# VACCINE TRACKING SYSTEM

## PROJECT REPORT

**Submitted by**


KARTHIK BABU M (921020104025)
KISHON KARTHIK T (921020104026)
THANGARAJ K (921020104055)
VIDHYASAGAR S (921020104058)

# Content

# 1. INTRODUCTION

## 1.1 PROJECT OVERVIEW

The Vaccine Tracking System Using Blockchain is a project designed to leverage blockchain technology to enhance the transparency, security, and efficiency of vaccine distribution and tracking. This report summarizes the key aspects of the project, including its objectives, methodology, findings, and recommendations.

## 1.2 PURPOSE

The purpose of the "Vaccine Tracking System Using Blockchain" project is multifaceted and aimed at addressing critical issues within the vaccine supply chain, ultimately contributing to public health, safety, and trust. The key purposes of this project are as follows:

1. **Enhancing Vaccine Transparency:**
   The project aims to increase transparency in the vaccine supply chain by using blockchain technology. This transparency benefits various stakeholders, including regulators, healthcare providers, and the public, as they can trace the journey of vaccines from production to administration.

2. **Ensuring Vaccine Authenticity:**
   With the rise of counterfeit vaccines in some regions, ensuring vaccine authenticity is crucial. The project's purpose is to verify the authenticity and provenance of vaccines, reducing the risk of fraudulent or substandard vaccines entering the supply chain.

3. **Improving Supply Chain Efficiency:**
   By implementing a blockchain-based system, the project seeks to streamlinthe vaccine supply chain. Real-time tracking and automated smart contracts help reduce delays, errors, and the potential for vaccine spoilage.

4. **Enhancing Data Integrity:**
   Maintaining data integrity is essential for vaccine tracking and public trust. This project's purpose is to ensure that vaccine-related data remains tamper-proof and secure, preventing data breaches and manipulation**.**

In summary, the main purpose of the "Vaccine Tracking System Using Blockchain" project is to leverage technology to improve vaccine supply chain management, protect public health, and enhance trust in vaccination processes by providing transparency, security, and efficiency in the tracking and distribution of vaccines.

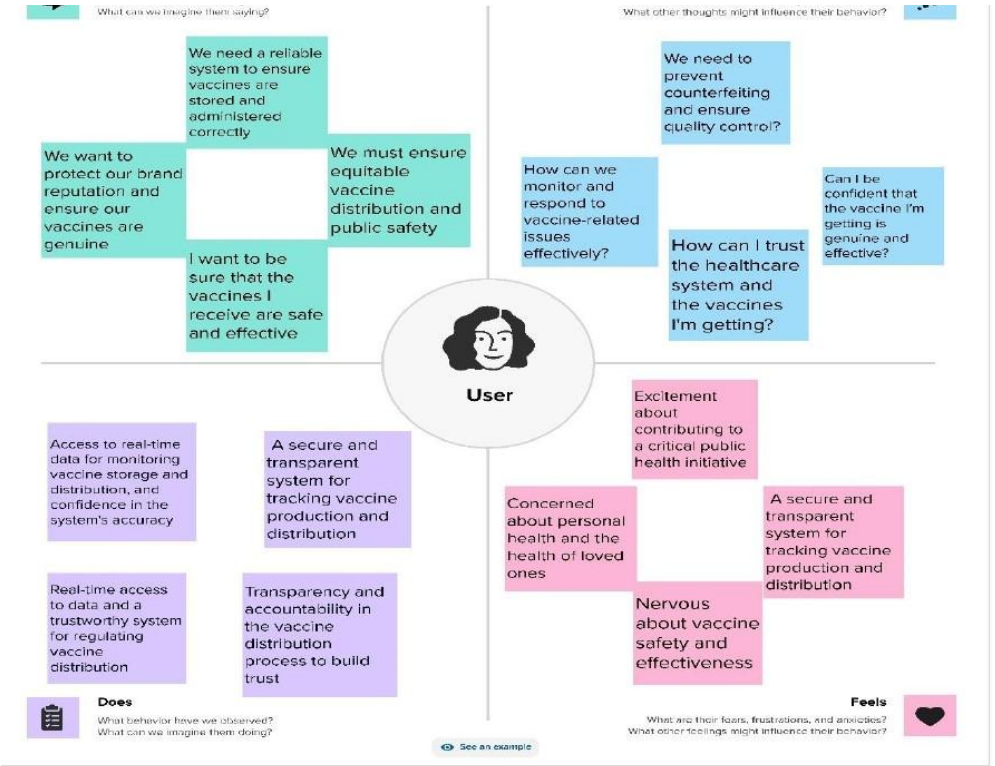
# 2. IDEATION & PROPOSED SOLUTION

## 2.1 PROBLEM STATEMENT DEFENITION

The "Vaccine Tracking System Using Blockchain" project emerges at a critical juncture where the global community faces unprecedented challenges in ensuring the efficient, transparent, and secure distribution of vaccines. The rapid development and distribution of vaccines in response to the COVID-19 pandemic have underscored the need for a robust and technologically advanced solution to address issues such as counterfeit vaccines, supply chain inefficiencies, and data integrity concerns. In light of these challenges, this project seeks to harness the transformative potential of blockchain technology to revolutionize vaccine supply chain management. By introducing blockchain's immutable ledger, smart contracts, and innovative authentication methods, this initiative aims to enhance transparency, traceability, and data integrity within the vaccine supply chain. The purpose of this report is to detail the project's objectives, methodologies, findings, and recommendations, underscoring the pivotal role of this system in safeguarding public health and redefining vaccine distribution in the modern age

## 2.1 EMPATHY MAP

An empathy map is a simple, easy-to-digest visual that captures knowledge about a user's behaviours and attitudes. It is a useful tool to helps 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.



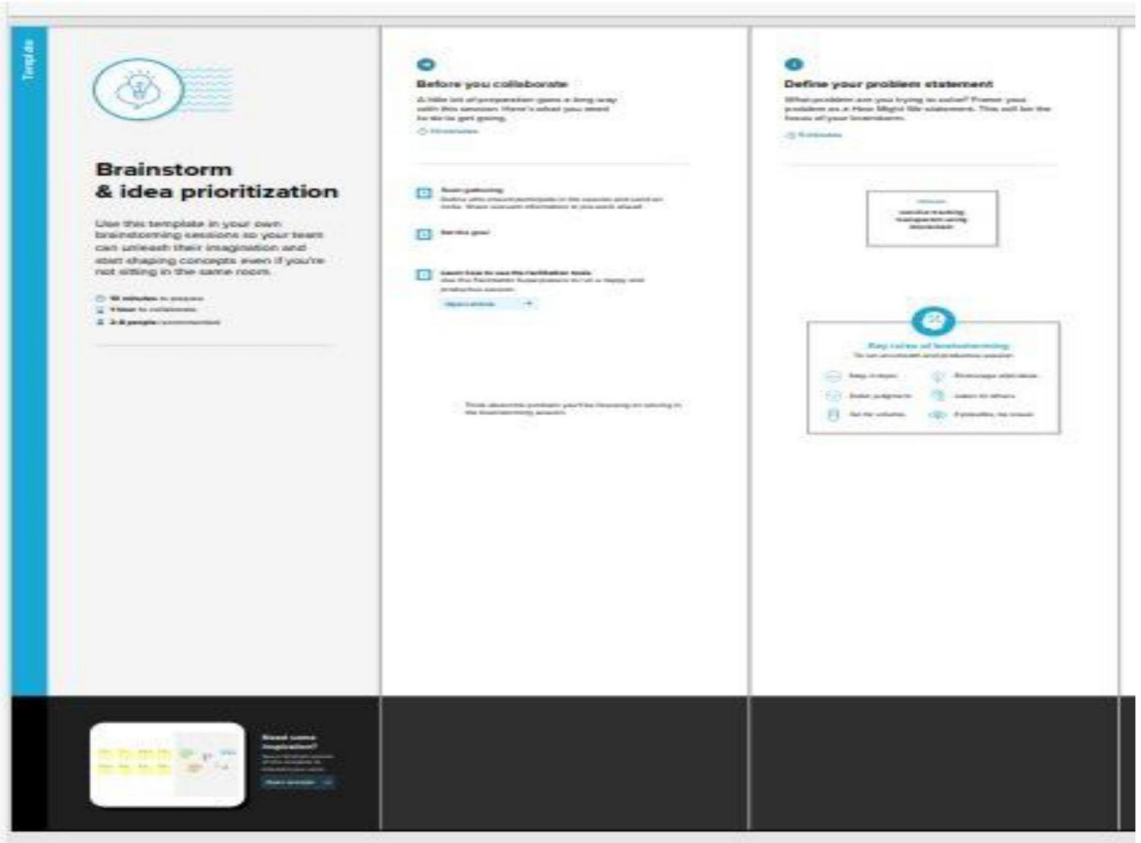
:

## 2.2 BRAINSTORM & IDEATION

### Brainstorm & Idea Prioritization :

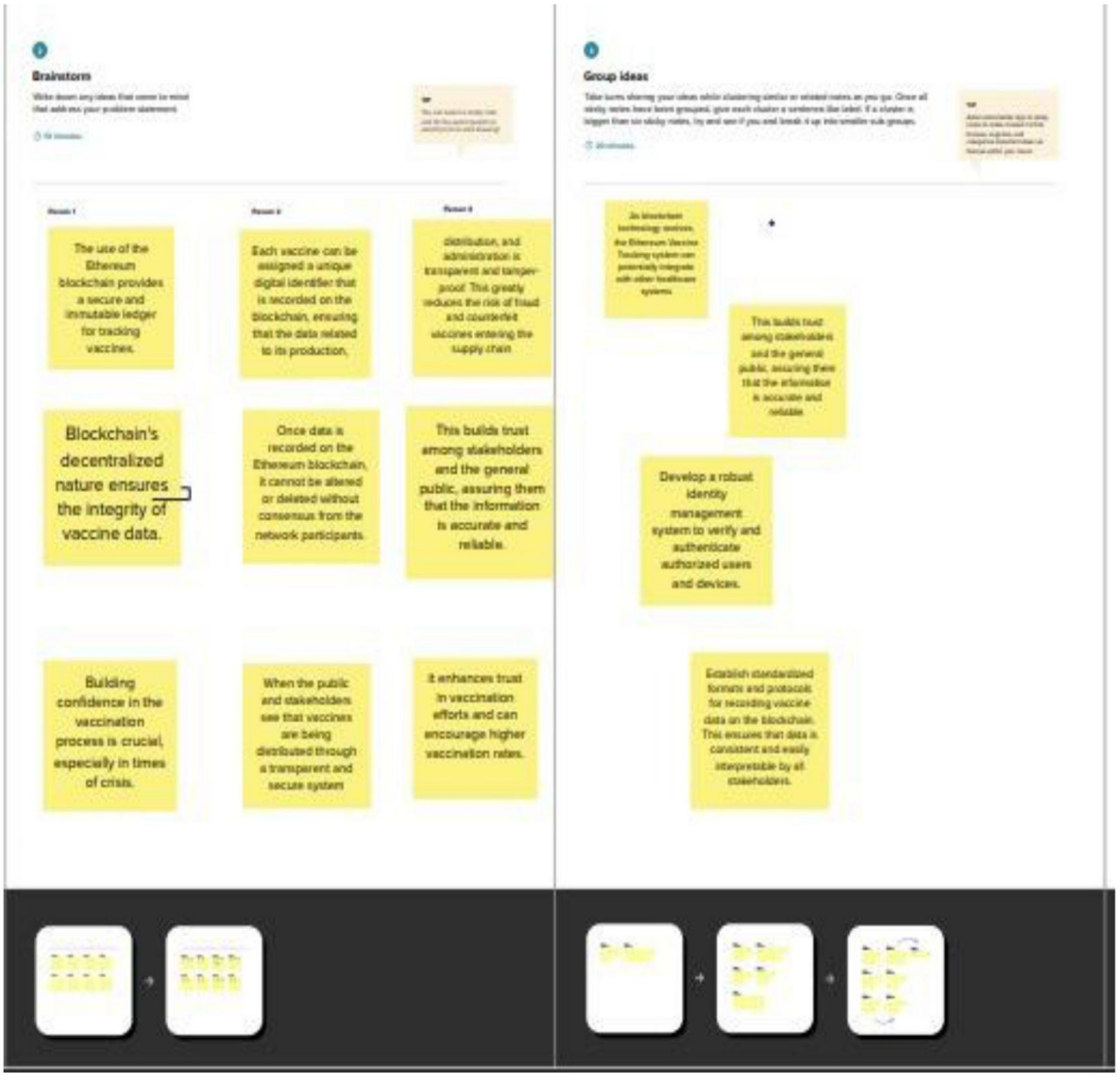
Brainstorming provides a free and open environment that encourages everyone within a team to participate in the creative thinking process that leads to problem solving. Prioritizing volume over value, out-of-the-box ideas are welcome and built upon, and all participants are encouraged to collaborate,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



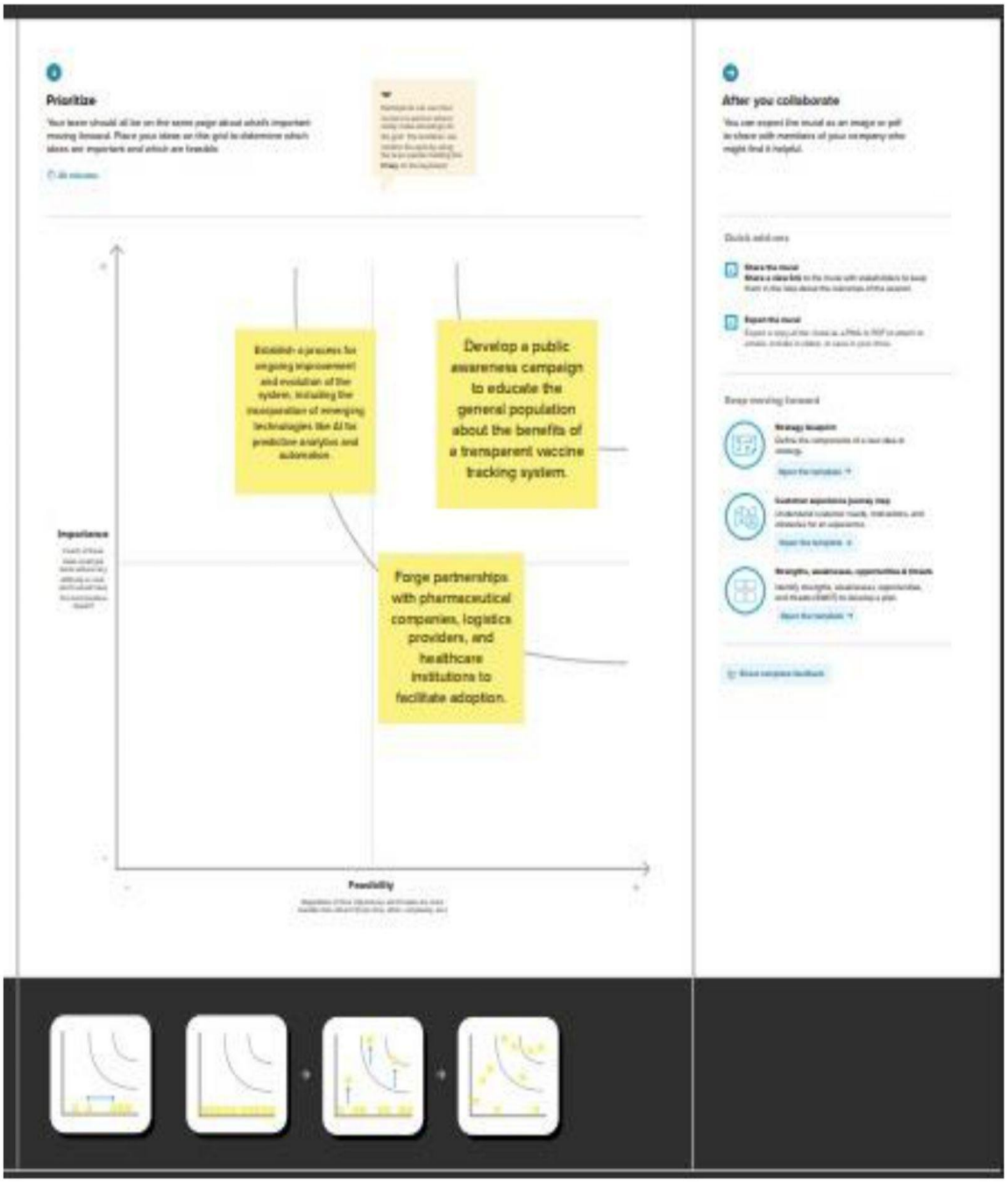
## Step-2: Brainstorm, Grouping

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



**Step-3: Idea Prioritization**

## Step-3: Idea Prioritization



## 2.3 PROPOSED SYSTEM

| S.No. | Parameter | Description |
|---|---|---|
| 1. | Blockchain Infrastructure | Decentralized blockchain network (e.g., Ethereum, Hyperledger) for secure and transparent record-keeping.. |
| 2. | Smart Contracts | Automated contracts for vaccine supply chain stages (production, distribution, administration) to enhance trustless transactions. |
| 3. | Data Integration | Connection with stakeholders (manufacturers, distributors, healthcare providers, regulators) to enable real-time data updates. |
| 4. | Authentication and Verification | Use of QR codes, RFID, or NFC tags for vaccine authentication and a mobile app or website for user verification. |
| 5. | User Interface | User-friendly interfaces for various stakeholders to interact with the system efficiently. |
| 6. | Data Analytics and Reporting | Analytics tools for real-time monitoring, anomaly detection, and report generation for regulatory compliance. |

# 3. REQUIREMENT ANALYSIS

## 3.1 Functional Requirements:

| FR No. | Functional Requirement (Epic) | Sub Requirement (Story / Sub-Task) |
|---|---|---|
| FR-1 | User Interface | The system must allow vaccine manufacturers to log production data, including batch information, manufacturing date, and quality control checks.s. |
| FR-2 | User Registration and Access Control | The system must enable vaccine distributors to record the movement of vaccine batches through the supply chain, with real-time updates triggered by smart contracts. |
| FR-3 | Blockchain Integration | Healthcare providers must be able to log vaccine administration, including patient information, date, and location. |
| FR-4 | Cataloging and Resource Management | End-users and regulators must have the ability to verify vaccine authenticity using a provided mobile app or website. |
| FR-5 | Lending and Returns | The system should provide data analytics tools for monitoring vaccine supply chain performance and detecting anomalies. |

## 3.2 Non – Functional Requirements

| FR No. | Non-Functional Requirement | Description |
|---|---|---|
| NFR-1 | **Resource Optimization** | The system should use system resources efficiently, ensuring that hardware and software resources are used optimally to minimize operational costs. |
| NFR-2 | **Security** | Data on the blockchain must be secured using state-of-the-art encryption and access controls to protect against data breaches. Compliance with relevant data protection regulations (e.g., GDPR) is mandatory. |
| NFR-3 | **Reliability** | The system should have a minimum uptime of 99.5% and should be capable of recovering gracefully from unexpected failures. |
| NFR-4 | **Performance** | The system should be capable of handling a high volume of transactions efficiently, with minimal latency. Response times should not exceed 2 seconds for user interactions. |
| NFR-5 | **Availability** | The system should log all transactions and activities on the blockchain for auditing and traceability purposes. |
| NFR-6 | **Data Backup and Recovery** | Regular data backups and a comprehensive disaster recovery plan should be in place to protect against data loss and system downtime |

# 4. PROJECT DESIGN

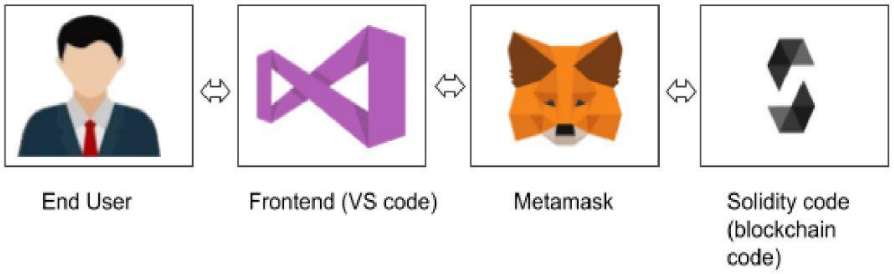
## 4.1 DATA FLOW DIAGRAM

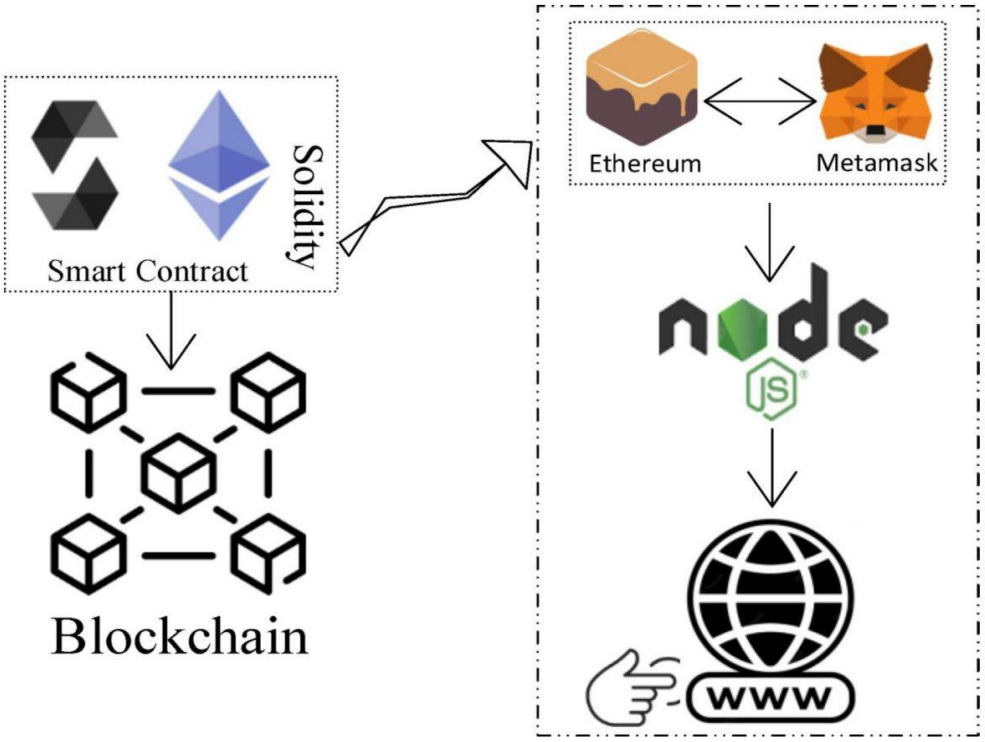
A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.


Vaccine System
External Vaccine Manufacturers
External Vaccine Distributors
External Healthcare Providers
Regulatory Body

## 4.2 SOLUTION AND TECHNICAL ARCHITECTURE

**Example - Solution Architecture Diagram:**




## 4.3 USER STORIES

| User Type | Functional Requirement (Epic) | User Story Number | User Story / Task | Acceptance criteria | Priority | Team Member |
|---|---|---|---|---|---|---|
| Librarian | Resource Catalogue Management | USN-1 | As a librarian, I want to be able to efficiently catalogue and manage library resources to ensure that the library's collection is organized and accessible to students and patrons. | I have access to a cataloguing feature where I can input information about new resources, including title, author, ISBN, and category. I can edit and update resource details in the catalogue as needed | High | Revanthramesh |
| Librarian | User Access Control | USN-2 | As a librarian, I want to have control over user access rights to ensure the security and privacy of sensitive library data. | I can set specific permissions for each user role, specifying what actions each role can perform within the system. | High | Rajapandian |
| Librarian | Resource Tracking and Overdue Fines | USN-3 | As a librarian, I need to track the status of library resources and manage overdue fines to ensure the efficient operation of the library. | I can view a list of overdue resources and the associated fines. | High | Arjunyuvanesh |
| Student | Resource Borrowing | USN-4 | As a student, I want to be able to borrow books from the library to support my studies and personal development. | I can access my user dashboard to view a list of borrowed books and their respective due dates. | High | Sachin |
| Administrator | Update and monitoring | USN-5 | I can update a model and monitor its performance. | Monitoring and enhancement | Medium | Revanthramesh |

# 5. CODING AND SOLUTIONS

## 5.1 code:

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

contract Vaccination {
    address public owner;

    constructor() {
        owner = msg.sender;
    }

    modifier onlyOwner() {
        require(msg.sender == owner, "Only the owner can perform this action");
        _;
    }

    struct Vaccine {
        string vaccineName;
        string manufacturer;
        uint256 manufacturingDate;
        string batchNumber;
        uint256 quantity;
        address customerAddress;
    }

    mapping(uint256 => Vaccine) public vaccines;
    uint256 public vaccineCount;

    event VaccineAdded(uint256 indexed vaccineId, string vaccineName, string manufacturer,
uint256 manufacturingDate, string batchNumber, address customerAddress);

    function addVaccine(uint256 vaccineId, string memory _vaccineName, string memory
_manufacturer, uint256 _manufacturingDate, string memory _batchNumber,uint256 _qty, address
_customerAddress) external onlyOwner {


        vaccines[vaccineId] = Vaccine(_vaccineName, _manufacturer, _manufacturingDate,
_batchNumber, _qty, _customerAddress);
        vaccineCount++;

        emit VaccineAdded(vaccineId, _vaccineName, _manufacturer, _manufacturingDate,
_batchNumber, _customerAddress);
    }

    function getVaccineDetails(uint256 _vaccineId) external view returns (string memory, string
memory, uint256, string memory,uint256, address) {

        Vaccine memory vaccine = vaccines[_vaccineId];
        return (vaccine.vaccineName, vaccine.manufacturer, vaccine.manufacturingDate,
vaccine.batchNumber, vaccine.quantity, vaccine.customerAddress);
    }
}
```

## 6. ADVANTAGES & DISADVANTAGES:

**Advantages** of Blockchain powered vaccine tracking

1.Transparency and Immutability: Blockchain records are tamper-resistant, providing a transparent and immutable ledger of vaccine-related data. This ensures that once vaccine information is recorded, it cannot be altered or deleted, reducing the risk of fraud, counterfeiting, or data manipulation.
2.Enhanced Security: Blockchain uses cryptographic techniques to secure data, making it highly resistant to unauthorized access and hacking. This is critical in protecting sensitive vaccine-related information, including patient records and vaccine supply chain data.
3.Traceability: Blockchain enables the tracking of vaccines throughout the supply chain, from manufacturing to distribution and administration. This traceability helps identify the source of any issues, such as contamination or tampering, and allows for faster recalls if necessary.
4.Reduced Counterfeiting: Counterfeit vaccines can have serious health implications. Blockchain can help authenticate the provenance of vaccines, reducing the risk of counterfeit products entering the market.

**Disadvantages** of Blockchain powered Library Management:

1..Scalability: Blockchain systems, particularly public blockchains like Bitcoin or Ethereum, can struggle with scalability. When it comes to vaccine tracking, which involves large volumes of data and transactions, the blockchain may not be able to handle the load efficiently. This can result in slow transaction times and high fees.
2.Energy Consumption: Many blockchain networks rely on energy-intensive consensus mechanisms, such as Proof of Work (PoW). This can lead to high energy consumption, which is not environmentally sustainable, and may not align with the principles of sustainability and responsible resource management in the context of vaccines and public health.
3.Privacy Concerns: While blockchain ensures data immutability and security, it can also raise privacy concerns, as all transactions are transparent and permanent. Sensitive information about vaccines, patients, and healthcare providers may be exposed on the blockchain, potentially compromising privacy.
4.Interoperability: The healthcare industry is highly fragmented, and various systems and standards are in use. Integrating blockchain into existing healthcare infrastructure can be challenging and may require extensive changes to ensure compatibility and interoperability.

## 8. CONCLUSION

Ethereum Vaccine Tracking system and blockchain-based solutions for vaccine distribution represent a significant leap forward in the quest for more secure, transparent, and efficient healthcare practices. These systems offer a beacon of hope and potential for a safer and more reliable future in the field of public health. The impact and potential of these systems are profound and far-reaching.

## 9. FUTURE SCOPE

The project's future scope includes the following possibilities for further improvement and expansion:

1. **Global Adoption:**

   As blockchain technology matures and gains wider acceptance, we can expect to see the global adoption of similar systems. This could create a standardized and interconnected approach to vaccine tracking and distribution, improving international collaboration in managing global health crises

2. **Enhanced Trust in Healthcare:**.

   Beyond vaccines, blockchain technology can be applied to other aspects of healthcare, including pharmaceuticals, clinical trials, and patient records. This will enhance overall trust in the healthcare system by ensuring data accuracy and security.

   **Mobile Applications:**

   Develop mobile applications for iOS and Android devices, allowing users to access library resources on their smartphones and tablets.

3. **Reduced Vaccine Wastage:**

   The real-time monitoring and transparency of vaccine distribution can help reduce wastage due to expiration or mishandling. This, in turn, can lead to cost savings and more efficient resource allocation.

4. **Supply Chain Efficiency:**

   The blockchain-based system can be extended to the broader pharmaceutical supply chain. This will enhance the transparency and efficiency of the movement of medical supplies and drugs, reducing delays and costs.

1. **APPENDIX:**

   **Source Code:**

   **Source Link:**
   https://drive.google.com/drive/folders/1h_JhyhD9742PO71-voCEsRISV6EkfVo4?usp=drive_link

   **DEMO VIDEO LINK:**

   https://drive.google.com/file/d/1L8GJpGzlHqVj2wIx0W0pJbCOp-CGldbo/view?usp=drive_link

   **GITHUB LINK:**

   https://github.com/Karthik9952/Vaccine-Tracking-Transparent.git