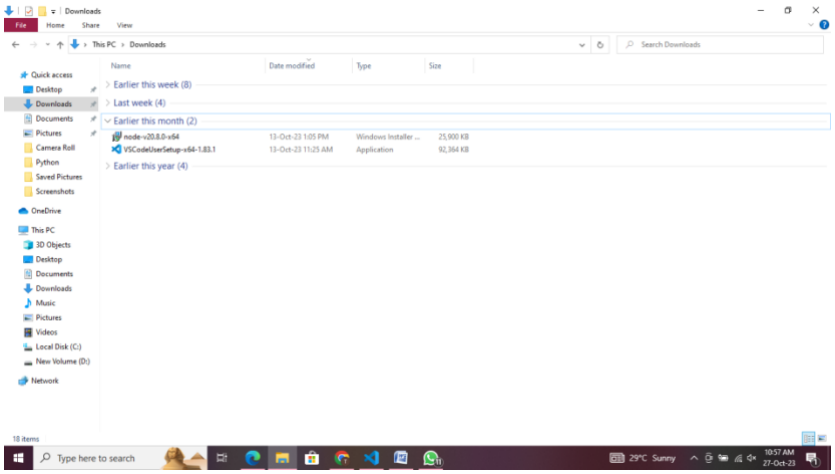
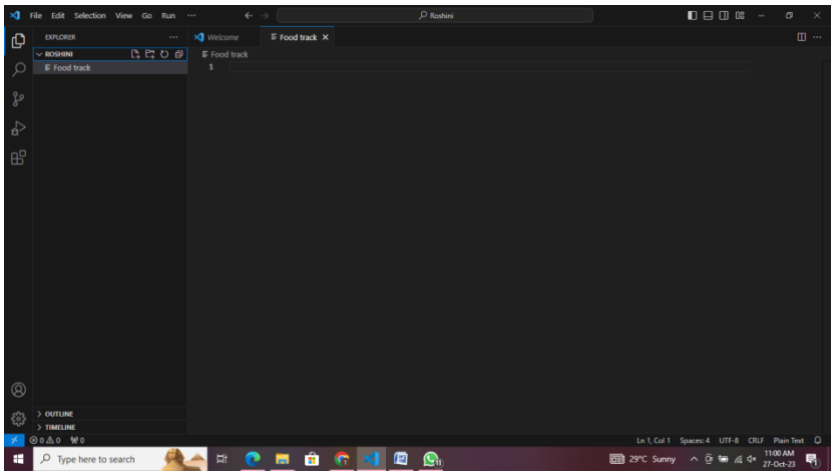
6.1 Technical Architecture

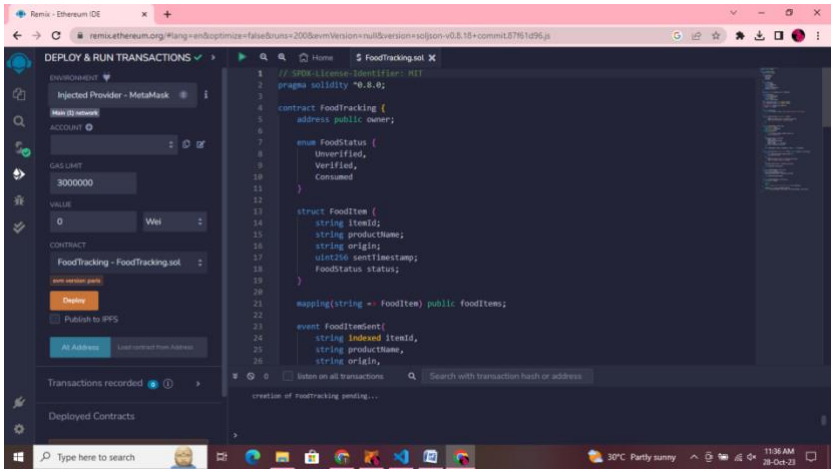
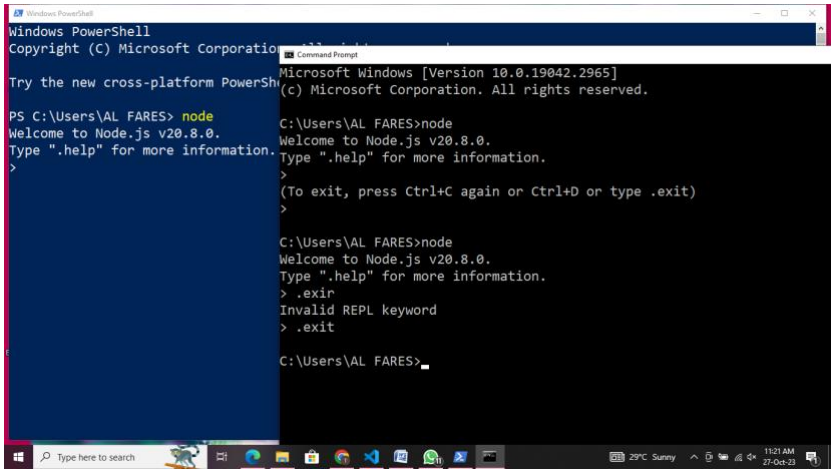
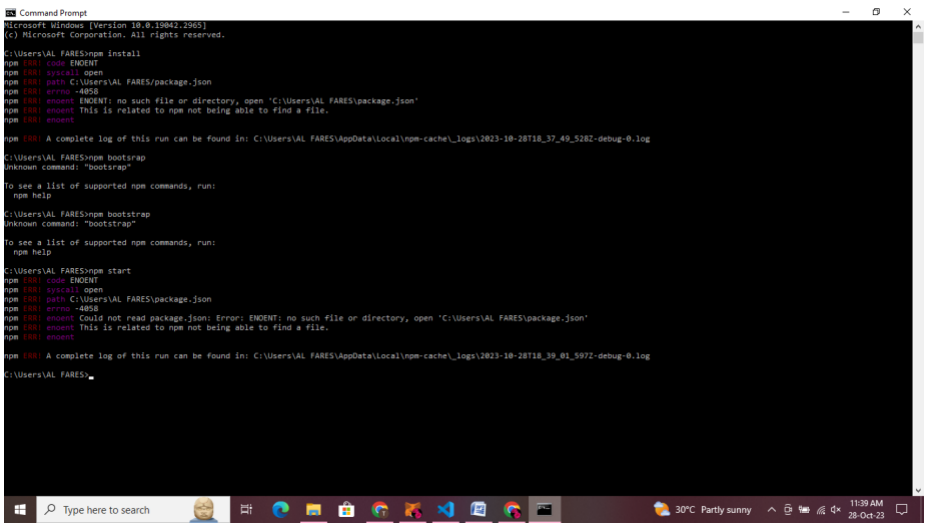


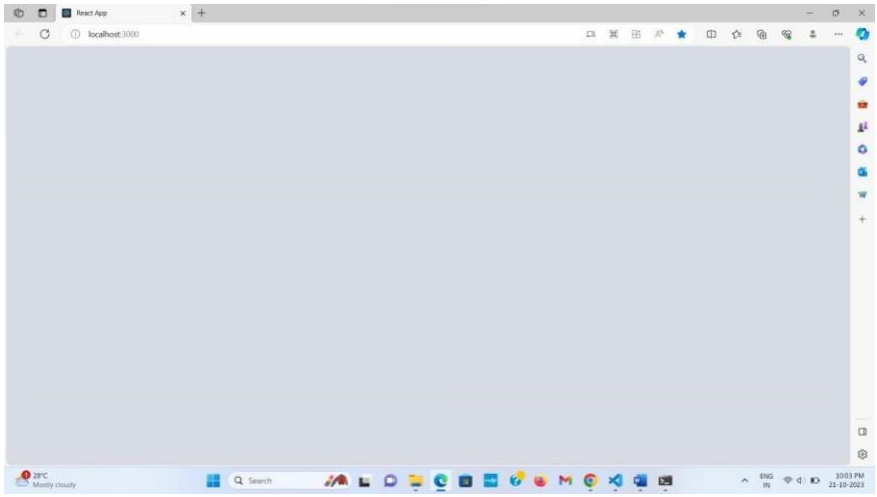
7.Performance Testing

7.1 Performance Metrics

S. No	Parameter	Values	Screenshot

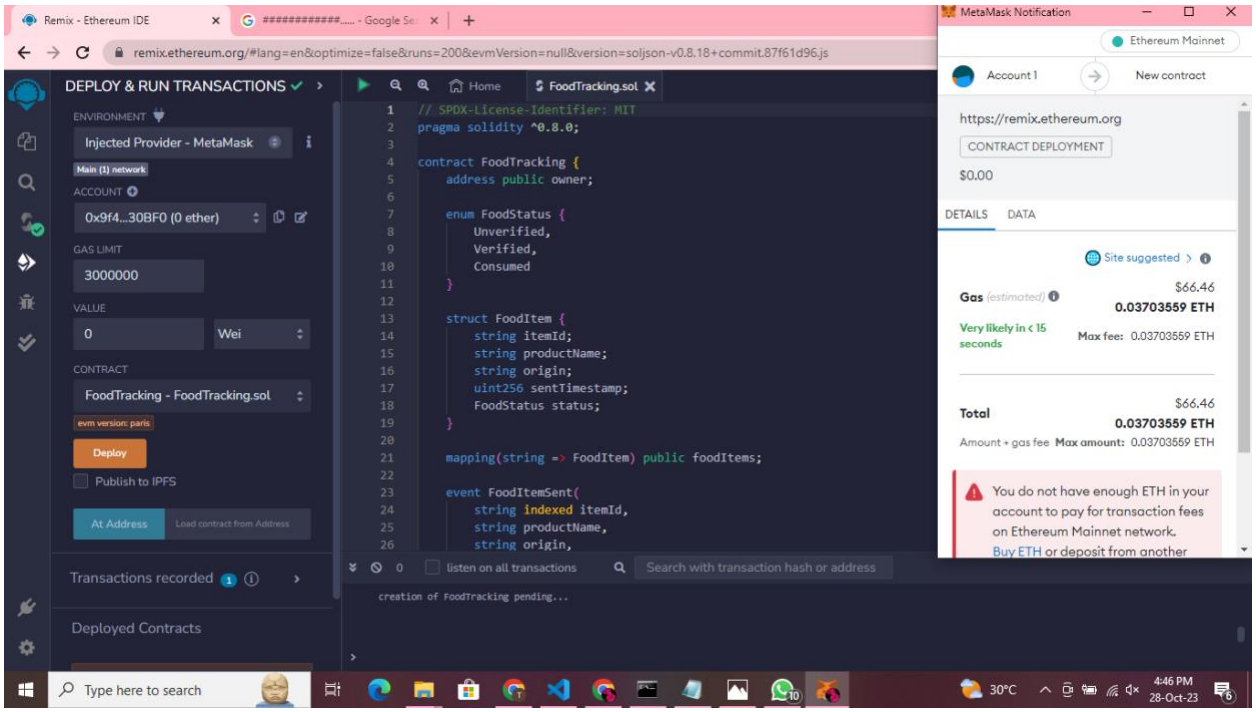
1	Information Gathering	Setup all the prerequisite	 Metamask  VS code & node js
2	Extract the zip file	Open to vs code	

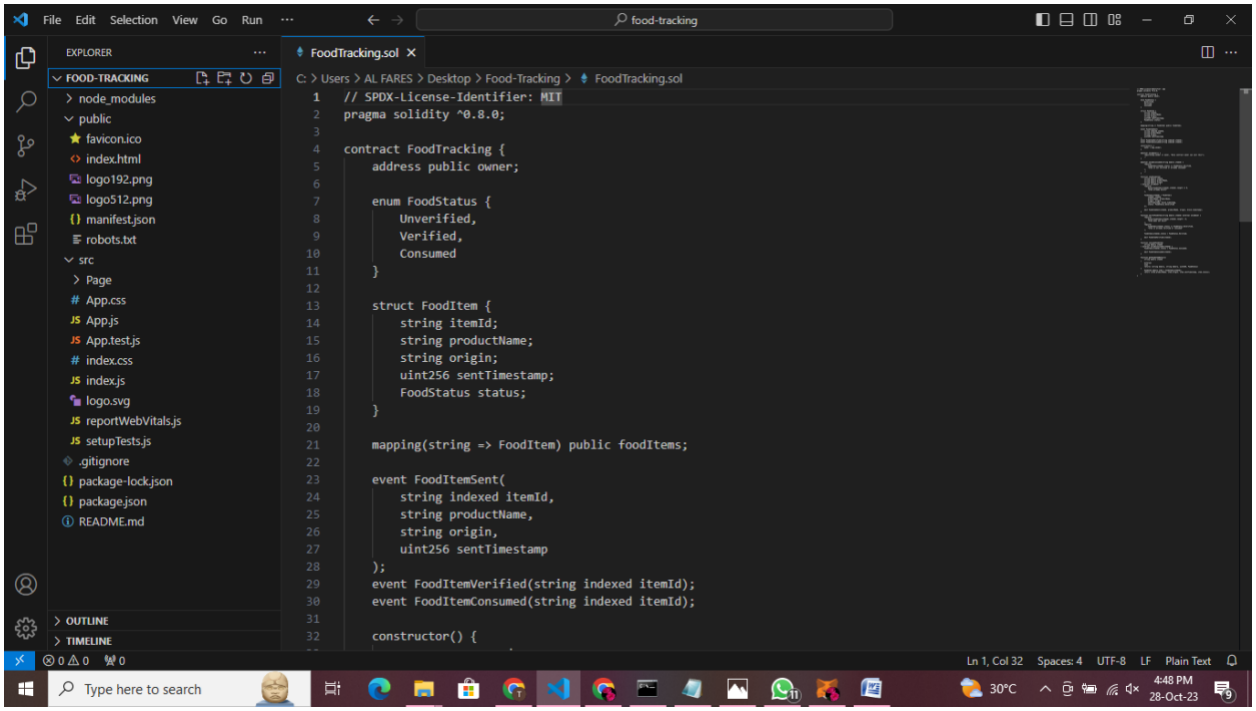
3.	Remix ide platform explorating	Deploy the smart contract code Deploy and run the transaction. By selecting the environment - inject the MetaMask.	
4	Open file explorer	Open the extracted file and click on the folder. Open src, and search for utiles. Open cmd enter commands 1.npm install 2.npm bootstrap 3. npm start	 

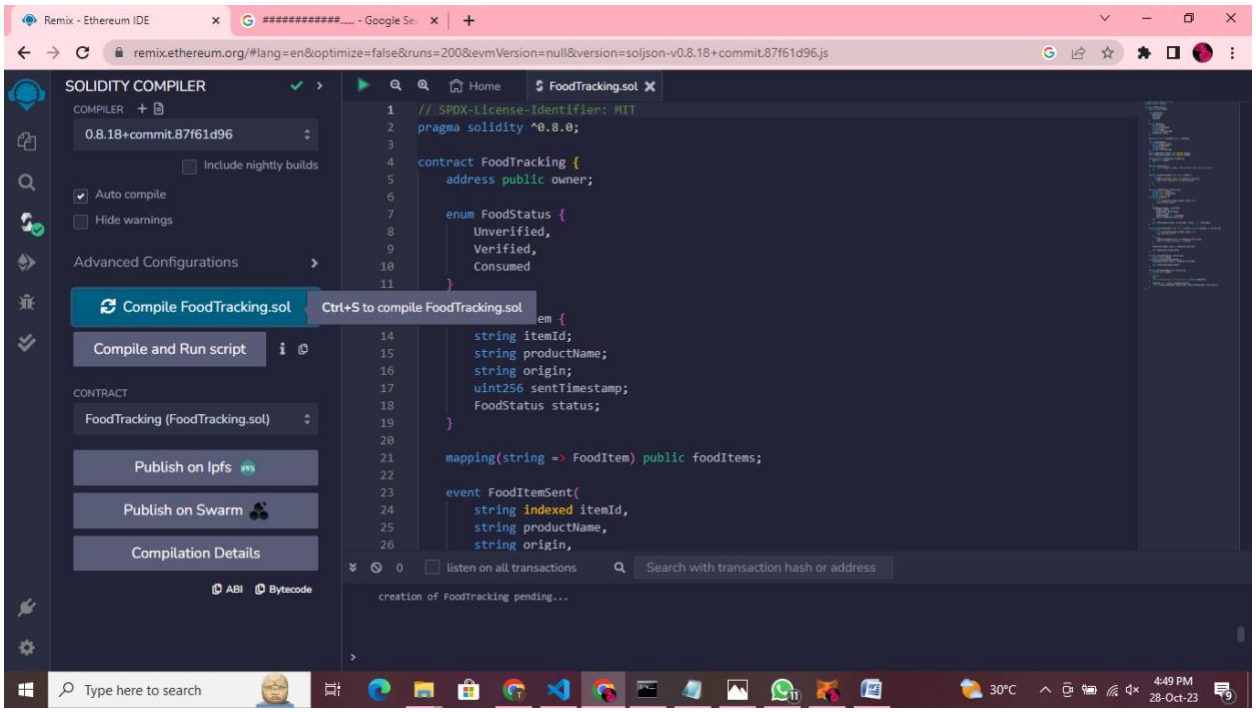
5	Local host IP address	copy the address and open it to chrome so you can see the front end of your project	

8.Results

8.1 Output screenshots




File Edit Selection View Go Run
food-tracking
EXPLORER
FOOD-TRACKING
node_modules
public
favicon.ico
index.html
logo192.png
logo512.png
manifest.json
robots.txt
src
Page
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
OUTLINE
TIMELINE
FoodTracking.sol
C: > Users > AL FARES > Desktop > 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() {
Ln 1, Col 32 Spaces: 4 UTF-8 LF Plain Text
Type here to search
30°C
4:48 PM
28-Oct-23


Remix - Ethereum IDE
remix.ethereum.org/#lang=en&optimize=false&runs=200&evmVersion=null&version=soljson-v0.8.18+commit.87f61d96.js
SOLIDITY COMPILER
COMPILER
0.8.18+commit.87f61d96
Include nightly builds
Auto compile
Hide warnings
Advanced Configurations
Compile FoodTracking.sol
Ctrl+S to compile FoodTracking.sol
Compile and Run script
CONTRACT
FoodTracking (FoodTracking.sol)
Publish on Ipfs
Publish on Swarm
Compilation Details
ABI
Bytecode
Home
FoodTracking.sol
// SPDX-License-Identifier: MIT
pragma solidity ^0.8.0;
contract FoodTracking {
address public owner;
enum FoodStatus {
Unverified,
Verified,
Consumed
}
string itemId;
string productName;
string origin;
uint256 sentTimestamp;
FoodStatus status;
mapping(string => FoodItem) public foodItems;
event FoodItemSent(
string indexed itemId,
string productName,
string origin,
listen on all transactions
Search with transaction hash or address
creation of FoodTracking pending...
Type here to search
30°C
4:49 PM
28-Oct-23

9.Advantages & Disadvantages

Advantages:

- Accurate and tamper-resistant food data.
- Efficiently prevent, contain, or rectify contamination outbreaks while reducing the loss of revenue.
- Creates more transparency and trust in the authenticity of Verifiable Credential data.
- Secure and efficient data transfer between parties.
- Verifiable Credentials help eliminate and prevent fraud .
- Helps organizations comply with food regulations.
- Customers can instantly see information about food origins and product details.

Disadvantages:

- The blockchain integration in FTS may slow the network functionality. Most of the article does not focus on this issue.
- The technological growth in the FTS attracts many new types of attacks which are lightly focused on by most of the related literature.
- A common security framework applicable to all the platforms is missing in the literature.
- This creates interoperability, compatibility, and standardization issues.
- A lack of proper implementation knowledge is a barrier to integrating blockchain in FTS.

10.Conclusion

The main objective of this work was to find out the primary research contributions as well as the benefits of Blockchain in the food supply chain. We have obtained 14 primary studies from digital libraries and the web sources and analysed them. Most of the studies used Ethereum Blockchain platform. The topics of research covered by the studies identified for this SLR included: Food traceability, Blockchain-based supply chains, use of Iot and Smart Contract-Tokens, Visual analysis methods, data storage for monitoring, quality and safety management, a secure traceability scheme and a supply chain delivery system. Blockchain-based traceability systems provided numerous ground-breaking traceability advantages, including complete farm-to-fork traceability, recoding of every single transaction, digital tracking, decentralised file systems, visualisation methods for intuitively displaying risks, and the ability to reconstruct the product's history up to the origin for quality verification.

11.Future Scope

The technology can only enhance the security and privacy of data but also streamline business operations and increase efficiency. It can benefit the industries such as finance, advertising, supply chain, cybersecurity, and more.

Implementing innovative Blockchain solutions helps us get detailed insights into every single event and take informed actions. This enhanced visibility enables us to manage suppliers better, conduct more efficient quality checks, and drastically reduce time and costs at various levels of the supply chain.

12.Appendix

Source 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);
    }
}
```

GitHub link

https://github.com/ThiruvalarRoshini2003/foodtracking.git

Project Demo link

https://drive.google.com/file/d/1mn_Va9gHuGUZMg2pMf5vLwQonxqX8sPS/view?usp=drivesdk