VACCINE TRACKING-TRANSPARENT

A PROJECT REPORT

Submitted by

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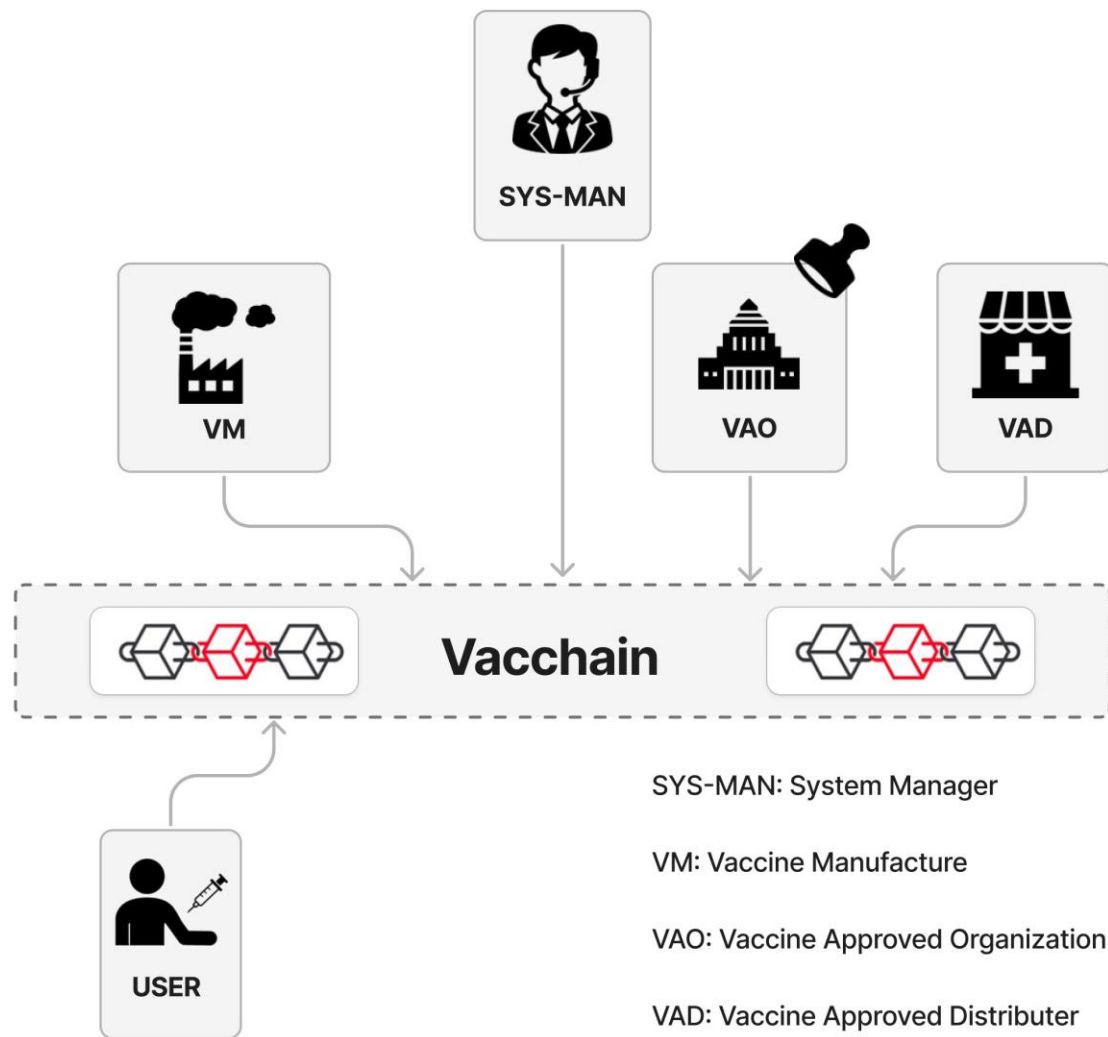**BACHELOR OF ENGINEERING**

In

**ELECTRONICS AND COMMUNICATION
ENGINEERING**

TEAM ID:NM2023TMID01594

1. INTRODUCTION

1.1 PROJECT REVIEW:

- An overview of our proposed system is shown in Figure, which shows several entity roles, such as SYS-MAN, VM, vaccine authorized organization (VAO), vaccine authorized distributor (VAD), and USER.

- Information on the abovementioned entities and vaccines is stored in a distributed ledger—the Vacchain ledger.

- The VM represents the company that manufactures the vaccine. Only the VM is able to record information on vaccines such as vaccine name, type, and ingredients into the Vacchain ledger.

- The VAO is the organization that approves the vaccine and is assumed to be a government agency of a country.

- The VAD may be an organization that buys and distributes vaccines, an express company that transports the vaccine, or a hospital that administers the vaccine. The USER is the vaccine beneficiary.

- The SYS-MAN is the manager of the system, which verifies the trust of other entities such as the VM, VAO, and VAD.

- The SYS-MAN acts as a guardian that protects the reliability of the data recorded in the Vacchain ledger and thus plays an important role in securing the network.

- The system is supposed to have multiple SYS-MANs, VMs, VAOs, VADs,and users.

SYS-MAN: System Manager

VM: Vaccine Manufacture

VAO: Vaccine Approved Organization

VAD: Vaccine Approved Distributer

1.2 PURPOSE :

Transparency: Blockchain creates an immutable and transparent ledger, enabling all parties involved in the vaccine supply chain to access real-time information. This transparency helps in verifying the origin, handling, and distribution of vaccines, ensuring that they are not counterfeit or tampered with.

Supply Chain Traceability: Blockchain allows for a comprehensive record of a vaccine's journey from production to distribution. This enables stakeholders to trace each batch, providing insights into storage conditions, transportation, and every intermediary involved.

Preventing Counterfeiting: The immutable nature of blockchain ensures that once data is recorded, it cannot be altered or deleted. This helps prevent

the production and distribution of counterfeit vaccines by providing an auditable trail, enabling verification of the authenticity of each vaccine.

Improved Efficiency: Blockchain's decentralized nature eliminates the need for intermediaries, reducing delays, errors, and costs in the supply chain. Smart contracts on blockchain can automate processes, such as verification and payment, streamlining the distribution process.

Data Security: Blockchain's cryptographic and consensus mechanisms make it highly secure. Encrypted and decentralized storage of data helps protect sensitive information regarding vaccines, ensuring that only authorized individuals can access specific data.

Public Health Management: A transparent and efficient system for vaccine tracking can help public health authorities and organizations in making informed decisions, especially during emergencies or outbreaks. Real-time data availability can aid in managing and containing the spread of diseases.

2. LITERATURE SURVEY

2.1 EXISTING PROBLEM :

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 colludingwith 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 .

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 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.

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.

Thecirculation 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.

2.2 REFERENCE :

We found a research article titled "A Decentralized COVID -19 Vaccine Tracking system using Blockchain Technology".The article prposes a vaccine tracking scheme called vaccine .our vaccine allows users to tack and trace the route of vaccine.
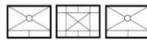
2.3 PROBLEM STATEMENT DEFINITION :

In today's increasingly interconnected world, ensuring the transparency and trustworthiness of vaccine distribution has become a critical imperative. Many people are hesitant to be vaccinated . It has been reported that people are hesitant to receive vaccines because of the negative information that they have been presented with on social media sites about the side effects of vaccines. In other words, anxiety and the fear of foreign-made, fake, and low-quality vaccines have discouraged vaccination. The circulation of fake vaccine passports to take advantage of loopholes regarding behavioral restrictions placed on those who are unvaccinated is even an issue. the circulation of low-quality and counterfeit vaccines seriously affects human health and the reputation of real vaccine manufacturers (VMs) and increases the amount of fear concerning vaccination. Middle class people cannot afford for the high quality vaccines . 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. People can not access with the real time data that's why counterfeit vaccines are increasing. We are going to make people to access with the real time datas of the vaccine from supplier to end user.We are also going to provides a trusty vaccine passport solution to prevent the circulation of fake vaccine passports.

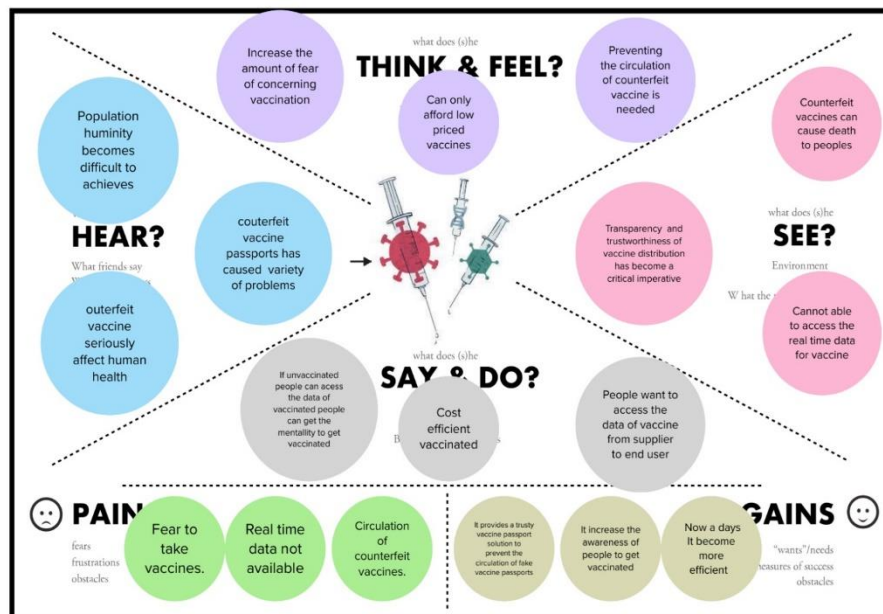# 3. IDEATION & PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS :

Empathy Map

3.2 IDEATION & BRAINSTORMING :

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

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

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

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

Open article →

MEMBERS IN THE IDEATION PROCESS
1. Team Leader   :Nalina.T
2. Team Member 1:Siyamala.G
3. Team Member 2:Sowsalya.S
4. Team Member 3:Haridha.M

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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

Key rules of brainstorming
To run an smooth and productive session

⊕ Stay in topic.   ☀ Encourage wild ideas.
⊕ Defer judgment.   🔊 Listen to others.
⊕ Go for volume.   👁 If possible, be visual.

PROBLEM STATEMENT

In today's increasingly inconnected world,ensuring the transparency and trustworthiness of vaccine distribution has become a critical imperative.people are hesitant to receive vaccines because of the negative information that they have been presented with on social media sites about the side effects of vaccines. To overcome this we are going to make people to acces with the real time datas of the vaccine from supplier to end user using block chain.we take blockchain technolgy ac vacchain in our system.

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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!

vaccine tracking (We take vaccine tracking system as vacchain)

VM(Vaccine Manufacture) VM represents the company that manufactures the vaccine

VM able to record information on vaccines such as vaccine name,type and ingredients into the vacchain.

VAO(Vaccine Approved Organization) VAO is organization that approves the vaccine and is assumed to be a government agency of a country

VAD(Vaccine Approved Distributer) VAD is an organization that buys and distributes vaccines,an express company that transports the vaccine,or a hospital that administers the vaccine.

SYS MAN SYS MAN is the manager of the system which verifies the trust of the other entities such as the VM,VAO and VAD

SYS MAN acts as guardian that protects the reliability of the data recorded in the vacchain and plays an important role in securing the network

USER vaccine benificiency

Back End Process VS Code Remix IDE Metamask File Connector.js
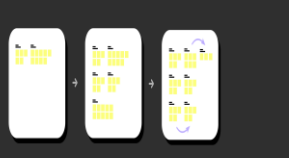
Front End Process VS Code .js

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.
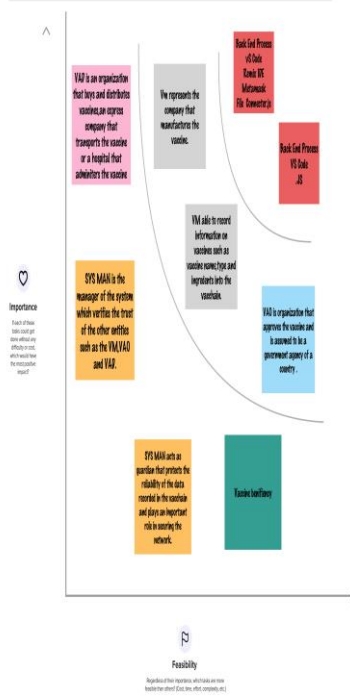
⏱ 20 minutes

VM IMAGINE MANUFACTURER

VAO VACCINE APPROVED ORGANIZATION

VAD VACCINE APPROVED DISTRIBUTERS

VM represents the company that manufacturers the vaccine

VM able to record information on vaccines such as vaccine name,type and ingredients into the vaccchain

VAO is organization that approve the vaccine and is assumed to be a government agency of a country

VAD is an organization that lays and distributes vaccines, an express company that transports the vaccine or a hospital that administers the vaccine

Back End Process
VS Code
Remix UIE
Metamask
File Connector.js

vaccine tracking
(VM's take vaccine tracking system as vacchain)

Front End Process
VS Code
.js

user

sys man

Vaccine beneficiary

SYS MAN is the manager of the system which verifies the trust of the other entities such as the VM,VAO and VAD

SYS MAN acts as guardian that protects the reliability of the data recorded in the vacchain and plays an important role in securing the network

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Prioritize

Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

⏱ 20 minutes

TIP
Participants can use their cursors to point at where sticky notes should go on the grid. The facilitator can confirm the spot by using the laser pointer holding the H key on the keyboard.

♡ Importance
If each of these tasks could get done without any difficulty or cost, which would have the most positive impact?

Back End Process
vS Code
Remix UIE
Metamask
File Connector.js

VAD is an organization that lays and distributes vaccines,an express company that transports the vaccine or a hospital that administers the vaccine

VM represents the company that manufacturers the vaccine.

Back End Process
VS Code
.js

VM able to record information on vaccines such as vaccine name,type and ingredients into the vaccchain.

SYS MAN is the manager of the system which verifies the trust of the other entities such as the VM,VAO and VAD

VAO is organization that approve the vaccine and is assumed to be a government agency of a country .

SYS MAN acts as guardian that protects the reliability of the data recorded in the vaccchain and plays an important role in securing the network.

Vaccine beneficiary

⚑ Feasibility

Regardless of their importance, which tasks are more feasible than others? (Cost, time, effort, complexity, etc.)

After you collaborate

You can export the mural as an image or pdf to share with members of your company who might find it helpful.

Quick add-ons

Share the mural
Share a view link to the mural with stakeholders to keep them in the loop about the outcomes of the session.

Export the mural
Export a copy of the mural as a PNG or PDF to attach to emails, include in slides, or save in your drive.

Keep moving forward

Strategy blueprint
Define the components of a new idea or strategy.

Open the template →

Customer experience journey map
Understand customer needs, motivations, and obstacles for an experience.

Open the template →

Strengths, weaknesses, opportunities & threats
Identify strengths, weaknesses, opportunities, and threats (SWOT) to develop a plan.

Open the template →

🔲 Share template feedback

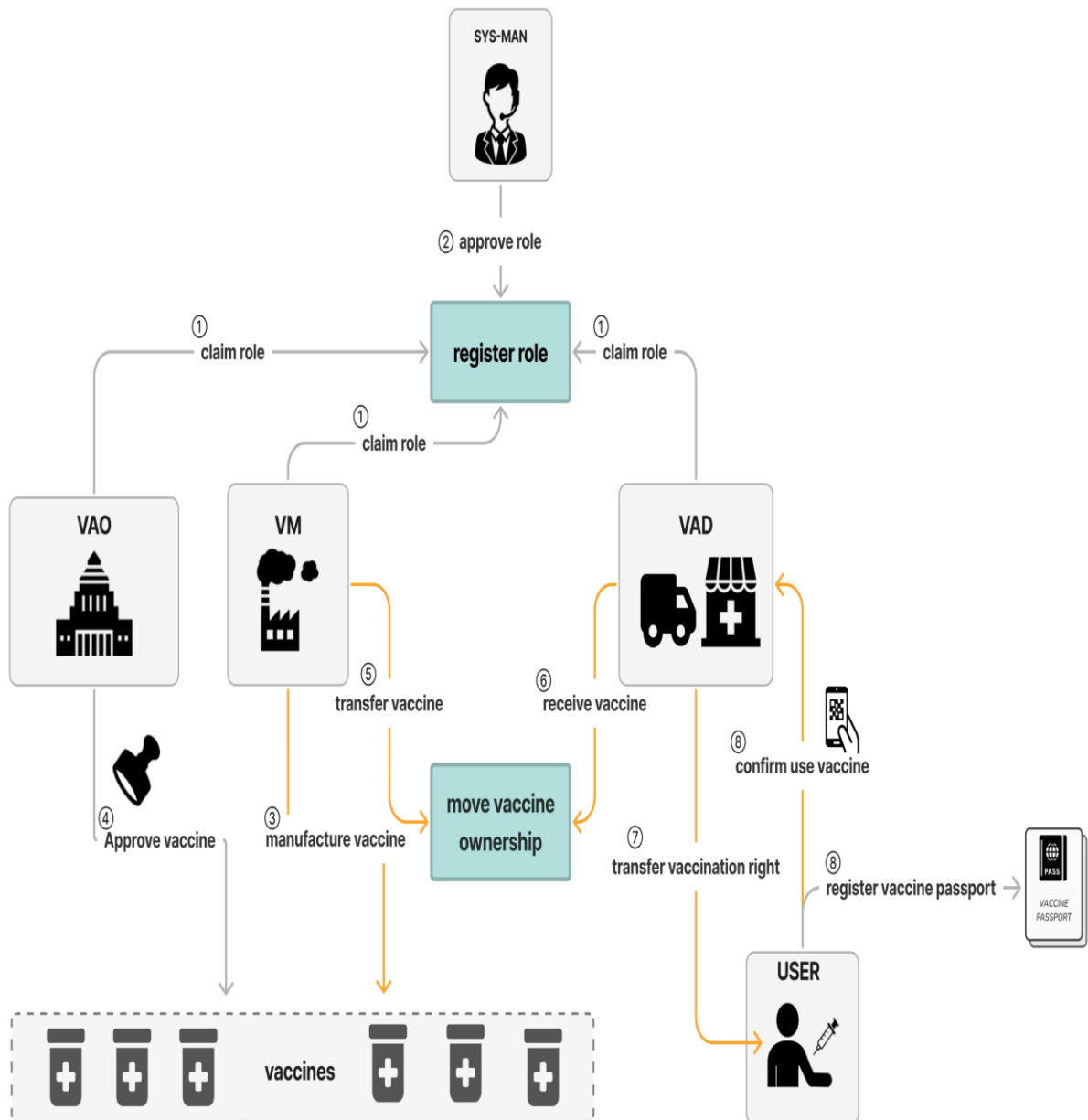## 4. REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENT :

s.no	Functional Requirement (Epic)	Sub Requirement (Story/Sub-task)
1.	**End user**	• The USER accepts the vaccination, followed shortly by the vaccination history being registered in the Vacchain system (block chain) and the vaccine passport being created.
2.	**VS Code**	• Download the VS Code and download the zip file . • Extract the zip file. • open it in the VS Code. • After the implementationof code VS Code is used as a frontend to intract with the user.
3.	**Remix IDE**	• Remix IDE is a no-setup tool with a GUI for developing smart contracts. • Used by experts and beginners alike, Remix will get you going in double time. • Remix plays well with other tools, and allows for a simple deployment process to the chain of your choice. • Remix is famous for its visual debugger.
4.	**MetaMask**	• Metamask allow users to store and manage account keys, broadcast transactions, send and receive Ethereum based cryptocurrencies and tokens and securely connect decentralized application through a compatible web browser or the mobile app's built in browser.
5.	**File Connector.js**	• The Javascript connector executes a JavaScript program that is compiled by the JDK. • This program returns a content item which is handed off to the fetcher

4.2 NON-FUNCTIONAL REQUIREMENTS :

S.no	Non-Functional requirements	Description
1	Decentralization	The system is decentralized,so it is very to tamper with or delete records.
2	Security	In this system it is possible to trace vaccines so that if they are found to be counterfeit or deficient vaccines,they can be traced back to the original source.
3	Reliability	Being immutable allows blockchain data to becomes trustworthy and reliable evidence for many kinds of services.
4	Performance	It store the real time value of people who get vaccinated.
5	Cost	It was cost -effective and even cost-saving.
6	Awareness	It create awareness among the people because they can see their data of vaccination with the help this system.
7	Usability	To get rid of counterfeit vaccines and avoid loopholes.

5. PROJECT DESIGN

5.1 DATA FLOW DIAGRAMS & USER STORIES :

5.2 SOLUTION ARCHITECTURE :

End User ⟷ Frontend (VS code) ⟷ Metamask ⟷ Solidity code (blockchain code)

Vacchain

SYS-MAN
- approve_role()
- register_vac_type()

VM
- register_vac_info()
- transfer_vaccine()
- receive_vaccine()

VAD
- transfer_vaccination_right()

VAO
- approve_vaccine()

USER
- confirm_vaccine()
- register_vaccine_pass()

ALL
- claim_role()
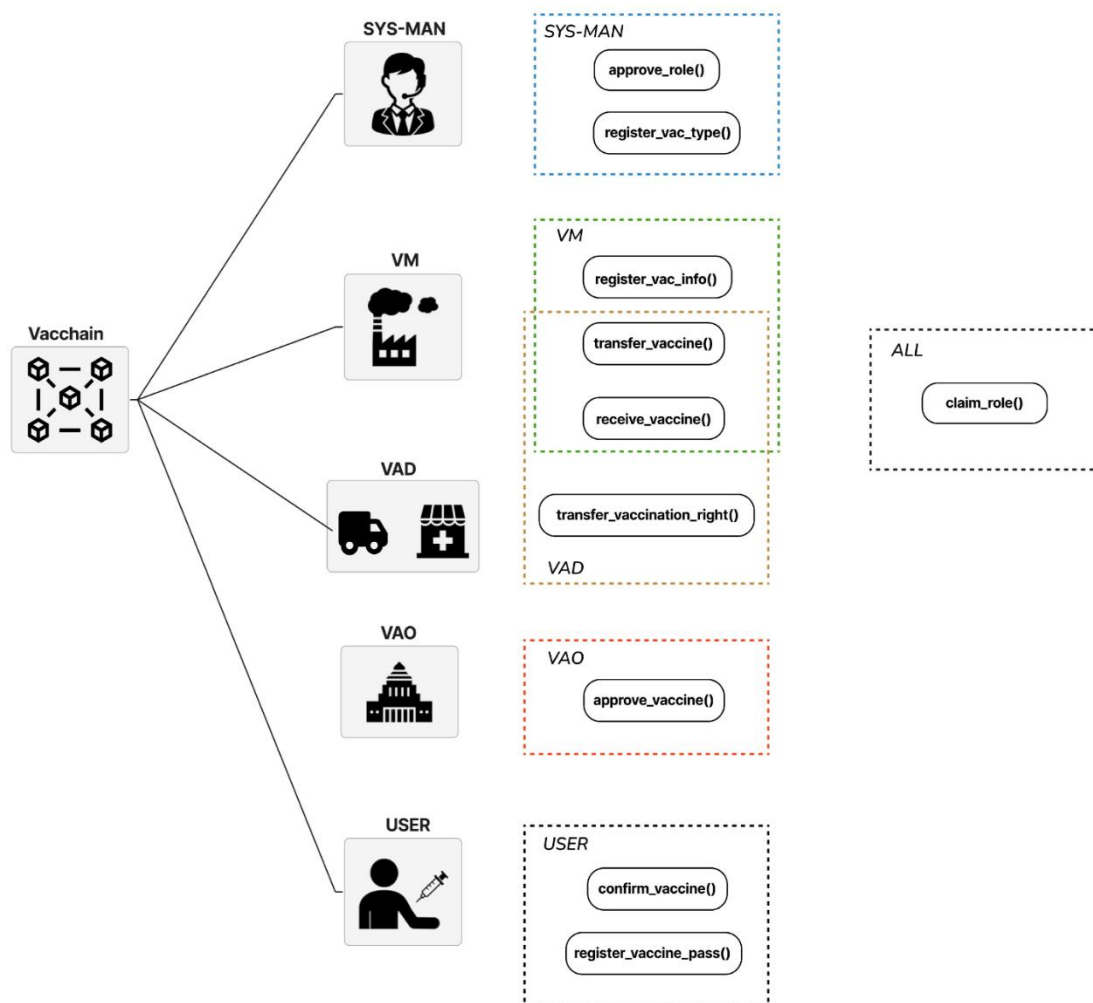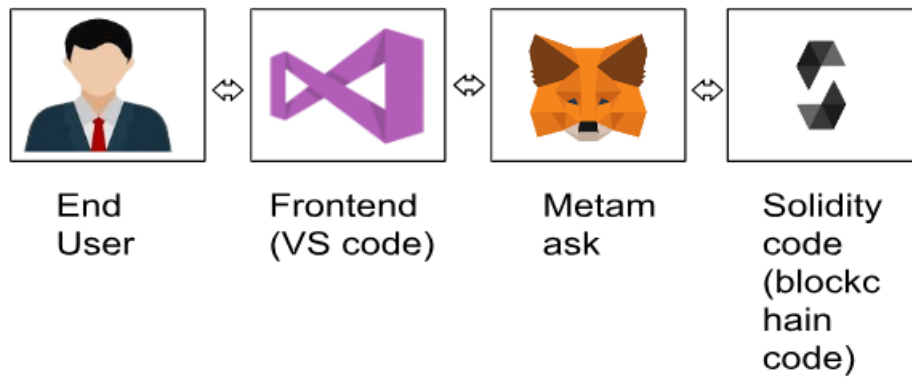
6. PROJECT PLANNING & SCHEDULING

6.1 TECHNICAL ARCHITECTURE :
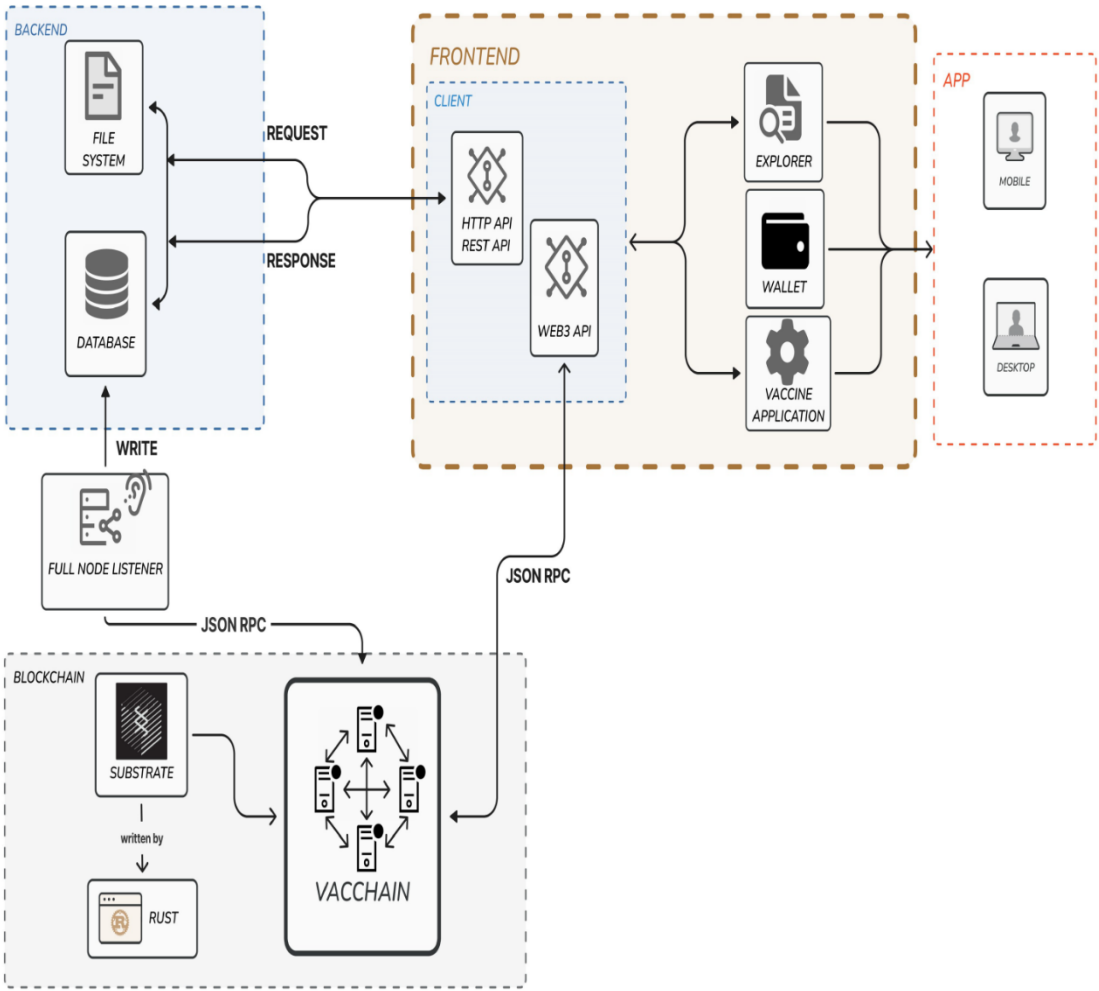
7. CODING & SOLUTIONING

7.1 FEATURES :

- We provide the real time access to datas of the vaccine to the users.
- Users can see the data analysis of the vaccine from the supplier to enduser.

```javascript
const { ethers } = require("ethers");

const abi = [
 {
  "inputs": [],
  "stateMutability": "nonpayable",
  "type": "constructor"
 },
 {
  "anonymous": false,
  "inputs": [
   {
    "indexed": true,
    "internalType": "uint256",
    "name": "vaccineId",
    "type": "uint256"
   },
   {
    "indexed": false,
    "internalType": "string",
    "name": "vaccineName",
    "type": "string"
   },
   {
    "indexed": false,
    "internalType": "string",
    "name": "manufacturer",
    "type": "string"
   },
   {
    "indexed": false,
    "internalType": "uint256",
    "name": "manufacturingDate",
    "type": "uint256"
   },
   {
    "indexed": false,
```

```json
      "internalType": "string",
      "name": "batchNumber",
      "type": "string"
    },
    {
      "indexed": false,
      "internalType": "address",
      "name": "customerAddress",
      "type": "address"
    }
  ],
  "name": "VaccineAdded",
  "type": "event"
},
{
  "inputs": [
    {
      "internalType": "uint256",
      "name": "vaccineId",
      "type": "uint256"
    },
    {
      "internalType": "string",
      "name": "_vaccineName",
      "type": "string"
    },
    {
      "internalType": "string",
      "name": "_manufacturer",
      "type": "string"
    },
    {
      "internalType": "uint256",
      "name": "_manufacturingDate",
      "type": "uint256"
    },
    {
      "internalType": "string",
      "name": "_batchNumber",
      "type": "string"
    },
    {
      "internalType": "uint256",
      "name": "_qty",
      "type": "uint256"
    },
    {
      "internalType": "address",
```

```json
      "name": "_customerAddress",
      "type": "address"
     }
    ],
    "name": "addVaccine",
    "outputs": [],
    "stateMutability": "nonpayable",
    "type": "function"
   },
   {
    "inputs": [
     {
      "internalType": "uint256",
      "name": "_vaccineId",
      "type": "uint256"
     }
    ],
    "name": "getVaccineDetails",
    "outputs": [
     {
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      "type": "string"
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      "internalType": "string",
      "name": "",
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      "name": "",
      "type": "string"
     },
     {
      "internalType": "uint256",
      "name": "",
      "type": "uint256"
     },
     {
      "internalType": "address",
      "name": "",
      "type": "address"
```

```json
      }
    ],
    "stateMutability": "view",
    "type": "function"
  },
  {
    "inputs": [],
    "name": "owner",
    "outputs": [
      {
        "internalType": "address",
        "name": "",
        "type": "address"
      }
    ],
    "stateMutability": "view",
    "type": "function"
  },
  {
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        "name": "",
        "type": "uint256"
      }
    ],
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        "type": "uint256"
      }
    ],
    "name": "vaccines",
    "outputs": [
      {
        "internalType": "string",
        "name": "vaccineName",
        "type": "string"
      },
      {
        "internalType": "string",
```

```
      "name": "manufacturer",
      "type": "string"
    },
    {
      "internalType": "uint256",
      "name": "manufacturingDate",
      "type": "uint256"
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    {
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      "name": "batchNumber",
      "type": "string"
    },
    {
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      "name": "quantity",
      "type": "uint256"
    },
    {
      "internalType": "address",
      "name": "customerAddress",
      "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 = "0x99998E8D54A66CA6e31f1c6321C9280668759672"

export const contract = new ethers.Contract(address, abi, signer)
```

8. PERFORMANCE TESTING

8.1 PERFORMANCE METRICS :

- Increase the number of vaccine provider sites, including through the use of pharmacies. This can be done through a competitive application process, through enrollment of specific providers into such a program, or through other means.

- Enroll/train vaccine providers, including complementary providers, to build capacity to vaccinate pediatric and adult populations in accordance with ACIP recommendations.

- Enlist/educate adult providers, including specialists that see high risk patients, to identify and refer patients to vaccination clinics if they are not themselves vaccinators.

- Fund local health departments to expand their operations (e.g., providing vaccinations during evenings, overnight, and on weekends) and to increase their throughput.

- Support public health workforce recruitment and training including working with health providers from rural communities, communities of color, and/or communities of high social vulnerability.

- Implement vaccine strike teams, mobile vaccine clinics, satellite clinics, temporary, or off-site clinics to travel and provide vaccination services in non-traditional settings and/or to supplement the work of local health departments in underserved communities.

- Implement site visits to COVID-19 vaccination clinics to provide monitoring and quality assurance support (supportive supervision) and to promote quality improvement. Support vaccine administration sites by responding to issues, questions, and ensuring training as needed for new products or changes to products.

9. RESULTS

9.1 OUTPUT SCREENSHOTS :
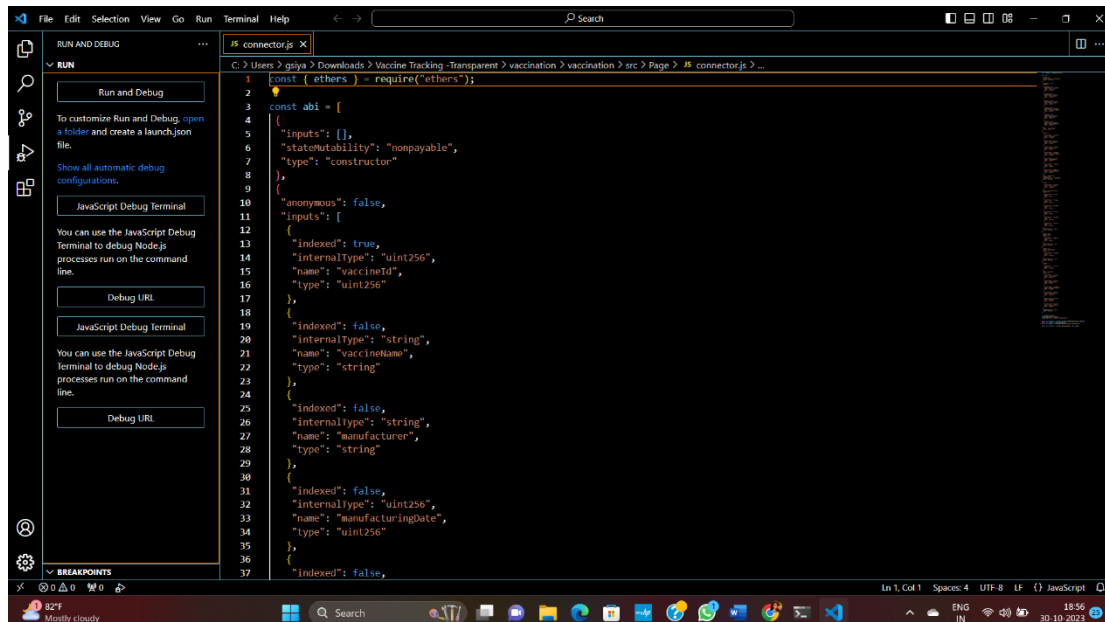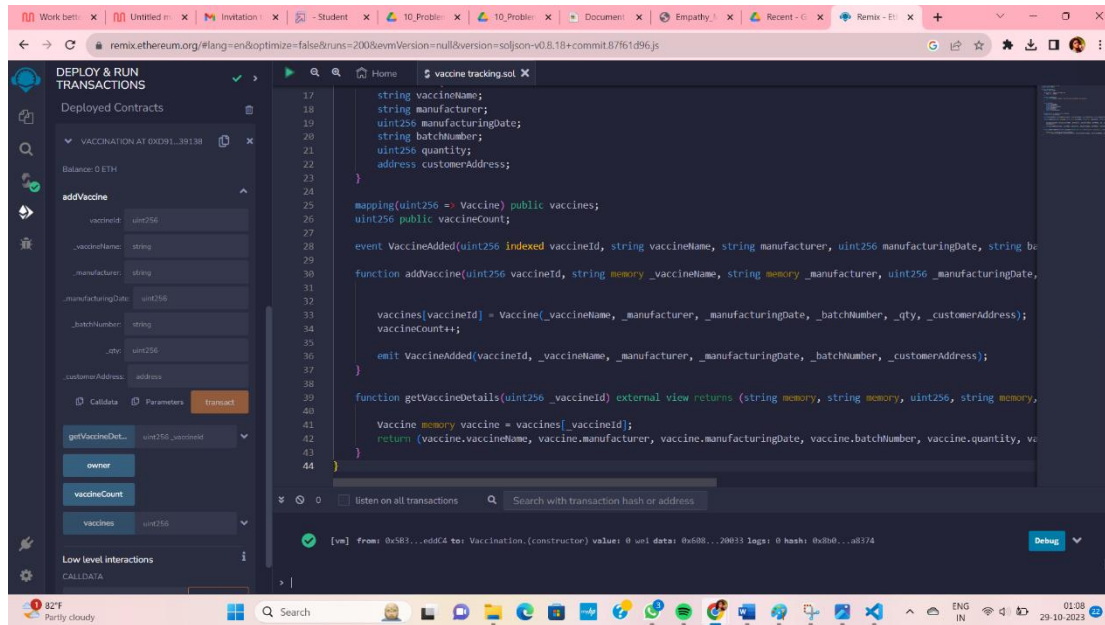
10. ADVANTAGES & DISADVANTAGES

ADVANTAGES :

1. Transparency: Blockchain provides a transparent and immutable ledger of vaccine production, distribution, and administration. This transparency reduces the risk of fraud, counterfeiting, and errors within the supply chain.

2. Security: Blockchain's cryptographic features make it highly secure. Vaccine data is protected from unauthorized access, ensuring the integrity of vaccination records and preventing tampering.

3. Traceability: Every step of a vaccine's journey can be traced, from production to administration. This traceability helps quickly identify the source of any issues or defects in the supply chain.

4. Efficiency: Blockchain streamlines record-keeping and data sharing among stakeholders, reducing paperwork, duplication, and administrative overhead. This efficiency can save time and resources.

5. Real-time Monitoring: IoT sensors and smart contracts integrated with blockchain can provide real-time monitoring of vaccine conditions, such as temperature, ensuring the vaccines remain safe and effective.

6. Data Accessibility: Patients, healthcare providers, and authorities can access vaccination records easily and securely, making it simpler to verify immunization status.

7. Vaccine Passport: Blockchain-based digital vaccine passports can provide a secure and verifiable way for individuals to prove their vaccination status for travel, work, or access to various services.

8. Global Collaboration: Blockchain can facilitate international cooperation in vaccine distribution, allowing for better coordination during pandemics and global health crises.

9. Trust and Confidence: By ensuring the integrity of vaccine data, blockchain technology can enhance public trust in vaccination programs, which is crucial for public health efforts.

10. Adverse Event Reporting: Blockchain can provide a secure platform for reporting and tracking adverse events associated with vaccines, enhancing safety monitoring.

DISADVANTAGES :

1.Complex Implementation: Implementing blockchain for vaccine tracking can be complex and expensive. It requires the development of secure, decentralized networks and integration with existing systems.

2.Technical Expertise: Btechnology demands specialized knowledge and skills, which may not be readily available in all healthcare systems or regions.

3. Scalability: As the volume of vaccine data grows, scalability can become an issue. Blockchain networks may need to handle large amounts of data, potentially slowing down transactions.

4. Privacy Concerns: While blockchain can secure data, there are concerns about privacy. Storing sensitive medical information on a blockchain requires strict adherence to data protection regulations, such as GDPR.

5.Interoperability: Ensuring that different blockchain networks and systems can interoperate is a challenge. Vaccine tracking may involve multiple parties, and these systems need to communicate effectively.

6.Regulatory Hurdles: Regulatory and legal frameworks for using blockchain in healthcare and vaccination programs may not be well-established, leading to uncertainty.

7. Initial Setup Costs: The initial investment required to set up blockchain infrastructure can be high, making it a barrier for some healthcare organizations and governments.

8. **Energy Consumption**:Some blockchain networks, like Bitcoin's, consume significant amounts of energy. Green, sustainable solutions may be needed.

9. Resistance to Change: Implementing blockchain in established healthcare systems can face resistance from stakeholders who are accustomed to traditional methods.

10. Data Recovery: If private keys are lost or compromised, recovering data can be challenging or impossible, which may result in data loss.

11. CONCLUSION :

we develop a highly secure decentralized system for vaccine distribution. To enhance system security and data reliability, we propose three mechanisms: an SYS MAN, the mutual agreement of vaccine ownership, and a vaccine passport. The SYS-MAN approves or revokes the role of entities who join the system. The mutual agreement manages the transfer of vaccine ownership. The vaccine passport eliminates the need to circulate counterfeit vaccines. We implement and evaluate the network on the open source Substrate platform.

Theoretically, the system is highly secure due to the use of the abovementioned three proposed mechanisms. Our testing also shows that the system operates smoothly. However, Vacchain still has limitations that should be addressed in the future. For example, Vacchain does not yet focus on solving the fundamental issues of blockchain tech nology, such as consensus, processing throughput, storage size, and scalability. Our future work will aim to enhance the scalability and processing rate of the system. Furthermore, upgrading the network consensus is our next research theme. We fully expect a bright future where there is no use for counterfeit vaccines.

12. FUTURE SCOPE :

1. Supply Chain Transparency: Blockchain can create an immutable record of vaccine production, distribution, and storage, helping to prevent counterfeit vaccines from entering the supply chain.

2. Real-time Monitoring: Smart contracts and IoT devices can be integrated into the blockchain to monitor temperature, location, and expiration dates of vaccines, ensuring they remain safe and effective.

3. Data Security: Patients' vaccination records can be securely stored on the blockchain, allowing for easy and secure access by authorized parties, such as healthcare providers and government agencies.

4. Immunization Passports: Blockchain-based digital immunization passports can help individuals prove their vaccination status for travel, work, or other activities.

5. Research and Development: Blockchain can facilitate the sharing of vaccine-related research data while maintaining data privacy and security.

6. Vaccine Adverse Event Reporting: It can provide a transparent and secure platform for reporting and tracking adverse events associated with vaccines.

7. Global Coordination: Blockchain technology can facilitate international cooperation in vaccine distribution and tracking, particularly in response to pandemics.

13. APPENDIX :

GitHub:
https://github.com/NalinaThanappan/NM2023TMID01594

DemoLink:
https://youtube.com/watch?v=QgRo3AaXUks&feature=shared