Project Report

Date	28 Oct 2023
Team ID	NM2023TMID04054
Project name	Vaccine tracking-Transparent

Vaccine tracking system-Transparent

1.Introduction

1.1 Project overview

Coronavirus disease 2019 (COVID-19) has spread quickly and changed the way of life of people all over the world. Building community immunity through vaccination has become mandatory in most countries for the purpose of overcoming the COVID-19 pandemic. Under such circumstances, numerous counterfeit vaccines are circulating because a large amount of money is generated by the global distribution of vaccines. The global market for vaccines is worth approximately 14 trillion Japanese yen [1], and vaccines are commanding enormous sums of money. In July 2021, approximately 2500 people in India received counterfeit COVID-19 vaccines—rather than the real vaccine, these individuals received saline solution [2]. Counterfeit COVID-19 vaccines have also been smuggled across borders, from China to South Africa [3]. In some middle- and low-income countries, where the vaccine supply is insufficient but people can only afford a low-priced vaccine, the probability of inexpensive counterfeit vaccines is relatively high. The circulation of counterfeit vaccines seriously affects human health, the reputation of real VMs, and the effectiveness of the prevention of the spread of COVID-19. Therefore, a strategy for preventing the circulation of counterfeit vaccines is needed.

1.2 Purpose

In addition, resistance to the COVID-19 vaccine remains high because of its rapid production and the early time frame for vaccination. As a result, the circulation of fake vaccine passports to take advantage of loopholes regarding behavioral restrictions placed on those who are unvaccinated is even an issue. One cunning method through which individuals obtain counterfeit vaccine passports involves them colluding with doctors to get them to illegally issue vaccine passports, despite these individuals not having been vaccinated, in exchange for the doctors receiving a bribe. Such fake passports are actually being traded via the dark web for approximately $250 [4]. This circulation of counterfeit vaccine passports has caused a variety of problems, including nonimmunized people spreading the virus and people who think about getting vaccinated believing that they do not have to face the risk of getting vaccinated and, thus, do not do so. As a result, the ultimate goal of vaccination, which is to achieve population immunity, becomes difficult to achieve. Thus, a strategy to prevent the distribution of fake vaccine passports is needed.

2.LITERATURE SURVEY

2.1EXISTING PROBLEM

Regulation: The healthcare industry is heavily regulated ,and blockchain technology is still in its early stages of development.

Interoperablity: Blockchain is a distributed ledger technology which means that it is not compatible with existing healthcare systems.

There have been instance of security branches and hacking attacks on blockchain networks, and these problems can result in monetary losses and damage to the integrity of the network. To mitigate risks, companies are working to improve the security of blockchain networks and appalications.

Nodes are necessary for the correct operation of the Blockchain network. The Blockchain's quality is dependent on the nodes' quality. For instance, the robust Blockchain used by Bitcoin encourages nodes to join the network. The same cannot be said for a Blockchain network where nodes are not incentivised.

2.2REFERENCES

Fighting Counterfeit Pharmaceuticals: New Defenses for an Underestimated-and Growing-Menace. Available online: https://www.strategyand.pwc.com/gx/en/insights/2017/counterfeit-pharmaceuticals.html (accessed on 21 August 2022).

Sgueglia, K. 15 People Face Charges in Connection to a Conspiracy with Fake COVID-19 Vaccine Cards, DA Says. Available online: https://edition.cnn.com/2021/08/31/us/manhattan-charges-covid-vaccine-card-scheme/index.html (accessed on 3 August 2022).

Shuster, S. 'Tip Of the Iceberg': Interpol Says Fake COVID-19 Vaccines Were Smuggled Across Continents. Available online: https://time.com/5943581/interpol-face-covid-vaccine/ (accessed on 20 June 2022).

2.3PROBLEM STATEMENT DEFINITION

Energy Consumption

The process of validating transactions on a blockchain network requires a lot of computing power, which in turn requires a lot of energy. This has led to concerns about carbon emissions and the environmental impact of blockchain technology.

Scalability

Blockchain networks can be slow and inefficient due to the high computational requirements needed to validate transactions. As the number of users, transactions, and applications increases, the ability of blockchain networks to process and validate them in a timely way becomes strained. This

makes blockchain networks difficult to use in applications that require fast transaction processing speeds.

Security

Blockchain's security measures have often been touted as key strengths of the technology — but the security of blockchain networks is not without its challenges. There have been instances of security breaches and hacking attacks on blockchain networks, and these problems can result in monetary losses and damage to the integrity of the network.

Complexity

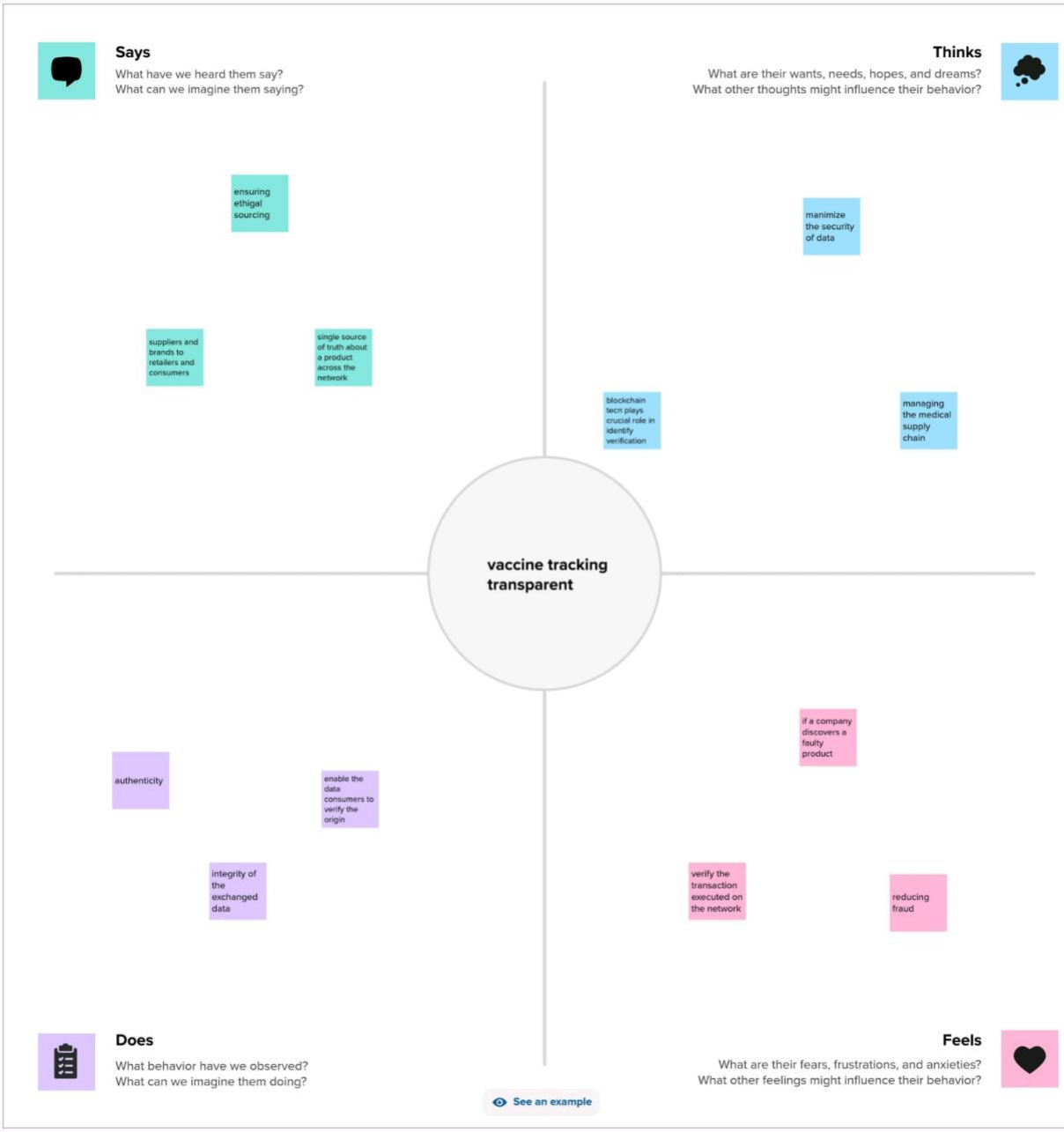
Blockchain is a complex technology that requires a high level of technical expertise to implement and maintain. Tech challenges may hinder the widespread adoption of blockchain technology and discourage potential users and developers from with it. Blockchain’s complexity can also lead to errors and inefficiencies in implementation.

engaging with it. Blockchain’s complexity can also lead to errors and inefficiencies in implementation.

engaging with it. Blockchain’s complexity can also lead to errors and inefficiencies in implementation.

3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas


Says
What have we heard them say?
What can we imagine them saying?
ensuring ethigal sourcing
suppliers and brands to retailers and consumers
single source of truth about a product across the network
Thinks
What are their wants, needs, hopes, and dreams?
What other thoughts might influence their behavior?
manimize the security of data
blockchain tecn plays crucial role in identify verification
managing the medical supply chain
vaccine tracking transparent
authenticity
enable the data consumers to verify the origin
integrity of the exchanged data
if a company discovers a faulty product
verify the transaction executed on the network
reducing fraud
Does
What behavior have we observed?
What can we imagine them doing?
Feels
What are their fears, frustrations, and anxieties?
What other feelings might influence their behavior?
See an example

3.2 Ideation & Brainstorming

Template

Brainstorm & idea prioritization

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.

10 minutes to prepare
1 hour to collaborate
2-8 people recommended

Before you collaborate

A little bit of preparation goes a long way with this session. Here's what you need to do to get going.

10 minutes

A **Team gathering**
Define who should participate in the session and send an invite. Share relevant information or pre-work ahead.

B **Set the goal**
Think about the problem you'll be focusing on solving in the brainstorming session.

C **Learn how to use the facilitation tools**
Use the Facilitation Superpowers to run a happy and productive session.

Open article →

1 Define your problem statement

What problem are you trying to solve? Frame your problem as a How Might We statement. This will be the focus of your brainstorm.

5 minutes

PROBLEM

The COVID-19 supply chain system aims to facilitate access to several critical items for vaccine distribution and tracking in an Internet of Medical Things (IoMT).

Need some inspiration?
See a finished version of this template to kickstart your work.

Open example →

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

Person 2

Person 3

Person 4

3

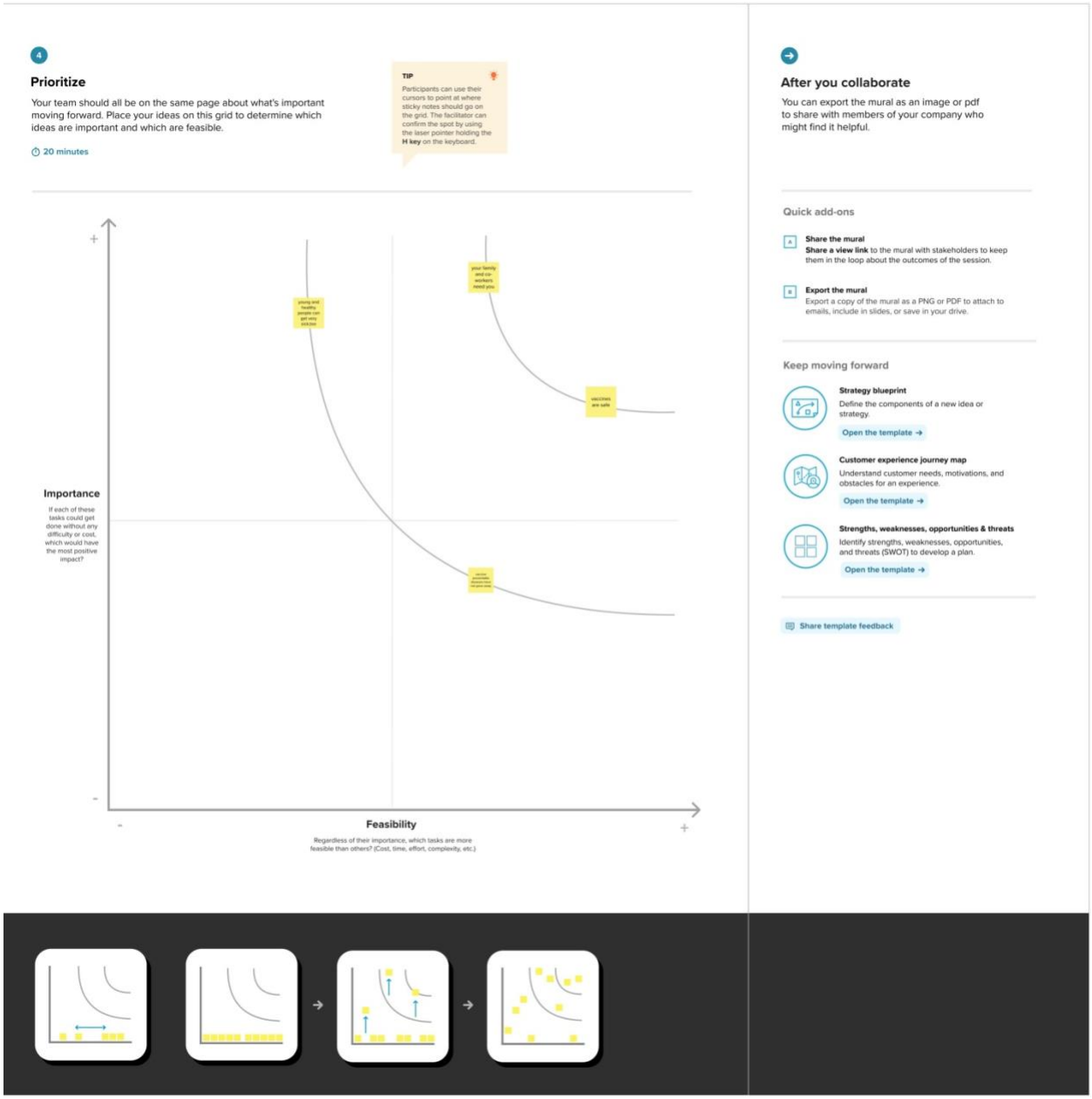
Group ideas

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.



4.REQUIREMENT ANALYSIS

4.1FUNCTIONAL REQUIREMENT

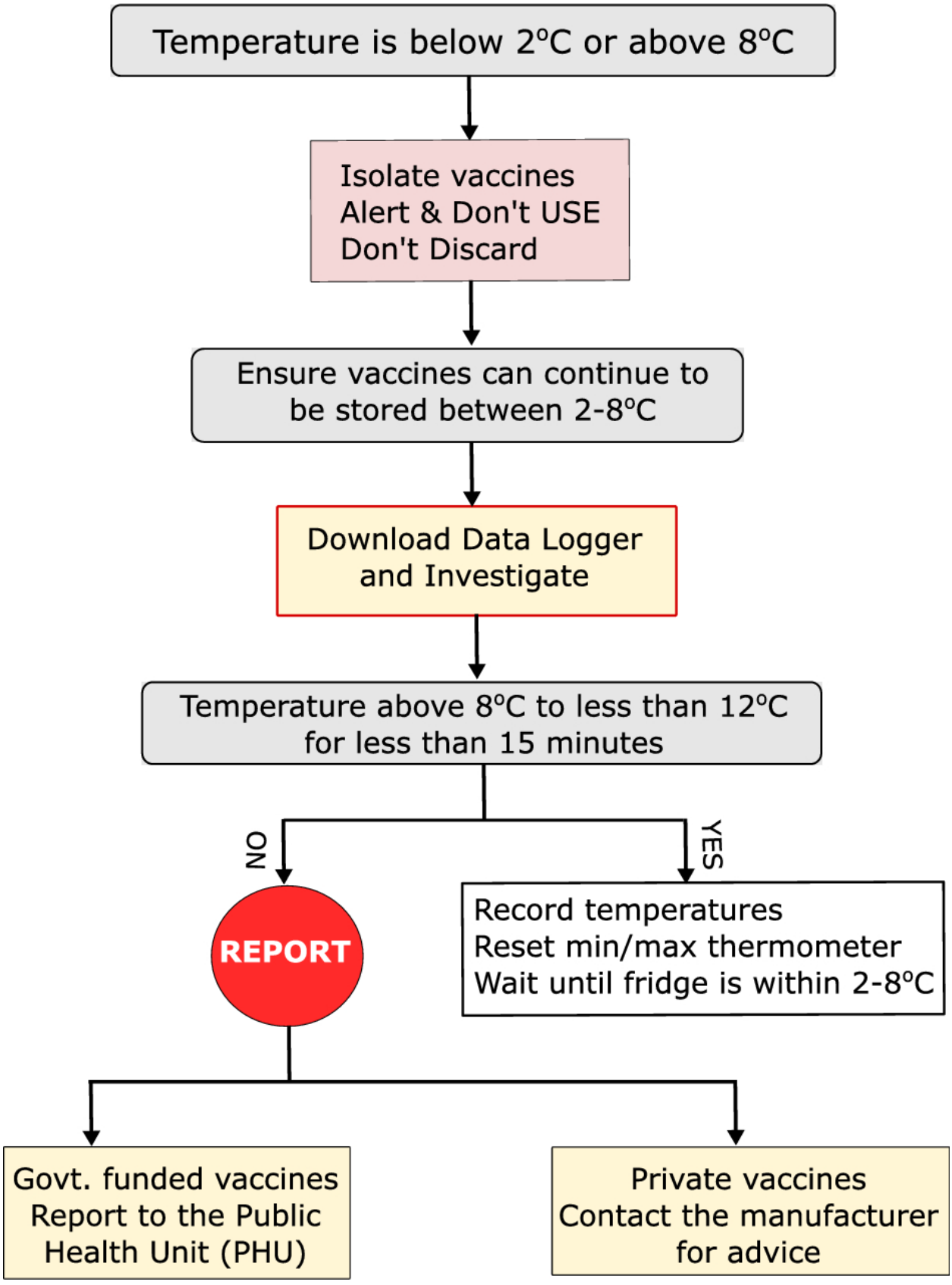
Strong programming skills in at least one popular language, such as Java or Python. Knowledge of cryptography and data structures (like linked lists and arrays). Good understanding of networking concepts (like TCP/IP and DNS) and how it works.

4.2NON-FUNCTIONAL REQUIREMENT

Non-functional requirements are product constraints or the features the system provides. They include constraints on timing, technology limits, and limitations imposed by standards.

5. PROJECT DESIGN

5.1 Data Flow Diagrams & User Stories

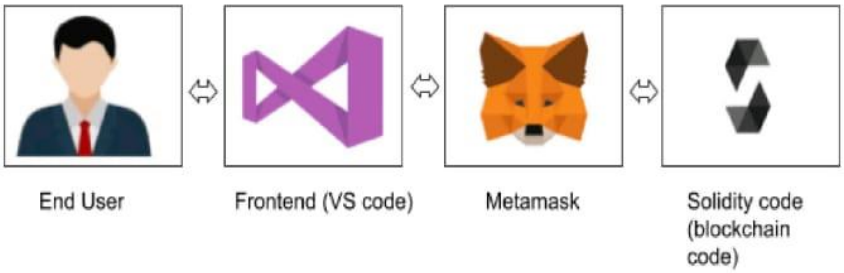

Temperature is below 2°C or above 8°C
Isolate vaccines
Alert & Don't USE
Don't Discard
Ensure vaccines can continue to be stored between 2-8°C
Download Data Logger and Investigate
Temperature above 8°C to less than 12°C for less than 15 minutes
NO
YES
REPORT
Record temperatures
Reset min/max thermometer
Wait until fridge is within 2-8°C
Govt. funded vaccines
Report to the Public Health Unit (PHU)
Private vaccines
Contact the manufacturer for advice

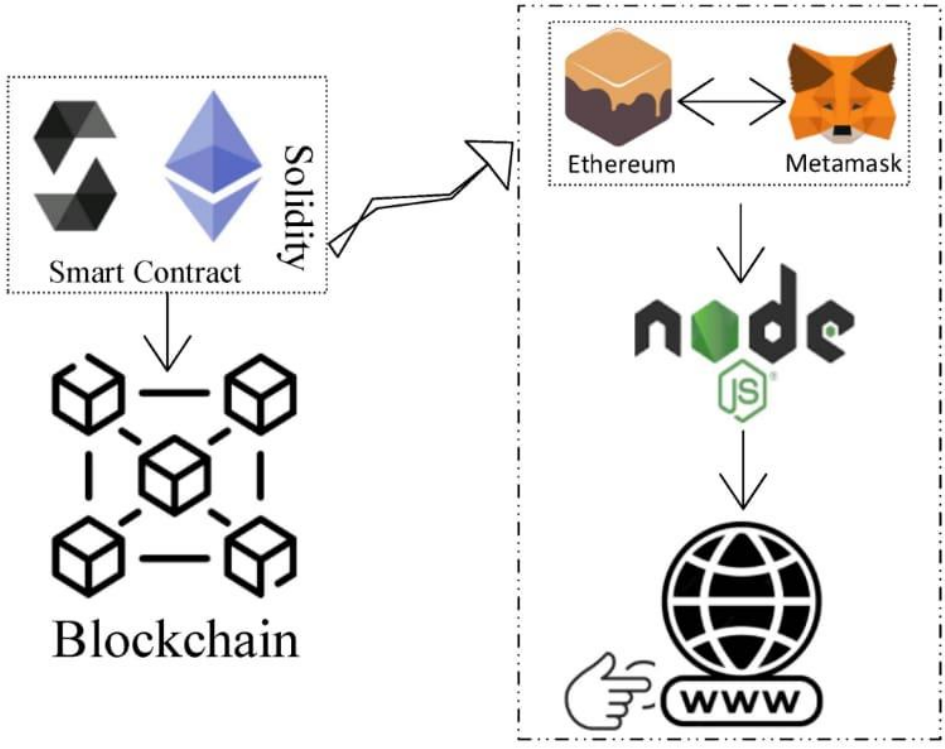
User Stories

User Number	User Story/Task	Priority
USN-1	Vaccines are delicate biological substances that gradually become inactive over time and must be kept under a recommended temperature range of 2–8 °C for both short and long-term storage.	High
USN-2	Exposure to heat or freezing temperatures can highly affect the immunological properties of these vaccines and make them completely ineffective.	High
USN-3	In practice, vaccines are stored in refrigerators, while thermometers and data loggers are used to record and monitor temperatures	Medium
USN-4	However, traditional systems are unreliable due to lack of battery backup, human error, periodic logging of temperatures, etc.	High
USN-5	Some of these vaccines are freeze-sensitive and must be preserved within the recommended temperature during the whole lifetime.	Medium
USN-6	Most of the existing solutions do not include battery backup systems and require manual readings or logging of temperatures, which can be subject to human tampering/error7.	High

5.2 Solution Architecture

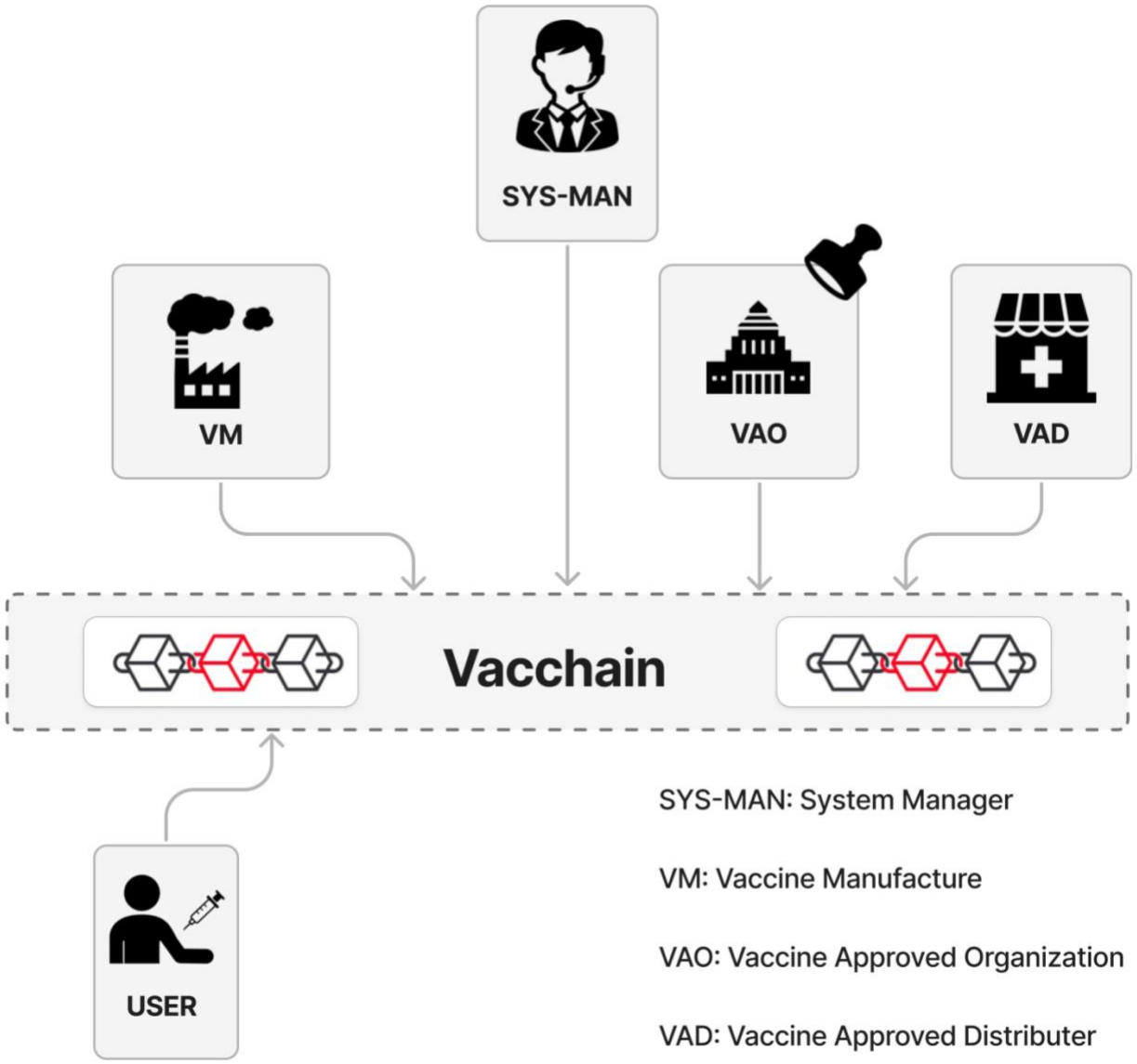
Example - Solution Architecture Diagram:





6. PROJECT PLANNING & SCHEDULING

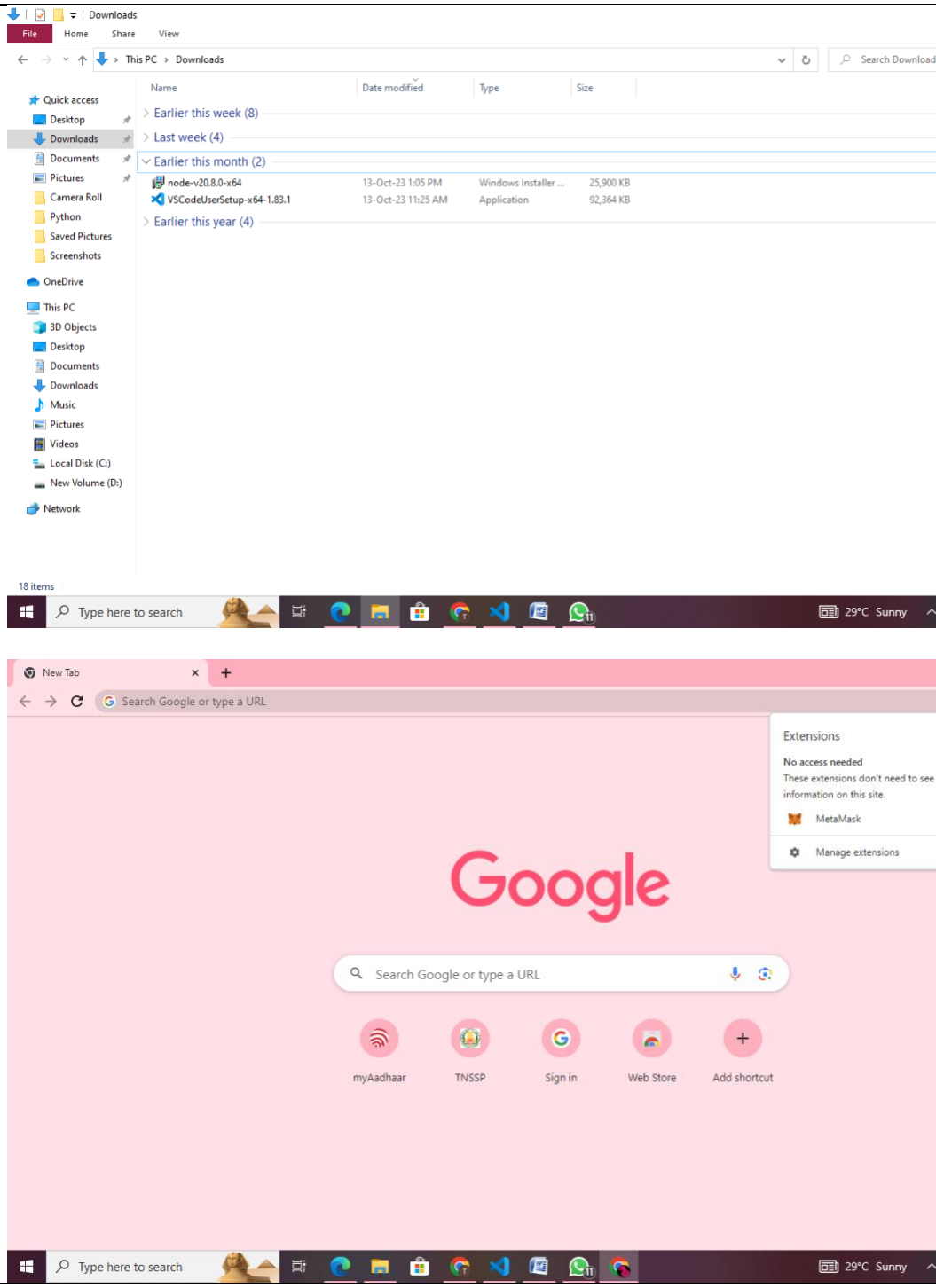
6.1 Technical Architecture

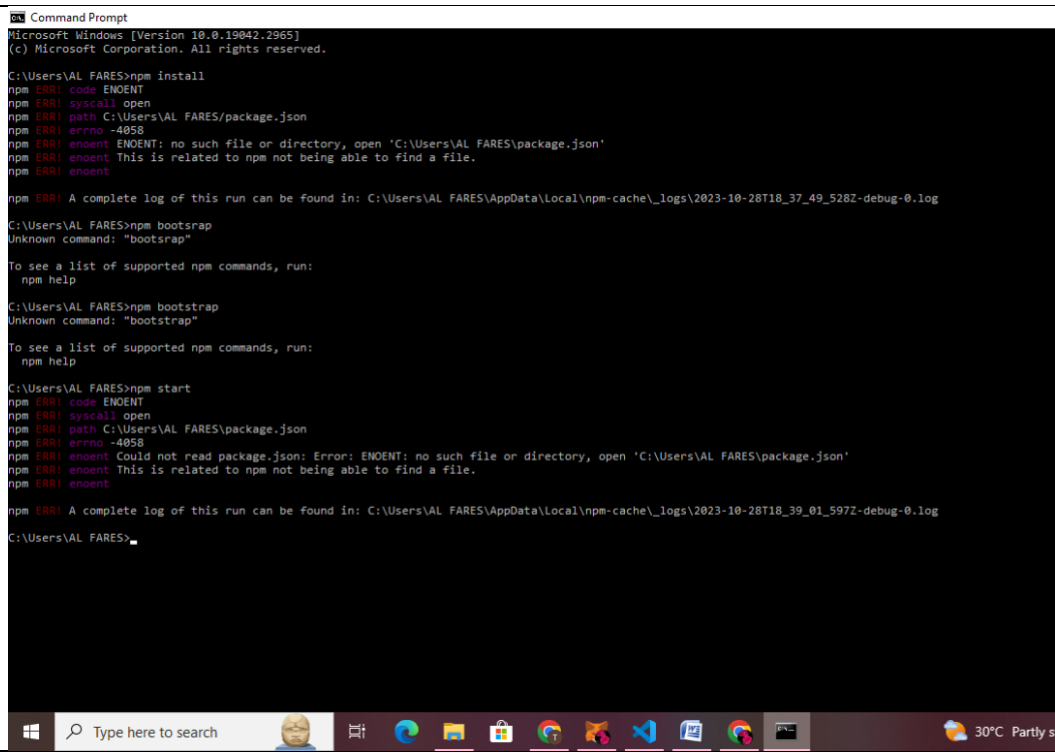
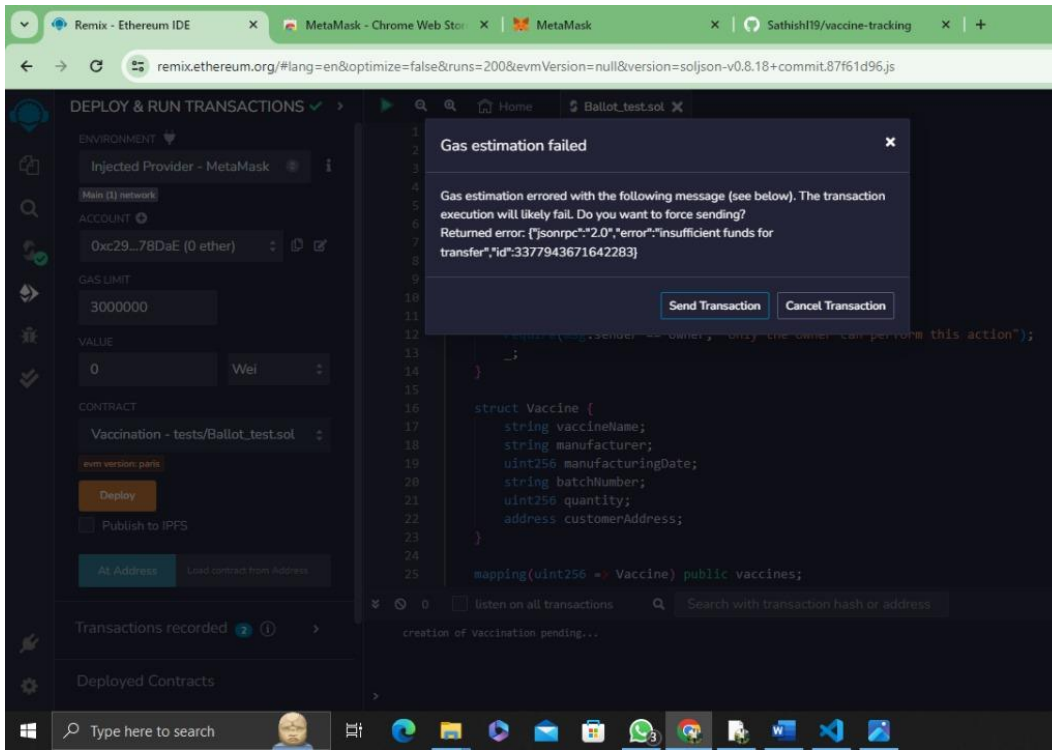


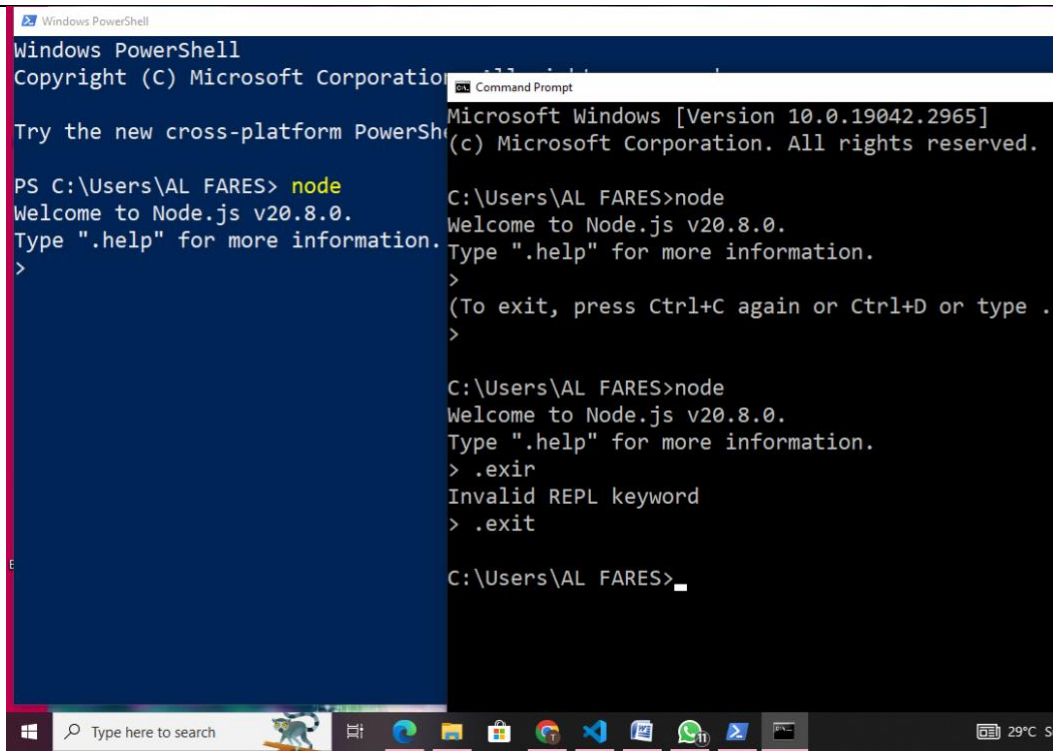
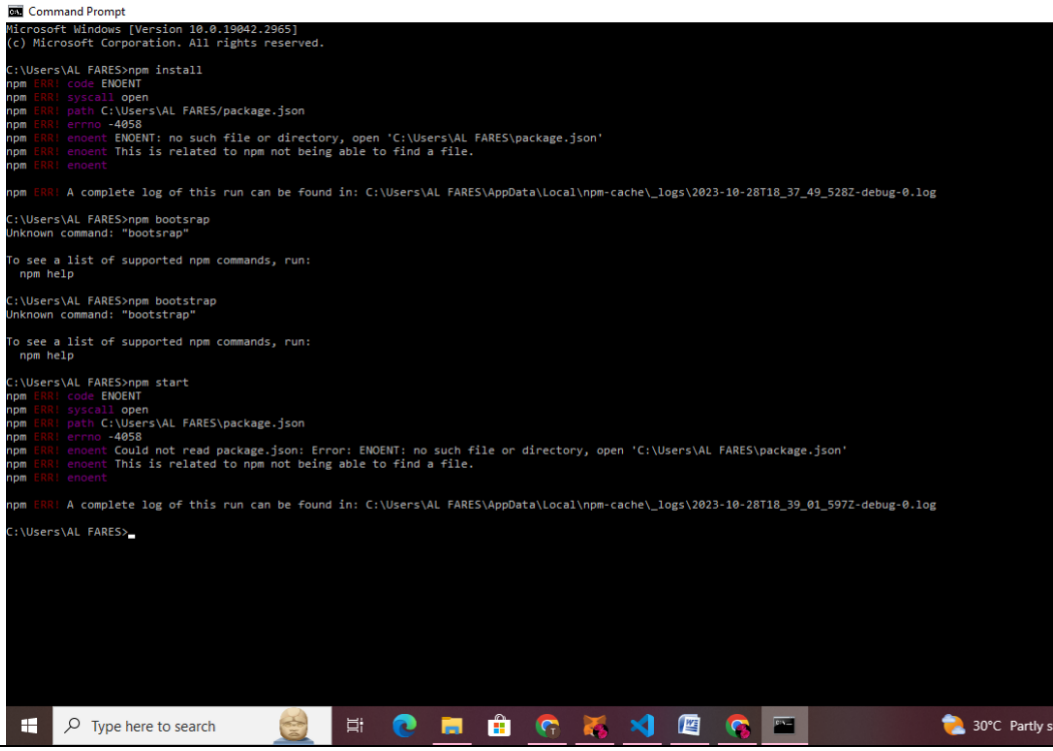
7. PERFORMANCE TESTING

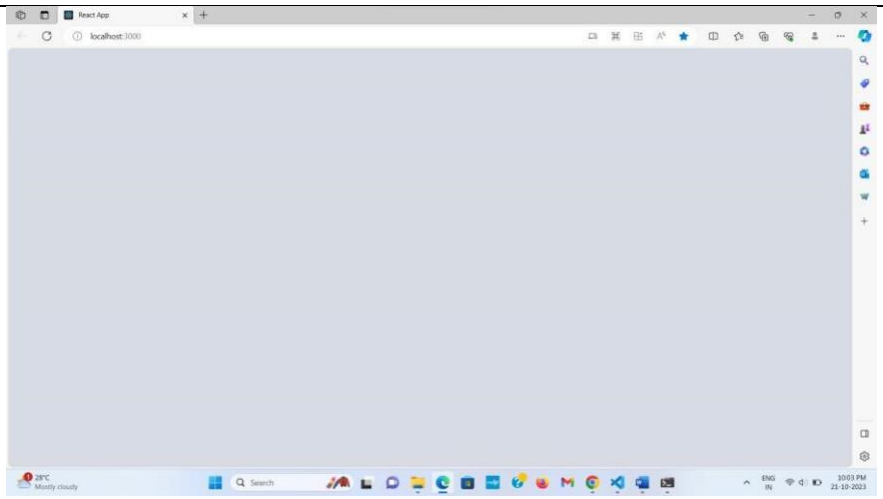
7.1 Performace Metrics

S.No.	Parameter	Values	Screenshot

1	Information gathering	Setup all the Prerequisite	
2	Extract the zip files	Open to vs code	

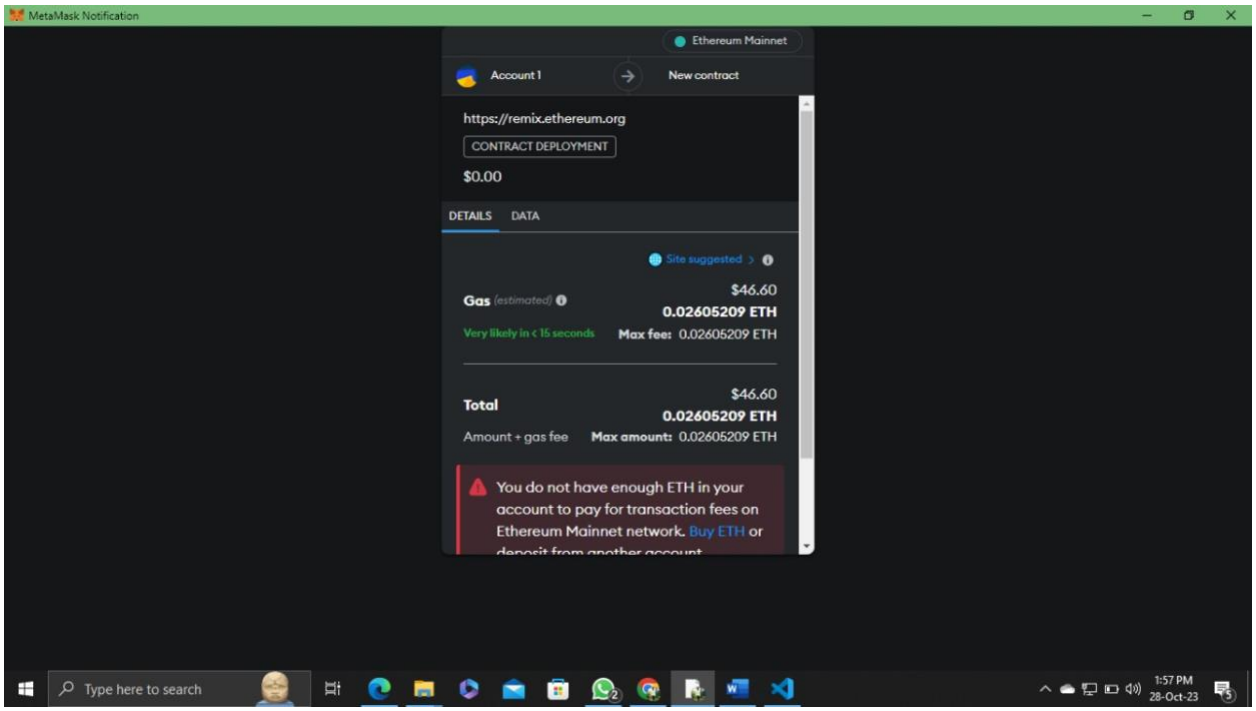
			
3	Remix Ide platform explortin g	Deploy the smart contract code Deploy and run the transacti on. By selecting the environm ent - inject the MetaMas k	

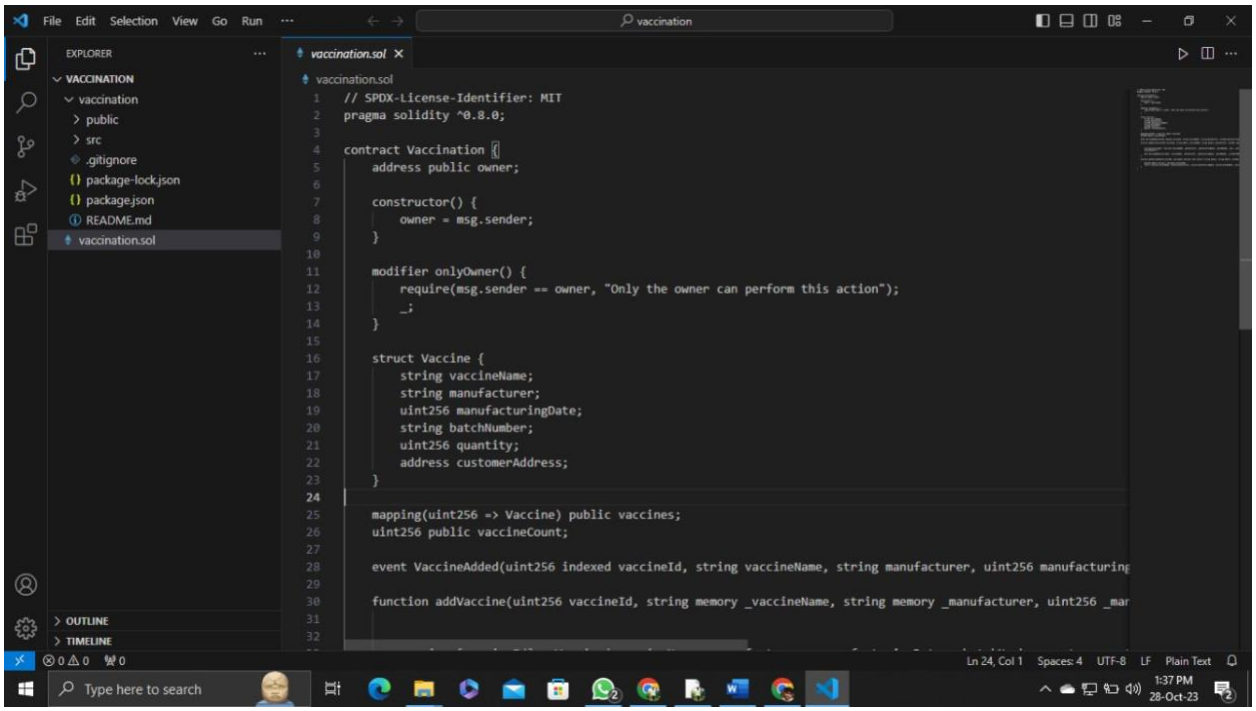
4	Open file explorer	Open the extracted file and click on the folder. Open src, and search for utiles. Open cmd enter commands 1.npm install 2.npm bootstrap 3. npm start	 

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

8. RESULTS

8.1 Output Screenshots




File Edit Selection View Go Run
vaccination
EXPLORER
VACCINATION
vaccination
public
src
.gitignore
package-lock.json
package.json
README.md
vaccination.sol
vaccination.sol
// 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 manufacturing
function addVaccine(uint256 vaccineId, string memory _vaccineName, string memory _manufacturer, uint256 _mar
OUTLINE
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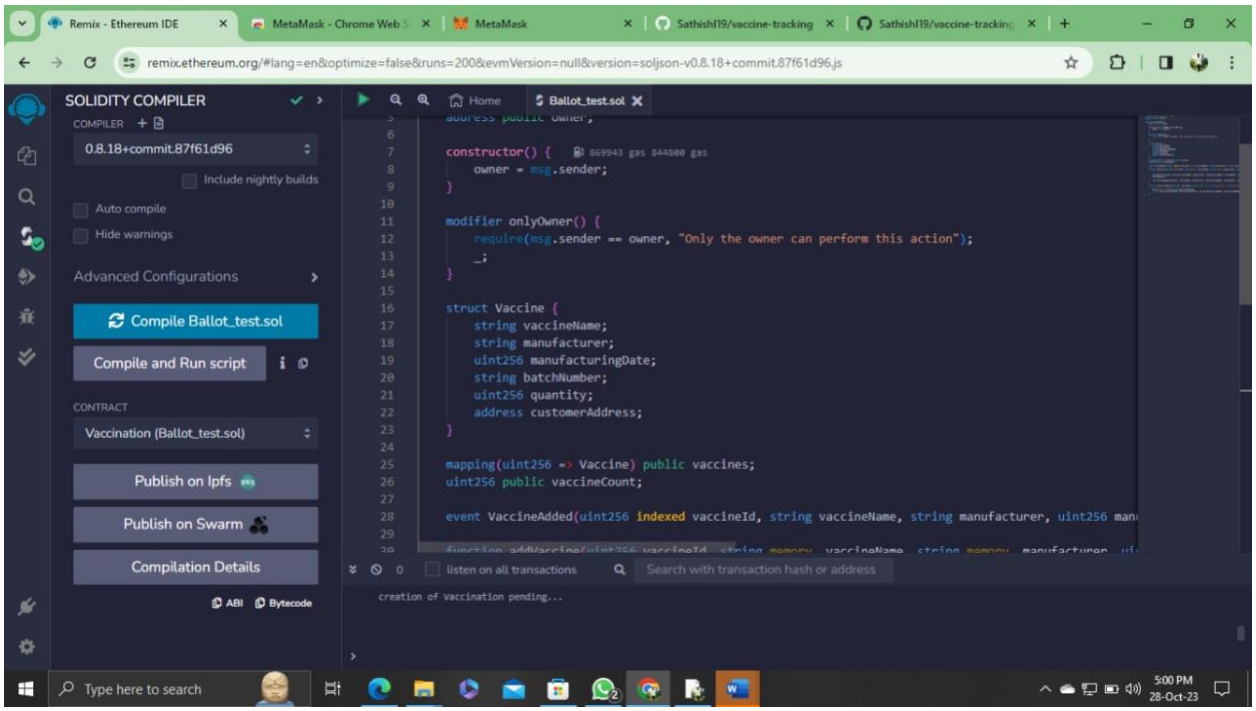
28-Oct-23


Remix - Ethereum IDE
MetaMask - Chrome Web S
MetaMask
Sathish119/vaccine-tracking
Sathish119/vaccine-tracking
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 Ballot_test.sol
Compile and Run script
CONTRACT
Vaccination (Ballot_test.sol)
Publish on Ipfs
Publish on Swarm
Compilation Details
ABI
Bytecode
Home
Ballot_test.sol
constructor() { 869943 gas 944800 gas
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 manu
listen on all transactions
Search with transaction hash or address
creation of Vaccination pending...
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28-Oct-23

9. ADVANTAGES & DISADVANTAGES

Advantages

- Transparency: Blockchain creates an immutable, transparent ledger of vaccine transactions, ensuring that data is trustworthy and can be audited by authorized parties.
- Data integrity: Blockchain's cryptographic hashing ensures that vaccine information remains tamper-proof, reducing the risk of fraud or data manipulation.
- Traceability: It enables real-time tracking of vaccine shipments, allowing for precise location monitoring, which can be crucial for ensuring vaccines reach their intended destinations.
- Supply chain optimization: Blockchain can improve the efficiency of the vaccine supply chain by providing real-time data, reducing delays, and minimizing errors.
- Authentication: It can enhance the authenticity of vaccines by creating unique identifiers for each dose, making it difficult for counterfeit products to enter the supply chain.
- Accessibility: Authorized parties, such as healthcare providers and government agencies, can access vaccine information securely, facilitating data sharing and collaboration.
- Patient empowerment: Patients can have more confidence in the vaccine process, knowing that their information is secure and verifiable.
- Reduced paperwork: Blockchain can streamline administrative processes, reducing the paperwork burden associated with vaccine tracking and management.
- Trust-building: By increasing transparency and security, blockchain can help build public trust in vaccination programs, which is essential for global health initiatives.
- Rapid response to emergencies: In case of vaccine-related emergencies or recalls, blockchain can expedite the identification and isolation of affected batches, preventing potential harm.

Disadvantages

- Scalability issues: Blockchain technology can face scalability challenges, particularly when it comes to handling a large volume of transactions, which could slow down the tracking process.
- Energy consumption: The energy consumption associated with maintaining and verifying a blockchain network can be considerable, potentially leading to environmental concerns.
- Complexity: Implementing and maintaining a blockchain-based system can be complex and may require specific technical expertise, making it challenging for some organizations to adopt and manage effectively.
- Data privacy concerns: While blockchain can provide transparency, it may also raise privacy concerns, as the distributed nature of the technology makes it difficult to entirely erase or modify data, potentially leading to unintended data exposure.
- Regulatory challenges: Regulations surrounding blockchain technology and its use in healthcare or vaccine management may not be fully established, posing legal and compliance challenges for organizations implementing these systems.

10. CONCLUSION

In conclusion, the integration of blockchain technology into vaccine tracking systems has the potential to revolutionize healthcare management by ensuring transparency, security, and data integrity. While it can mitigate various issues related to fraud, data tampering, and supply chain management, careful consideration must be given to the challenges of scalability, data privacy, regulatory compliance, and interoperability. By addressing these concerns and leveraging the advantages of blockchain, stakeholders can foster a more efficient, trustworthy, and accessible healthcare ecosystem that benefits global vaccination efforts and public health initiatives.

11. FUTURE SCOPE

The future scope of vaccine tracking through blockchain technology is promising. By leveraging blockchain's decentralized and transparent nature, it becomes possible to create an immutable record of vaccine manufacturing, distribution, and administration. This technology can help ensure the authenticity and integrity of vaccine-related data, thereby combating counterfeit drugs and ensuring the safety of administered vaccines. Additionally, blockchain can enhance supply chain transparency, enabling efficient monitoring of vaccine distribution, reducing inefficiencies, and ultimately contributing to the overall improvement of public health systems.

The future scope of vaccine tracking using blockchain technology is promising. Blockchain can enhance transparency, security, and traceability in vaccine supply chains.

12. APPENDIX

Source 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);

    }

}
```

GitHub link

https://github.com/SathishI19/vaccine-tracking-transparent.git

Project Demo link

https://drive.google.com/file/d/17F4rRlTHttFDN6k8HrfnF-M9rltm83sF/view?usp=drivesdk