**VACCINATION TRACKING -TRANSPARENT**

**A PROJECT REPORT**

Submitted by

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In partial fulfillment for the award of the degree

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**BACHELOR OF ENGINEERING**

**IN**

**ELECTRICAL AND ELECTRONICS ENGINEERING**

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**SRIRAM ENGINEERING COLLEGE**

**ANNA UNIVERSITY:CHENNAI 600025**

**30CTOBER 2023**

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| --- | --- | --- |
| **S.NO** | **CONTENT** | **PAGE NO** |
| **1** | **INTRODUCTION** |  |
| **1.1** | Project overview |  |
| 1.2 | Purpose |  |
| 2 | **LITERATURE REVIEW** |  |
| 2.1 | Existing problem |  |
| 2.2 | References |  |
| 2.3 | Problem statement definition |  |
| 3 | **IDEATION & PROPOSED SOLUTION** |  |
| 3.1 | Empathy map canvas |  |
| 3.2 | Ideation & Brainstorming |  |
| **4** | **REQUIREMENT ANALYSIS** |  |
| 4.1 | Functional requirements |  |
| 4.2 | Non-Functional requirements |  |
| 5 | **PROJECT DESIGNS** |  |
| 5.1 | Data Flow Diagram & User Stories |  |
| **5.2** | Solution Architecture |  |
| 6 | **PROJECT PLANNING & SCHEDULING** |  |
| 6.1 | Technical Architecture |  |
| 6.2 | Sprint Planning & Estimation |  |
| 6.3 | Sprint Delivery Schedule |  |
| 7 | **CODING & SOLUTIONING** |  |
| 7.1 | Feature 1 |  |
| 7.2 | Feature 2 |  |
| 7.3 | Database Scheme |  |
| 8 | **PERFORMANCE TESTING** |  |
| 8.1 | Performance Testing |  |
| 9 | **RESULTS** |  |
| 9.1 | Output Screenshots |  |
| 10 | **ADVANTAGES & DISADVANTAGES** |  |
| 11 | **CONCLUSION** |  |

**INTRODUCTION**

**PROJECT REVIEW**

In today's increasingly interconnected world, ensuring the transparency and trustworthiness of vaccine distribution has become a critical imperative. The Ethereum Vaccine Tracking system represents a pioneering solution to this pressing issue. This cutting-edge platform leverages the Ethereum blockchain's capabilities to establish a secure and transparent method for monitoring vaccine journeys, from production to administration. By harnessing blockchain technology, this system not only safeguards the integrity of vaccine data but also still confidence in the vaccination process among stakeholders and the general public. In this rapidly evolving landscape, the Ethereum Vaccine Tracking system stands as a beacon of reliability and accountability. It offers a streamlined approach to recording and verifying vaccine information, with authorized users being able to access real-time data. This introduction will delve into the core functionalities and transformative potential of this innovative solution, shedding light on how it can revolutionize vaccine distribution practices, bolster public health initiatives, and pave the way for a safer and more secure future.

**PURPOSE**

The business problem of Vaccine Tracking-Transparent is centred around the need for a robust and transparent system to monitor the distribution and administration of vaccines. Inefficient and opaque vaccine tracking systems can result in challenges such as vaccine wastage, unauthorized distribution, and inadequate monitoring of immunization coverage. These issues can lead to public health risks, misallocation of resources, and a lack of trust in vaccination programs. Implementing a transparent vaccine tracking solution aims to address these problems by providing real-time visibility into vaccine supply chains, ensuring vaccines reach the right recipients on time, and enabling data-driven decision-making to optimize vaccine distribution and administration efforts. This, in turn, enhances public health outcomes and builds trust in immunization programs.

**LITERATURE REVIEW**

Since the outbreak of the pandemic, there has been a rapid expansion in vaccine research focusing on exploiting the novel discoveries on the path physiology, genomics, and molecular biology of the severe acute respiratory syndrome infection. Although the current preventive measures are primarily socially distancing by maintaining a 1 m distance, it is supplemented using facial masks and other personal hygiene measures. However, the induction of vaccines as primary prevention is crucial to eradicating the disease to attempt restoration to normalcy. This literature review aims to describe the physiology of the vaccines and how the spike protein is used as a target to elicit an antibody-dependent immune response in humans. Furthermore, the overview, dosing strategies, efficacy, and side effects will be discussed for the notable vaccines: BioNTech/Pfizer, Moderna, AstraZeneca, Janssen, Gamaleya, and SinoVac. In addition, the development of other prominent vaccines will be highlighted alongside the sustainability of the vaccine-mediated immune response and current contraindications. As the research is rapidly expanding, we have looked at the association between pregnancy and COVID-19 vaccinations, in addition to the current reviews on the mixing of vaccines. Finally, the prominent emerging variants of concern are described, and the efficacy of the notable vaccines toward these variants has been summarized.

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Healthcare professionals and public health authorities have a central role in discussing vaccination against with their patients. Vaccines play a critical role in preventing deaths, and hospitalisation caused by infectious diseases, and are contributing to controlling the spread of the disease, thus their impact on infection and serious illness is significant. Both vaccinated and unvaccinated people also need to be aware of the additional protective behaviours required to control the pandemic locally.

The global impact of the pandemic has resulted in an unprecedented level of public interest in vaccines. This includes a focus on the development of vaccines and their regulatory review and safety monitoring. Much of this coverage has taken place through mass and social media. Reports of adverse events (side effects) have led some people to express concerns about getting vaccinated, delay getting vaccinated or be strongly opposed to vaccination. There are also differences in individual confidence in national safety monitoring systems. Another challenge in communicating the importance of vaccination is that in many, but not all, children and young adults are less clinically affected by infection and therefore some may see limited value in vaccinating this population. Clear and consistent communication of evidence and uncertainties is therefore essential to support people in making the critical choice to be vaccinated.

**REQUIREMENT ANALYSIS**

**FUNCTIONAL REQUIREMENTS**

Vaccine Tracking-Transparent has the potential for profound social and business impacts. From a social perspective, it can significantly enhance public health by ensuring the efficient and transparent distribution of vaccines, which is crucial in the fight against infectious diseases. This technology can help boost vaccination coverage rates, reduce vaccine wastage, and mitigate the risks of counterfeit vaccines entering the supply chain. This, in turn, leads to improved disease prevention and overall community well-being. On the business front, the implementation of such systems can streamline vaccine supply chain operations, reduce costs associated with vaccine distribution, and enhance the reputation of vaccine manufacturers and healthcare providers. Moreover, the transparency and trust established through Vaccine Tracking-Transparent can foster stronger partnerships and collaborations within the healthcare ecosystem, ultimately benefiting both public health and the vaccine industry.

**NON-FUNCTIONAL REQUIREMENTS**

This implementation guide includes a machine-readable representation of WHO guidelines for immunization, as documented in the WHO Digital Adaptation Kit: SMART Guidelines for Immunizations (link forthcoming) and explicitly encodes computer-interoperable logic, including data models, terminologies, and logic expressions, in a computable language to support implementation of immunization use cases by WHO Member States. The guide is part of the  to support countries to integrate WHO global health and data recommendations into digital systems accurately and consistently. It defines a series of FHIR Resources, Profiles, Extensions, and Terminology based on the WHO Immunization Digital Adaptation Kit .

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**DATA FLOW DIAGRAM**

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Specify the business problem

Business requirements

Literature Survey

Social or Business Impact.

**Tools And Technology Requirement**

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Remix IDE

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**Adding MetaMask extensions**

Deploy the code by injected metamask

Metamask extensions on remixing

**Implementation of Smart contract**

 using file Connector.js

**Interaction with frontend**

interact with the frontend for all functionalities

**Project Demonstration & Documentation**

Record explanation Video for project end to end solution

Project Documentation-Step by step project development procedure

**5.2SOLUTION ARCHITECTURE**

Solution architecture is a complex process – with many sub-processes – that bridges the gap between business problems and technology solutions. Its goals are to:

* Find the best tech solution to solve existing business problems.
* Describe the structure, characteristics, behavior, and other aspects of the software to project stakeholders.
* Define features, development phases, and solution requirements.
* Provide specifications according to which the solution is defined, managed, and delivered.

**6.PROJECT PLANNING AND SCHEDULING**

**6.1 TECHNICAL ARCHITECTURE**

\*Download VS code

\*Remix

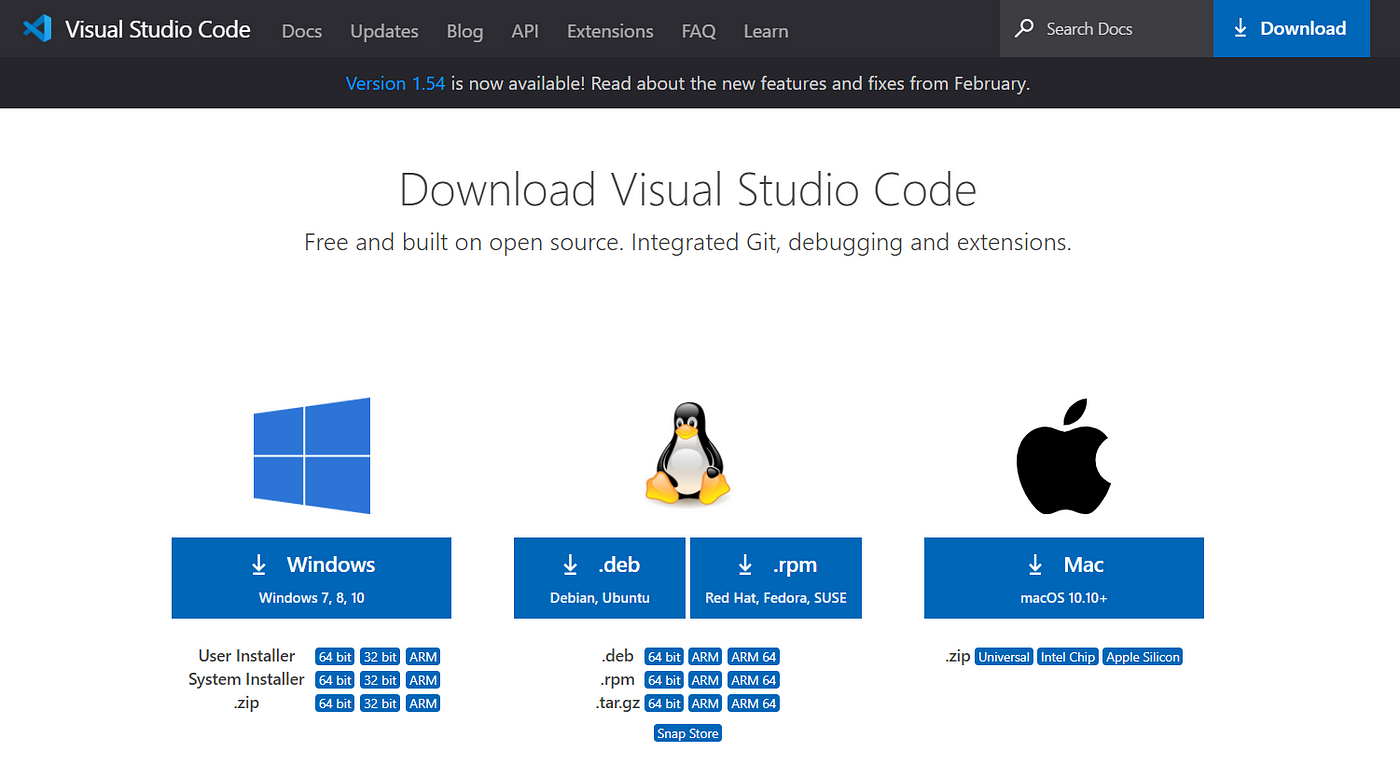
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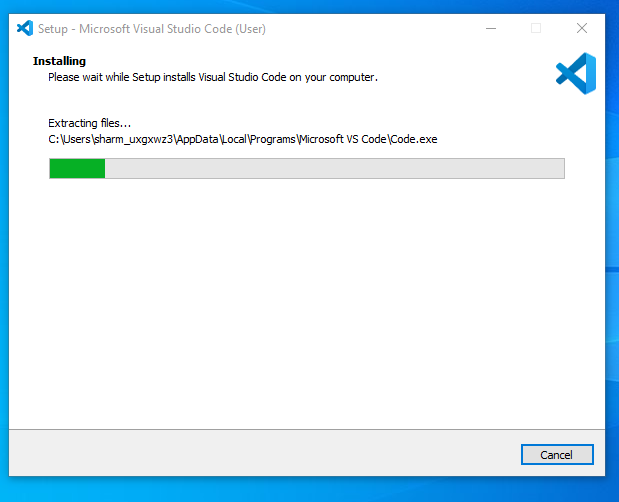
**6.2.SPRINT PLANNING AND ESTIMATION**

To install the VS Code follow the steps below

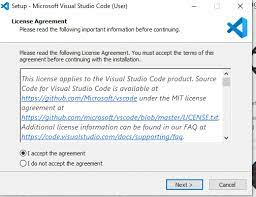
**STEP 1:   Download VS code from here** [**Link**](https://code.visualstudio.com/download)



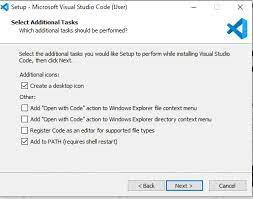
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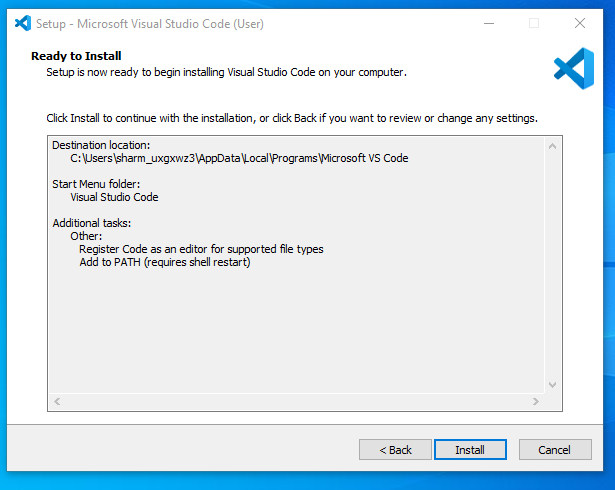
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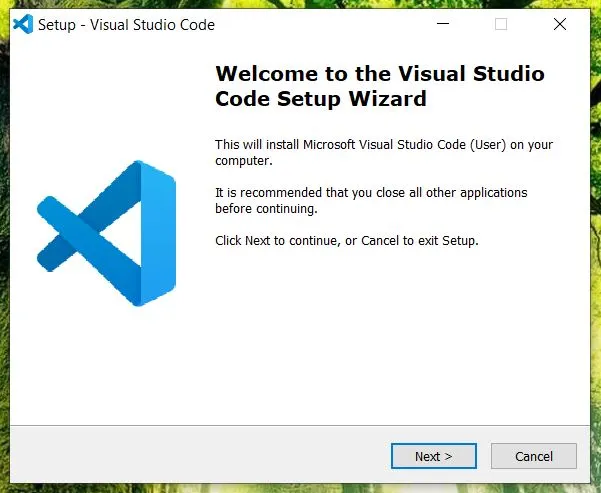
**Step 4: click on Next**

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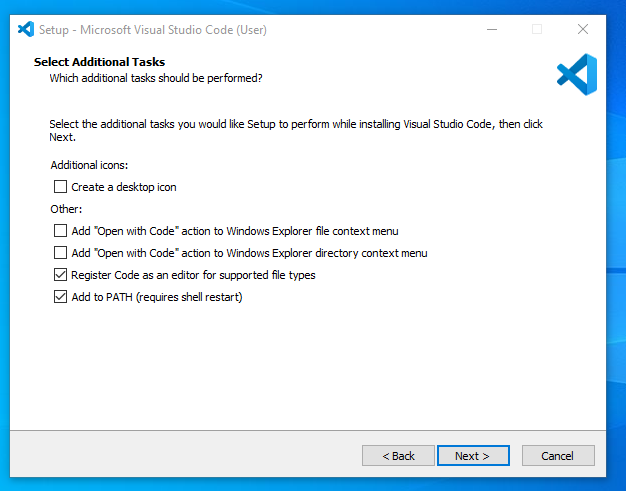
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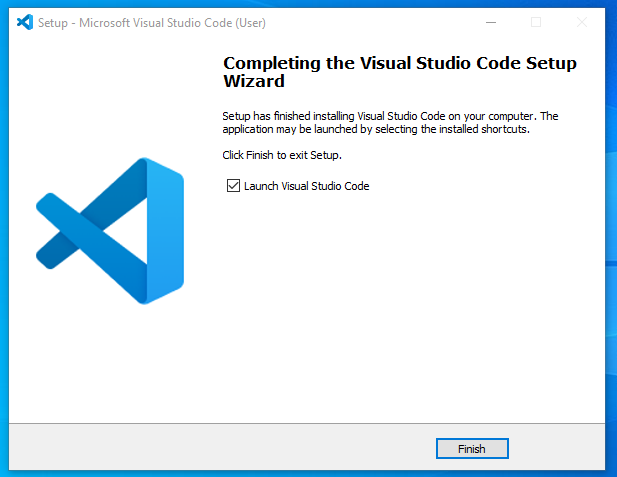
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**STEP 7: Click on add to path**

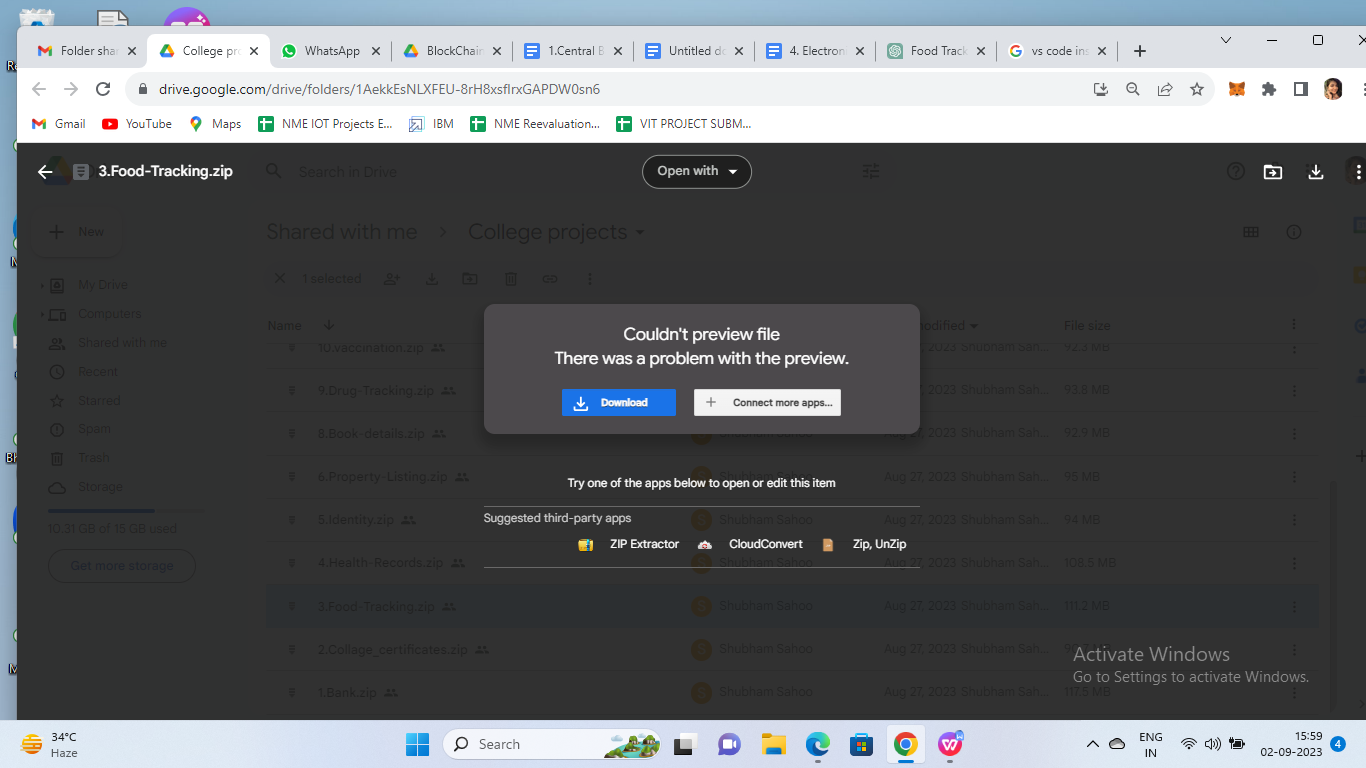
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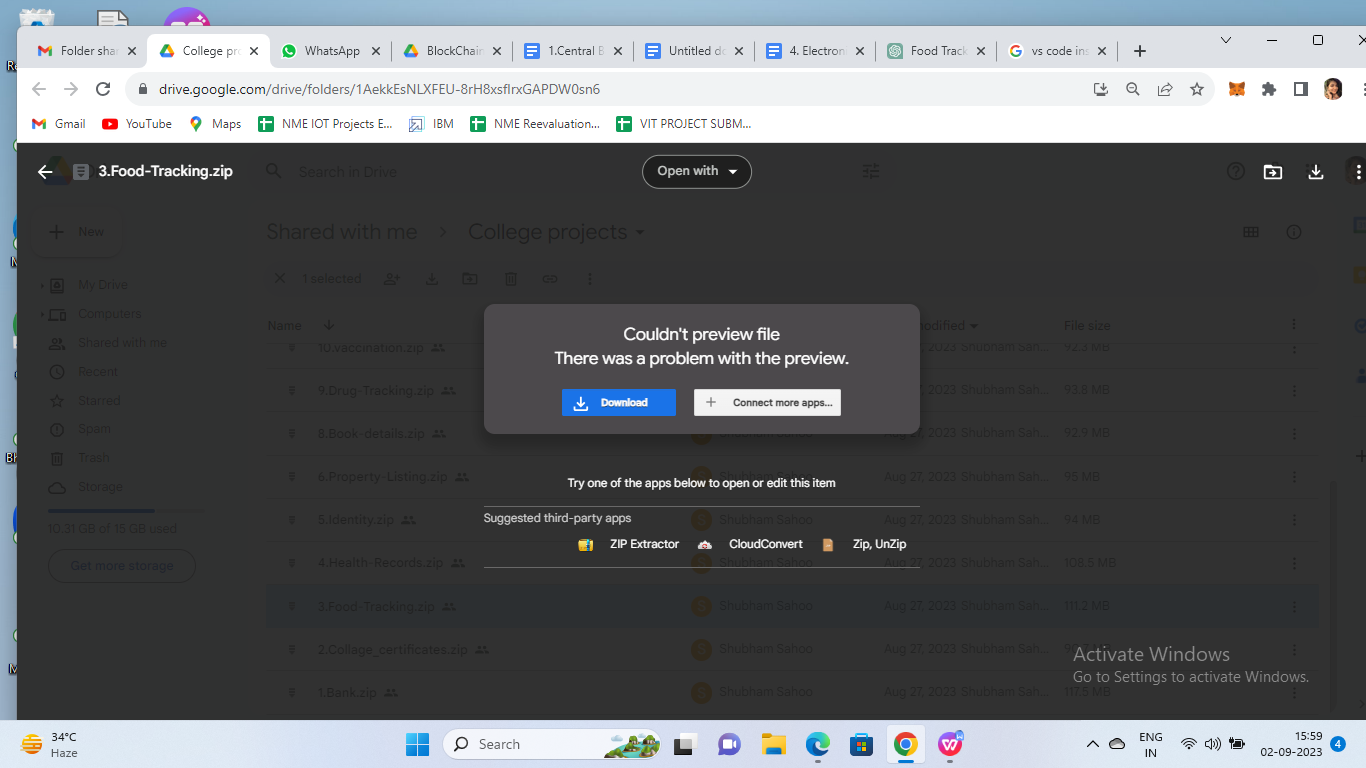
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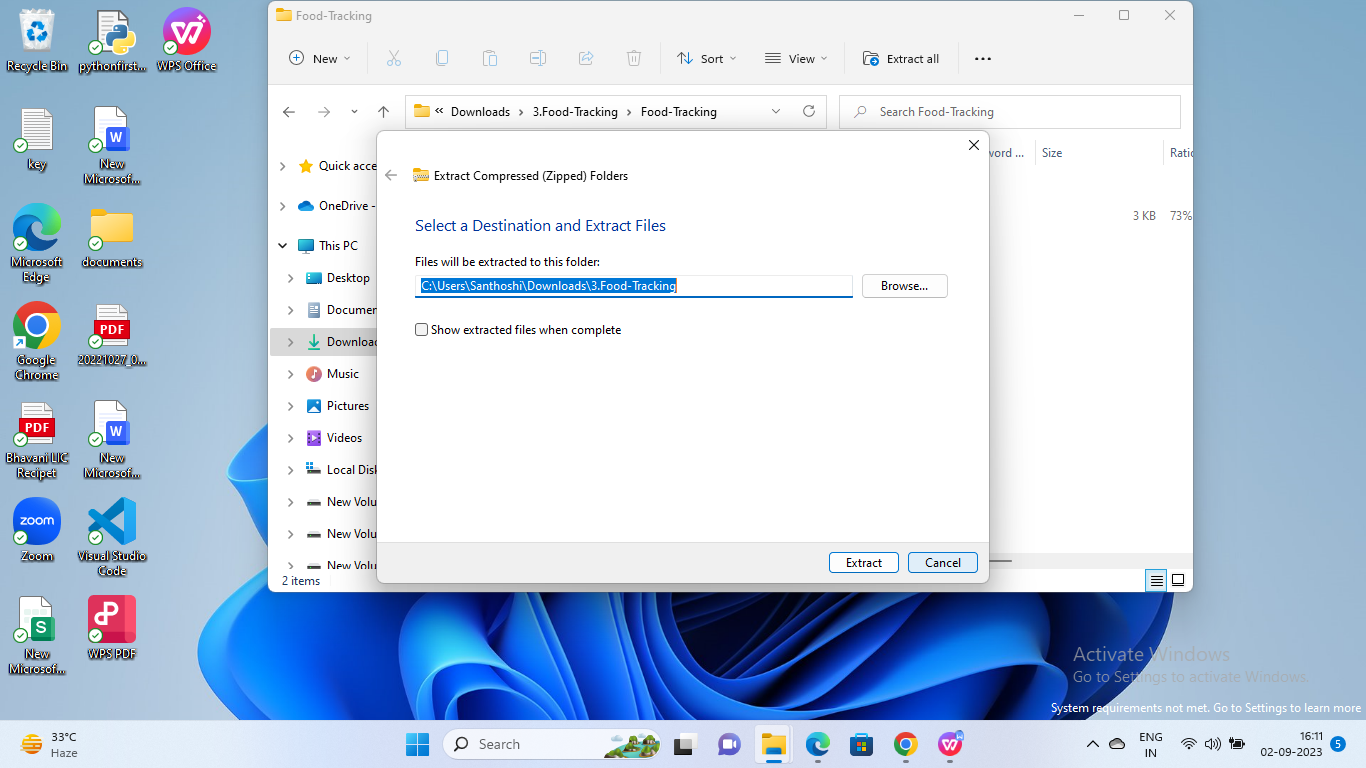
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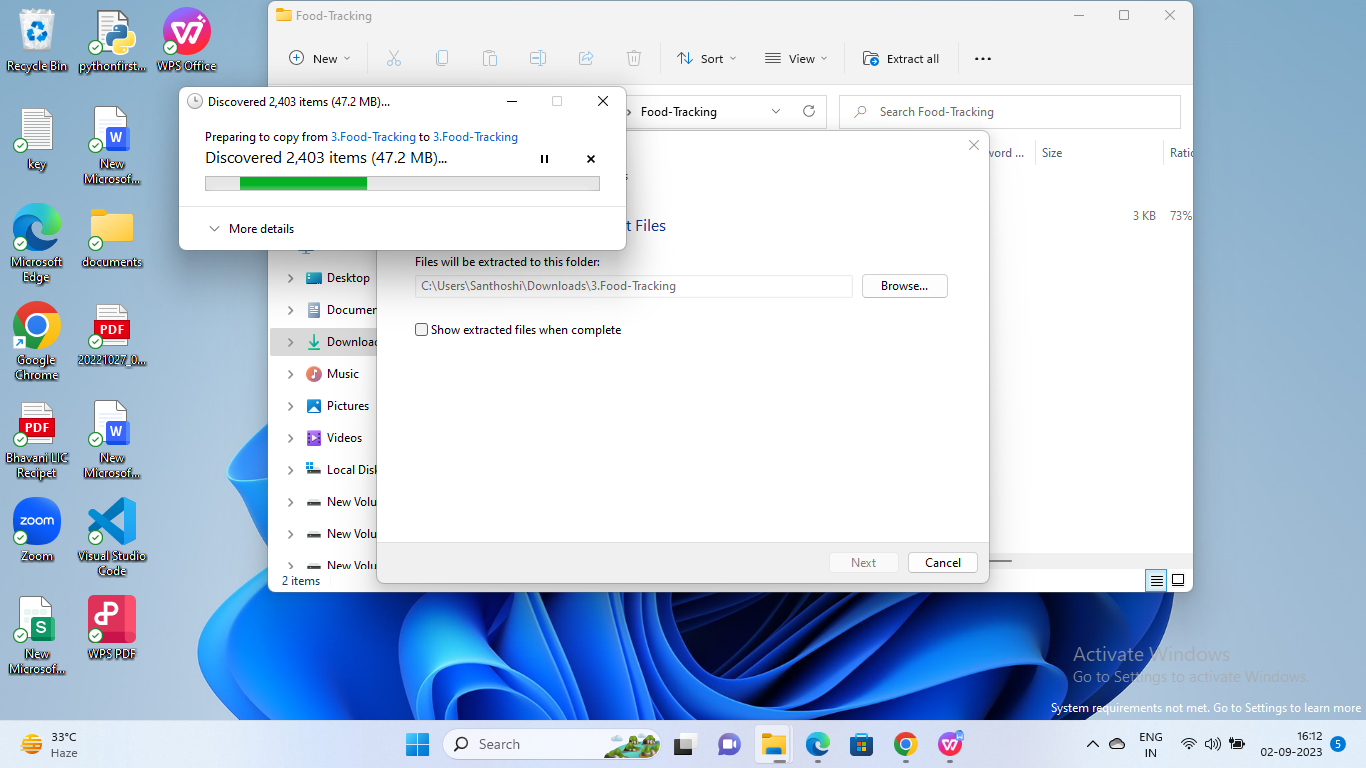
STEP 1: Open the zip file of the project



STEP 2:  Extract it and open in VS Code







**CODING AND SOLUTION**

// 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);

}

}

**8.PERFORMANCE TESTING**

8.1. PERFORMANCE METRICES

Eracting with the frontend in a Smart Contract Vaccine Tracking-Transparent system on the blockchain is crucial for a user-friendly and reliable experience. Through a user-friendly web or mobile application, healthcare providers, patients, and authorities can effortlessly access vaccine-related information. The frontend communicates with blockchain-based smart contracts through APIs or similar interfaces, enabling users to verify vaccine authenticity, track distribution routes, and access individual vaccination records. This seamless interaction ensures that all stakeholders can confidently participate in vaccination programs, fostering transparency, trust, and the efficient management of vaccine distribution and administration while enhancing global public health efforts.

**9.RESULTS**

**9.1.SCREENSCHOTS**

**ADVANTAGES**

Vaccines are one of the safest preventive care measures available. Vaccination can mean the difference between life and death. Vaccine-preventable infections can be deadly. Prior to the pandemic, approximately 50,000 adults died from vaccine-preventable diseases in the US each year

**DISADVANTAGES**

Vaccines do have some risk for adverse reaction, the most common being redness and soreness at the injection site or fever and allergic reactions.

**FUTURE SCOPE**

Traditionally, vaccines take over a decade to research, develop, and be confirmed as safe for use in humans. For many years, scientists have recognized that this process is not fast enough to respond to novel infectious diseases. Before emerged, scientists had been working on cutting-edge platform technologies to change the vaccine development landscape. In particular, a team at Imperial College London had been working on a groundbreaking new platform known as Rapidvac that aimed to develop new vaccines in months instead of years. When became a global pandemic, scientists were under immense pressure to develop a new vaccine in a short timeframe. Thanks to developments like Rapidvac, scientists were equipped with the tools to create new vaccinations in record-breaking times. Before 2020, the fastest development of a vaccine had been the four years it had taken to get the mumps vaccine approved back in the 1960s.

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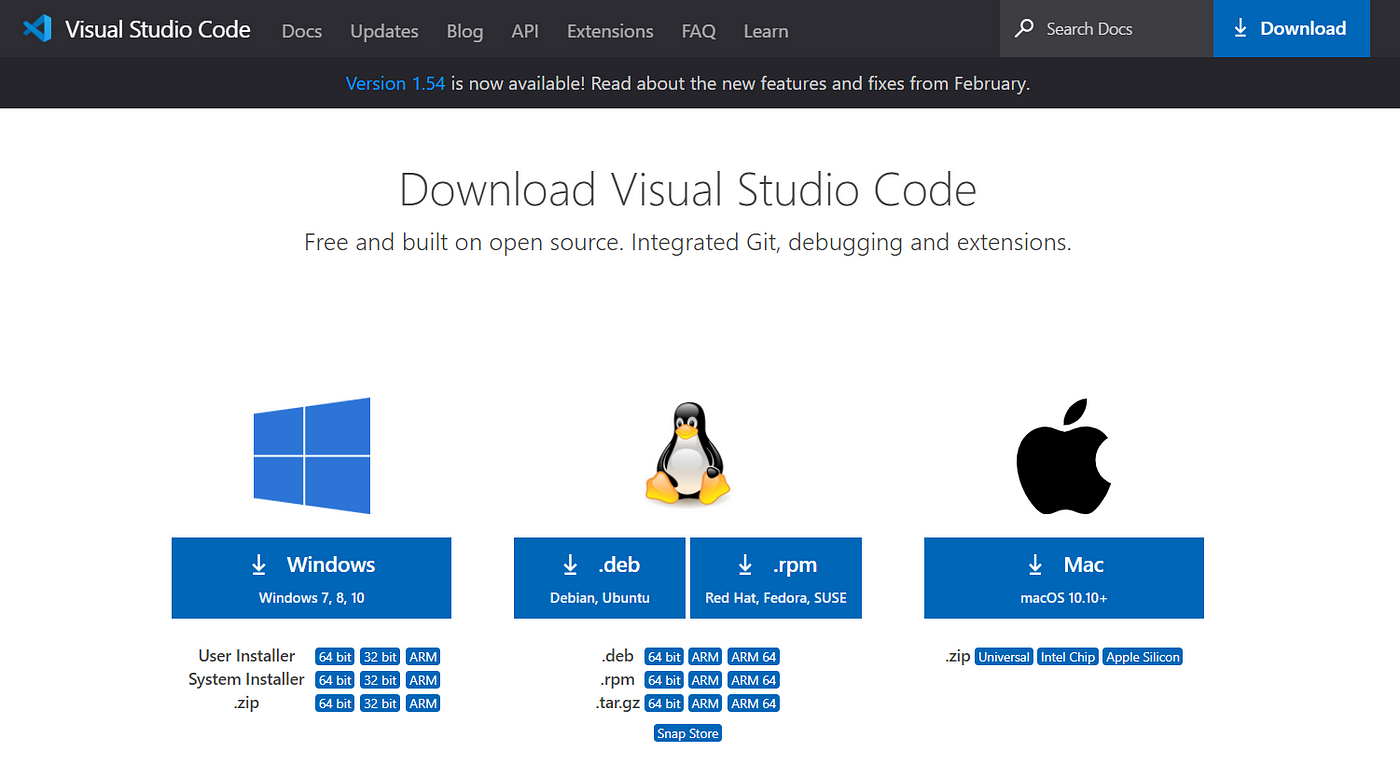
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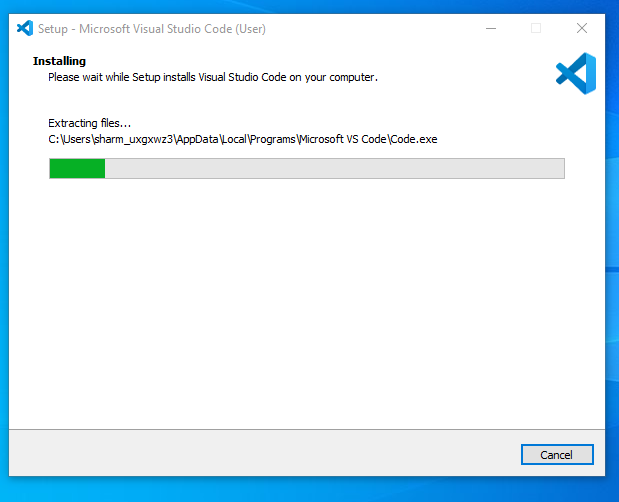
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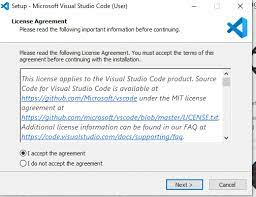
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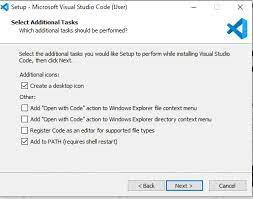
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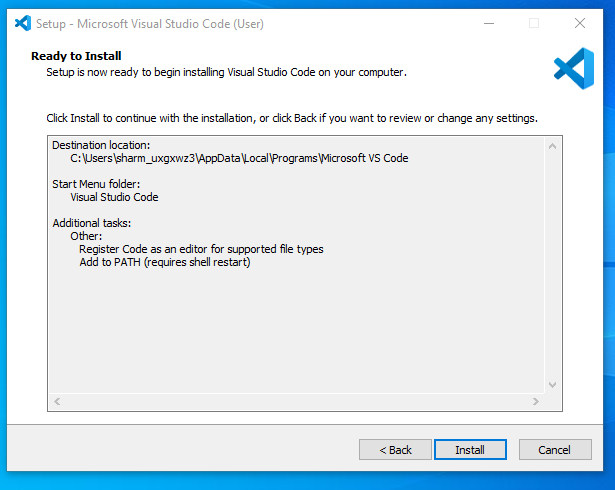
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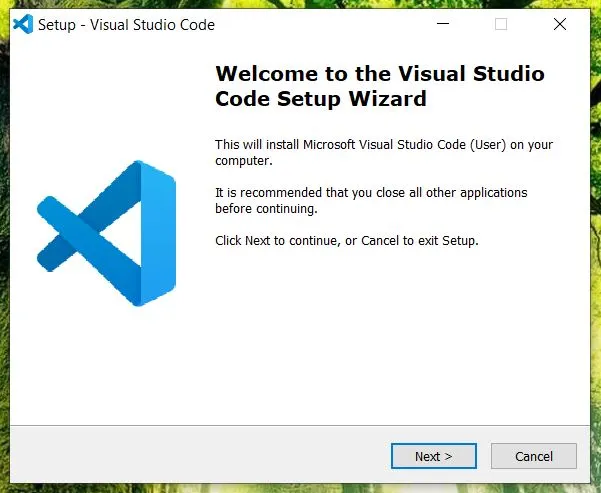
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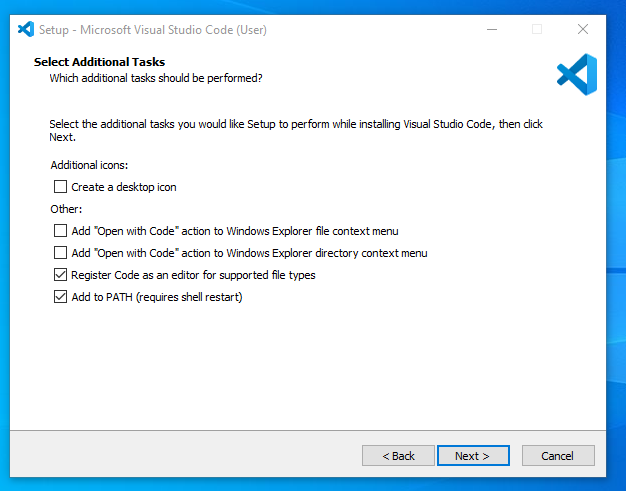
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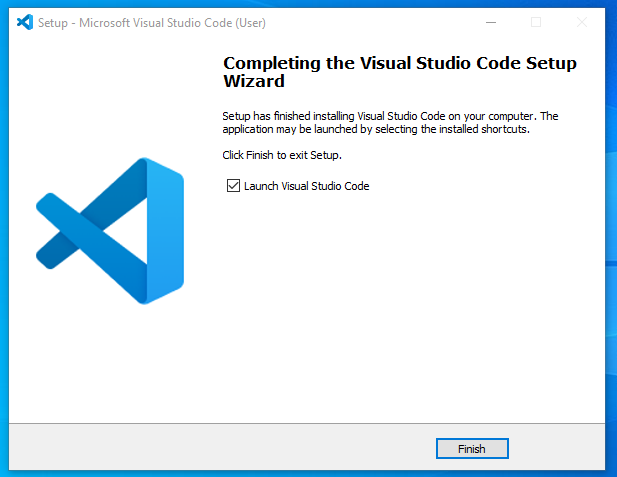
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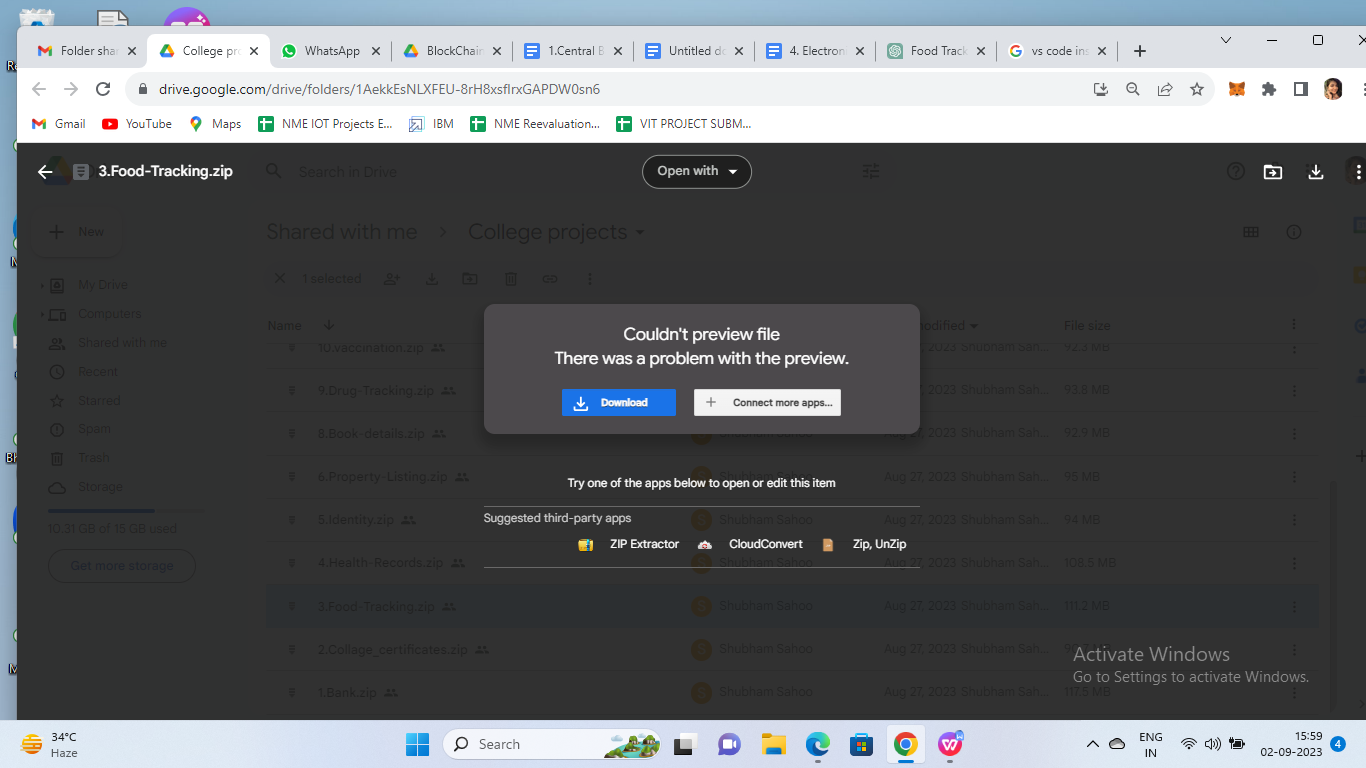
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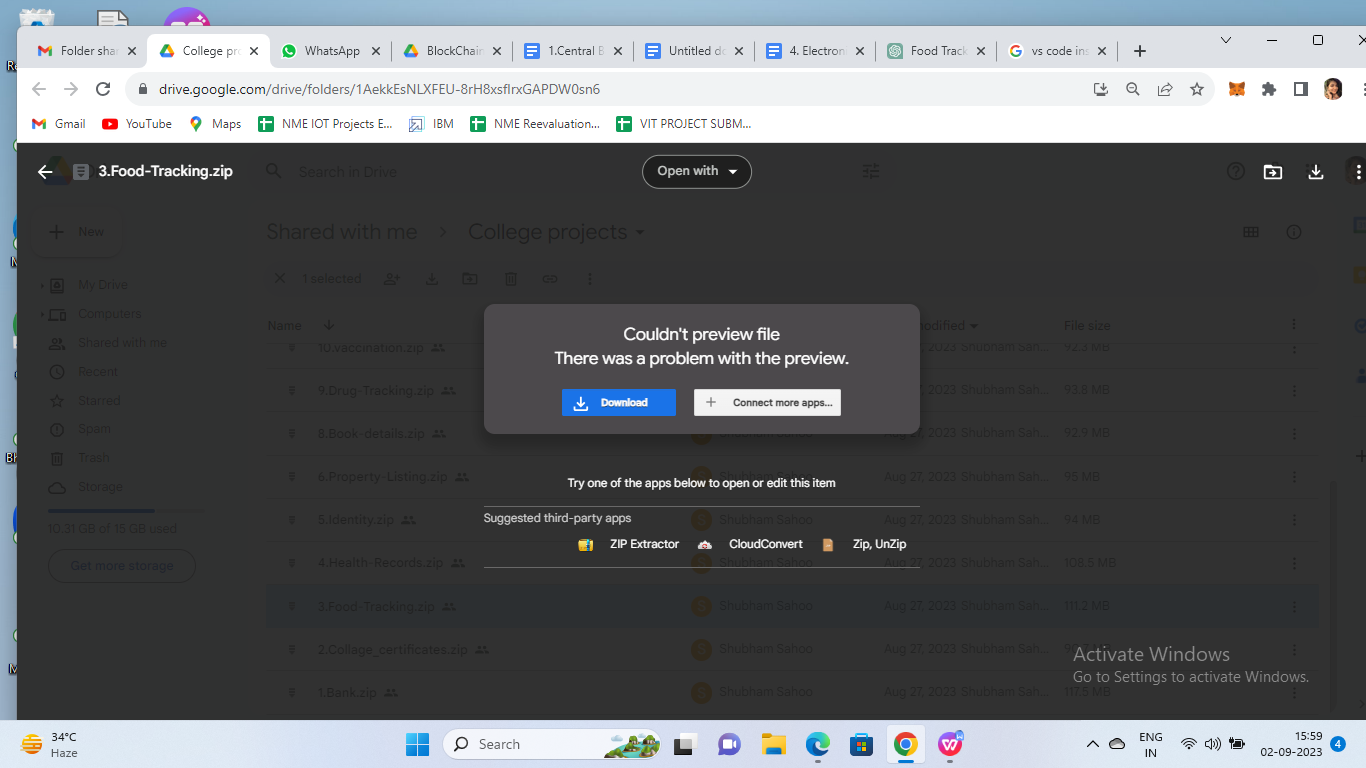
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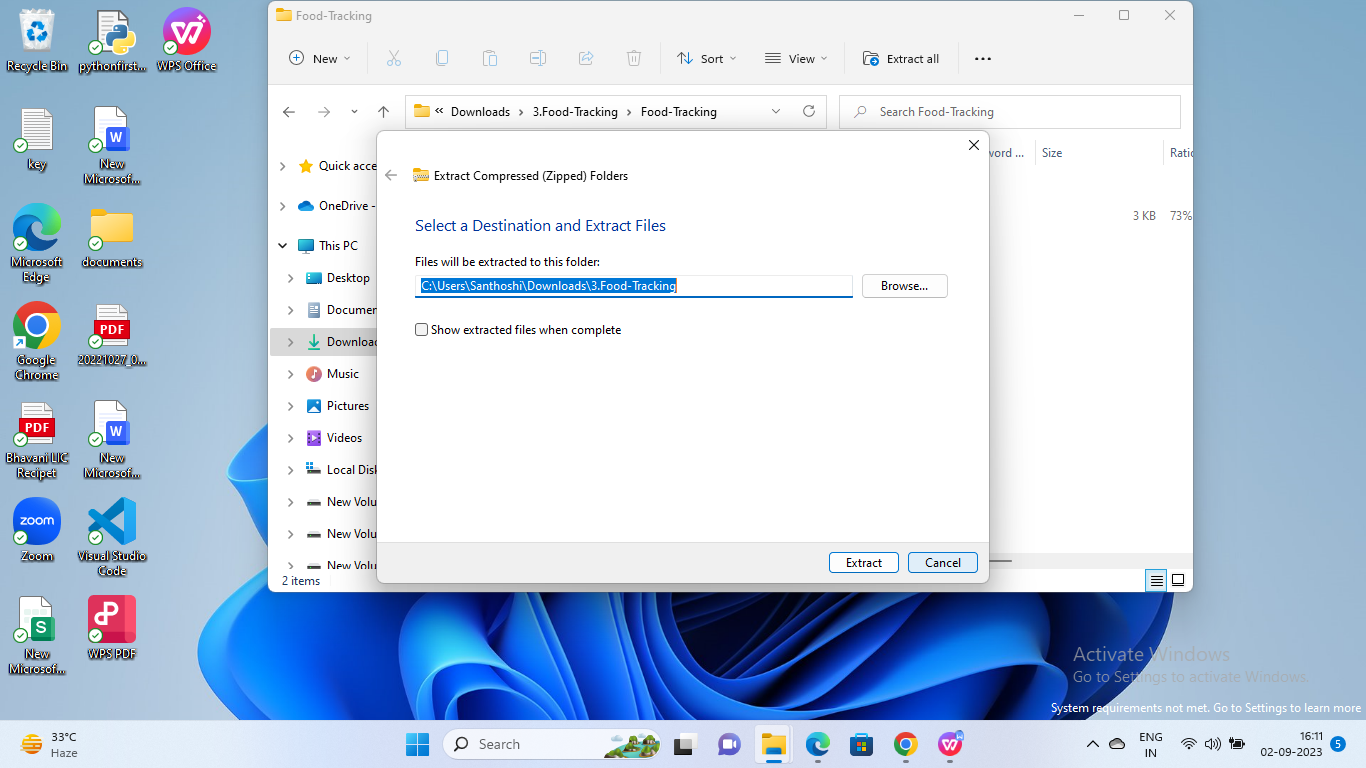
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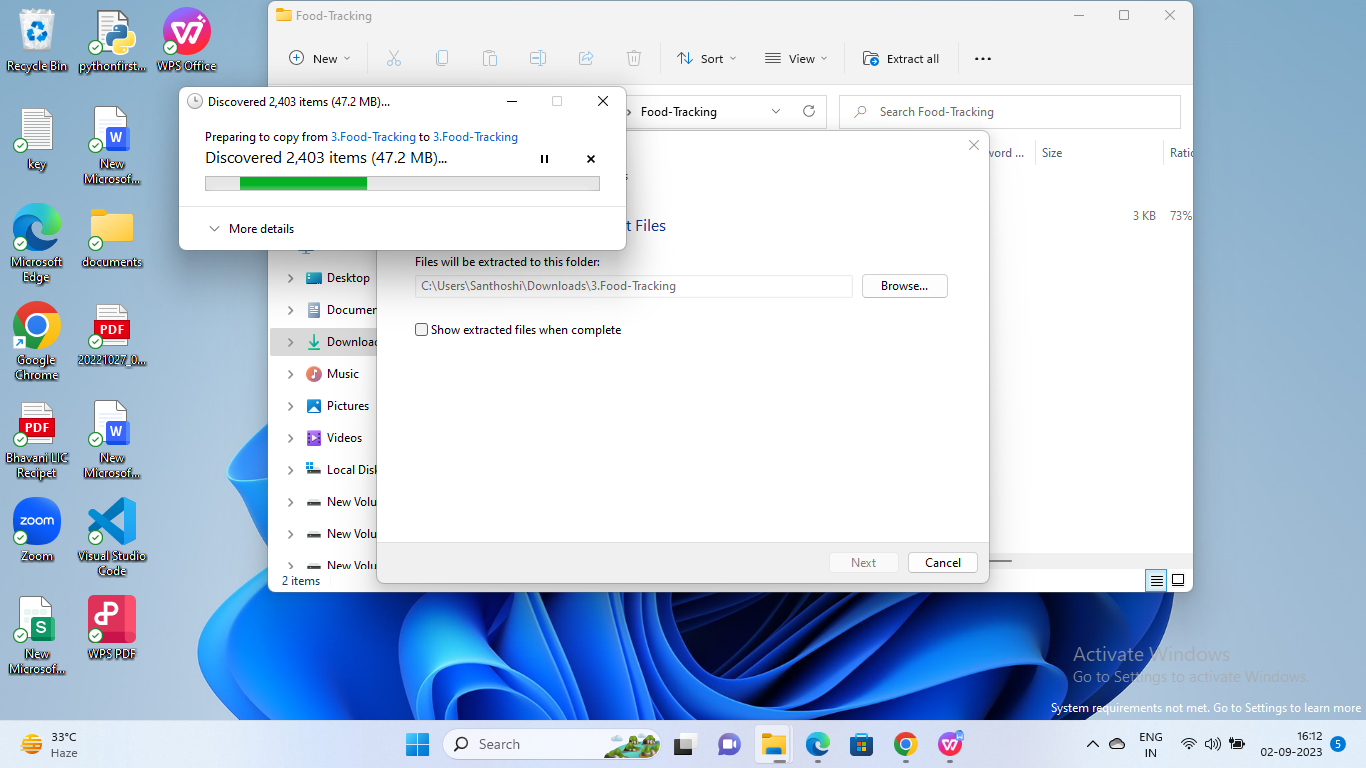
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**CODING AND SOLUTION**

// 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);

}

}

**8.PERFORMANCE TESTING**

8.1. PERFORMANCE METRICES

Eracting with the frontend in a Smart Contract Vaccine Tracking-Transparent system on the blockchain is crucial for a user-friendly and reliable experience. Through a user-friendly web or mobile application, healthcare providers, patients, and authorities can effortlessly access vaccine-related information. The frontend communicates with blockchain-based smart contracts through APIs or similar interfaces, enabling users to verify vaccine authenticity, track distribution routes, and access individual vaccination records. This seamless interaction ensures that all stakeholders can confidently participate in vaccination programs, fostering transparency, trust, and the efficient management of vaccine distribution and administration while enhancing global public health efforts.

**9.RESULTS**

**9.1.SCREENSCHOTS**

**ADVANTAGES**

Vaccines are one of the safest preventive care measures available. Vaccination can mean the difference between life and death. Vaccine-preventable infections can be deadly. Prior to the pandemic, approximately 50,000 adults died from vaccine-preventable diseases in the US each year

**DISADVANTAGES**

Vaccines do have some risk for adverse reaction, the most common being redness and soreness at the injection site or fever and allergic reactions.

**FUTURE SCOPE**

Traditionally, vaccines take over a decade to research, develop, and be confirmed as safe for use in humans. For many years, scientists have recognized that this process is not fast enough to respond to novel infectious diseases. Before emerged, scientists had been working on cutting-edge platform technologies to change the vaccine development landscape. In particular, a team at Imperial College London had been working on a groundbreaking new platform known as Rapidvac that aimed to develop new vaccines in months instead of years. When became a global pandemic, scientists were under immense pressure to develop a new vaccine in a short timeframe. Thanks to developments like Rapidvac, scientists were equipped with the tools to create new vaccinations in record-breaking times. Before 2020, the fastest development of a vaccine had been the four years it had taken to get the mumps vaccine approved back in the 1960s.

**INTRODUCTION**

**PROJECT REVIEW**

In today's increasingly interconnected world, ensuring the transparency and trustworthiness of vaccine distribution has become a critical imperative. The Ethereum Vaccine Tracking system represents a pioneering solution to this pressing issue. This cutting-edge platform leverages the Ethereum blockchain's capabilities to establish a secure and transparent method for monitoring vaccine journeys, from production to administration. By harnessing blockchain technology, this system not only safeguards the integrity of vaccine data but also still confidence in the vaccination process among stakeholders and the general public. In this rapidly evolving landscape, the Ethereum Vaccine Tracking system stands as a beacon of reliability and accountability. It offers a streamlined approach to recording and verifying vaccine information, with authorized users being able to access real-time data. This introduction will delve into the core functionalities and transformative potential of this innovative solution, shedding light on how it can revolutionize vaccine distribution practices, bolster public health initiatives, and pave the way for a safer and more secure future.

**PURPOSE**

The business problem of Vaccine Tracking-Transparent is centred around the need for a robust and transparent system to monitor the distribution and administration of vaccines. Inefficient and opaque vaccine tracking systems can result in challenges such as vaccine wastage, unauthorized distribution, and inadequate monitoring of immunization coverage. These issues can lead to public health risks, misallocation of resources, and a lack of trust in vaccination programs. Implementing a transparent vaccine tracking solution aims to address these problems by providing real-time visibility into vaccine supply chains, ensuring vaccines reach the right recipients on time, and enabling data-driven decision-making to optimize vaccine distribution and administration efforts. This, in turn, enhances public health outcomes and builds trust in immunization programs.

**LITERATURE REVIEW**

Since the outbreak of the pandemic, there has been a rapid expansion in vaccine research focusing on exploiting the novel discoveries on the path physiology, genomics, and molecular biology of the severe acute respiratory syndrome infection. Although the current preventive measures are primarily socially distancing by maintaining a 1 m distance, it is supplemented using facial masks and other personal hygiene measures. However, the induction of vaccines as primary prevention is crucial to eradicating the disease to attempt restoration to normalcy. This literature review aims to describe the physiology of the vaccines and how the spike protein is used as a target to elicit an antibody-dependent immune response in humans. Furthermore, the overview, dosing strategies, efficacy, and side effects will be discussed for the notable vaccines: BioNTech/Pfizer, Moderna, AstraZeneca, Janssen, Gamaleya, and SinoVac. In addition, the development of other prominent vaccines will be highlighted alongside the sustainability of the vaccine-mediated immune response and current contraindications. As the research is rapidly expanding, we have looked at the association between pregnancy and COVID-19 vaccinations, in addition to the current reviews on the mixing of vaccines. Finally, the prominent emerging variants of concern are described, and the efficacy of the notable vaccines toward these variants has been summarized.

**REFERENCES**

* AAP (American Academy of Pediatrics). Hepatitis B. In: Pickering LK, Baker CJ, Kimberlin DW, Long SS, editors. Red book: 2009 Report of the Committee on Infectious Diseases. 28th. Elk Grove Village, IL: American Academy of Pediatrics; 2009a. pp. 337–356.
* AAP. Measles. In: Pickering LK, Baker CJ, Kimberlin DW, Long SS, editors. Red book: 2009 Report of the Committee on Infectious Diseases. 28th. Elk Grove Village, IL: American Academy of Pediatrics; 2009b. pp. 444–455.
* AAP. Rubella. In: Pickering LK, Baker CJ, Kimberlin DW, Long SS, editors. Red book: 2009 Report of the Committee on Infectious Diseases. 28th. Elk Grove Village, IL: American Academy of Pediatrics; 2009c. pp. 579–584.
* AAP. Tetanus (lockjaw). In: Pickering LK, Baker CJ, Kimberlin DW, Long SS, editors. Red book: 2009 Report of the Committee on Infectious Diseases. 28th. Elk Grove Village, IL: American Academy of Pediatrics; 2009d. pp. 655–660.

**PROBLEM STATEMENT DEFINITION**

Healthcare professionals and public health authorities have a central role in discussing vaccination against with their patients. Vaccines play a critical role in preventing deaths, and hospitalisation caused by infectious diseases, and are contributing to controlling the spread of the disease, thus their impact on infection and serious illness is significant. Both vaccinated and unvaccinated people also need to be aware of the additional protective behaviours required to control the pandemic locally.

The global impact of the pandemic has resulted in an unprecedented level of public interest in vaccines. This includes a focus on the development of vaccines and their regulatory review and safety monitoring. Much of this coverage has taken place through mass and social media. Reports of adverse events (side effects) have led some people to express concerns about getting vaccinated, delay getting vaccinated or be strongly opposed to vaccination. There are also differences in individual confidence in national safety monitoring systems. Another challenge in communicating the importance of vaccination is that in many, but not all, children and young adults are less clinically affected by infection and therefore some may see limited value in vaccinating this population. Clear and consistent communication of evidence and uncertainties is therefore essential to support people in making the critical choice to be vaccinated.

**IDEATION AND PROPOSED SYSTEM**

**EMPATHY MAP CANVAS**

**REQUIREMENT ANALYSIS**

**FUNCTIONAL REQUIREMENTS**

Vaccine Tracking-Transparent has the potential for profound social and business impacts. From a social perspective, it can significantly enhance public health by ensuring the efficient and transparent distribution of vaccines, which is crucial in the fight against infectious diseases. This technology can help boost vaccination coverage rates, reduce vaccine wastage, and mitigate the risks of counterfeit vaccines entering the supply chain. This, in turn, leads to improved disease prevention and overall community well-being. On the business front, the implementation of such systems can streamline vaccine supply chain operations, reduce costs associated with vaccine distribution, and enhance the reputation of vaccine manufacturers and healthcare providers. Moreover, the transparency and trust established through Vaccine Tracking-Transparent can foster stronger partnerships and collaborations within the healthcare ecosystem, ultimately benefiting both public health and the vaccine industry.

NON-FUNCTIONAL REQUIREMENTS

This implementation guide includes a machine-readable representation of WHO guidelines for immunization, as documented in the WHO Digital Adaptation Kit: SMART Guidelines for Immunizations (link forthcoming) and explicitly encodes computer-interoperable logic, including data models, terminologies, and logic expressions, in a computable language to support implementation of immunization use cases by WHO Member States. The guide is part of the  to support countries to integrate WHO global health and data recommendations into digital systems accurately and consistently. It defines a series of FHIR Resources, Profiles, Extensions, and Terminology based on the WHO Immunization Digital Adaptation Kit .

**PROJECT DESIGN**

**DATA FLOW DIAGRAM**

**Define Problem / Problem Understanding**

Specify the business problem

Business requirements

Literature Survey

Social or Business Impact.

**Tools And Technology Requirement**

Download VS Code

Download the Zip file for the project and Extract it and open in VS Code

**Implementation**

Remix IDE

Create a file in contract folder with smart contract code in the file

**Adding MetaMask extensions**

Deploy the code by injected metamask

Metamask extensions on remixing

**Implementation of Smart contract**

 using file Connector.js

**Interaction with frontend**

interact with the frontend for all functionalities

**Project Demonstration & Documentation**

Record explanation Video for project end to end solution

Project Documentation-Step by step project development procedure

**5.2SOLUTION ARCHITECTURE**

Vaccine Tracking-Transparent has the potential for profound social and business impacts. From a social perspective, it can significantly enhance public health by ensuring the efficient and transparent distribution of vaccines, which is crucial in the fight against infectious diseases. This technology can help boost vaccination coverage rates, reduce vaccine wastage, and mitigate the risks of counterfeit vaccines entering the supply chain. This, in turn, leads to improved disease prevention and overall community well-being. On the business front, the implementation of such systems can streamline vaccine supply chain operations, reduce costs associated with vaccine distribution, and enhance the reputation of vaccine manufacturers and healthcare providers. Moreover, the transparency and trust established through Vaccine Tracking-Transparent can foster stronger partnerships and collaborations within the healthcare ecosystem, ultimately benefiting both public health and the vaccine industry.

**6.PROJECT PLANNING AND SCHEDULING**

**6.1 TECHNICAL ARCHITECTURE**

\*Download VS code

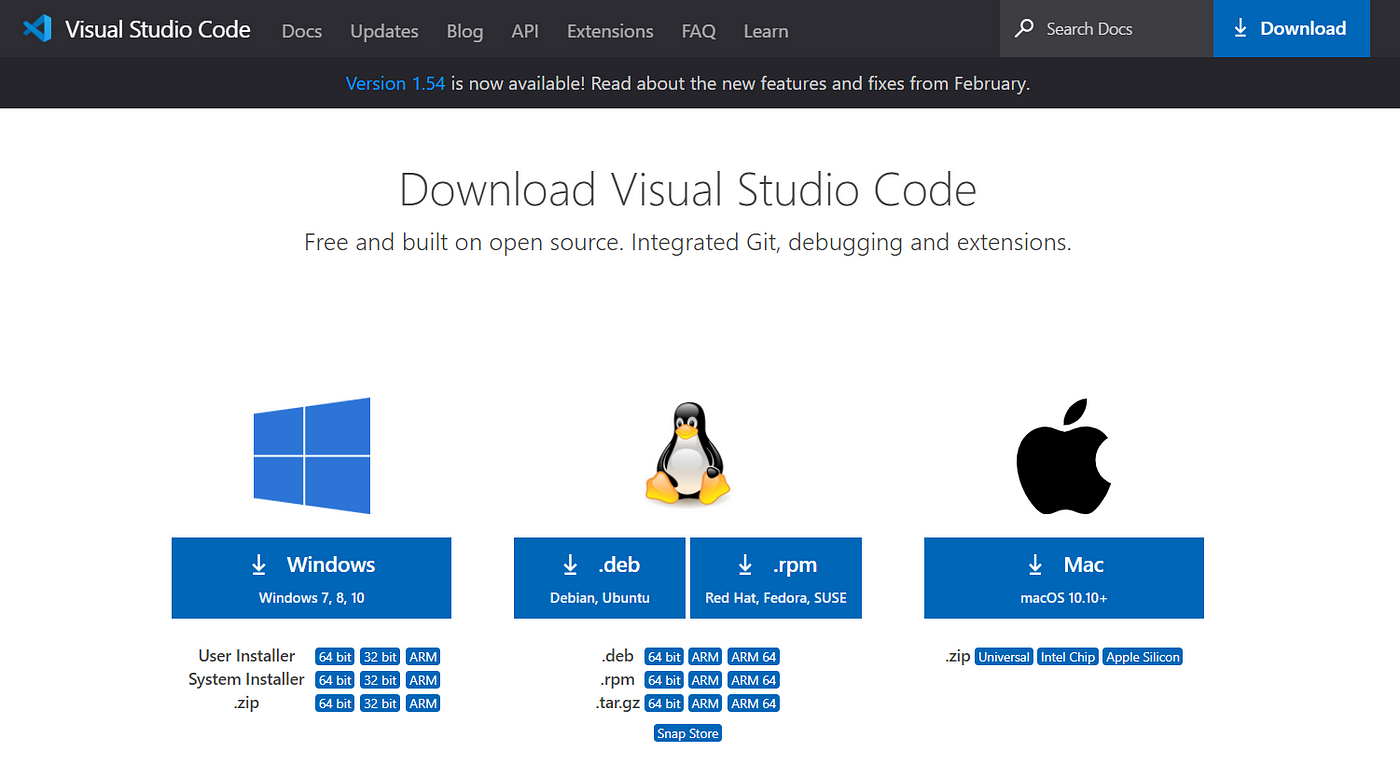
\*Remix

\*Github

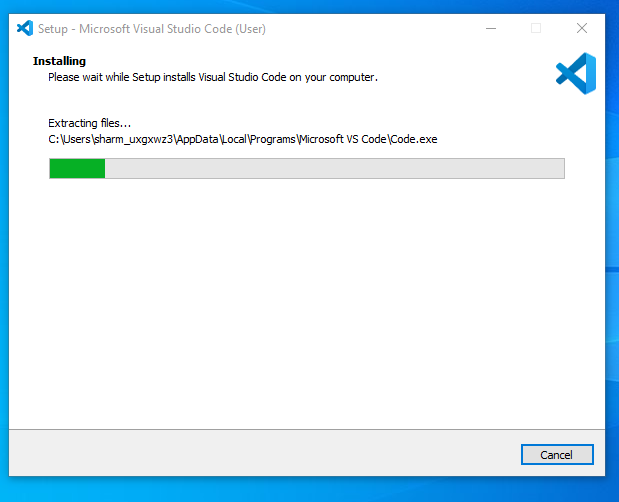
\*Metamask

**6.2.SPRINT PLANNING AND ESTIMATION**

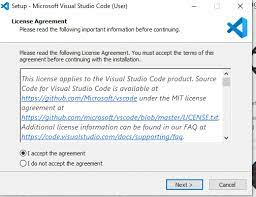
* To install the VS Code follow the steps below
* **STEP 1:   Download VS code from here** [**Link**](https://code.visualstudio.com/download)



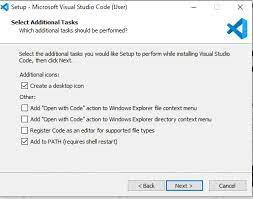
**STEP 2: Download the Visual Studio Code installer for Windows.**



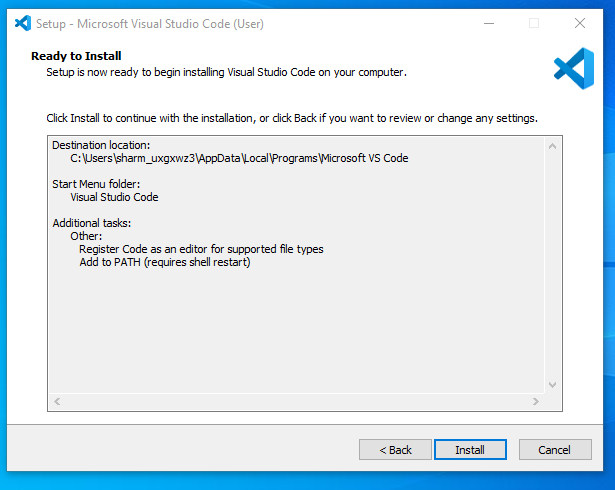
**STEP 3:  Once it is downloaded, run the installer (VSCodeUserSetup-{version}.exe). This will only take a minute.**

****

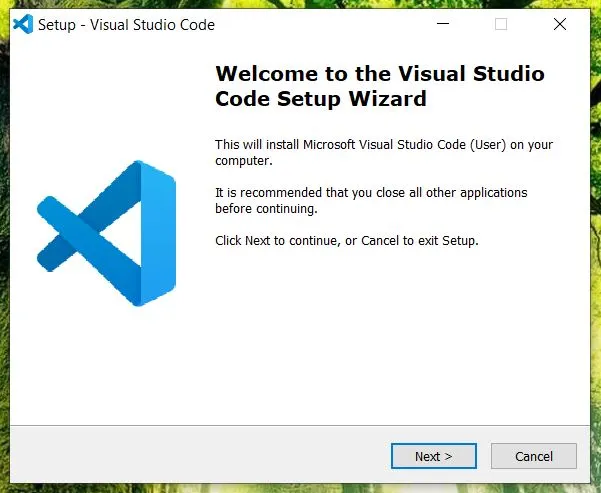
**Step 4: click on Next**

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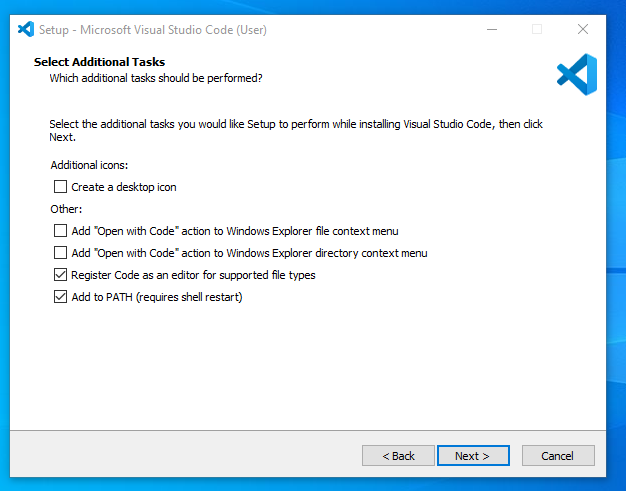
**STEP 5: Click on install**

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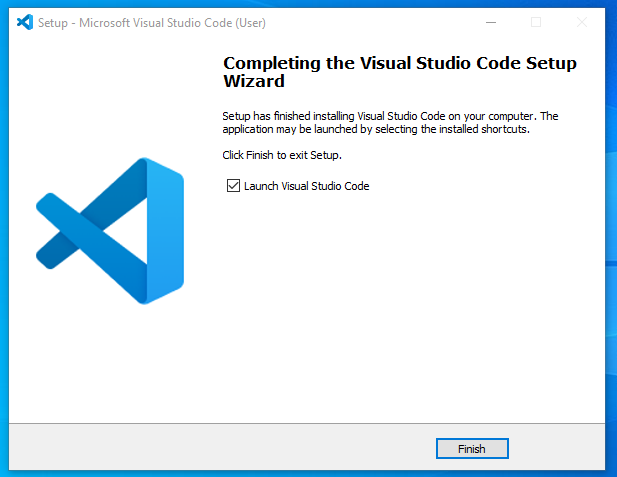
**STEP 6: Click on next**

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**STEP 7: Click on add to path**

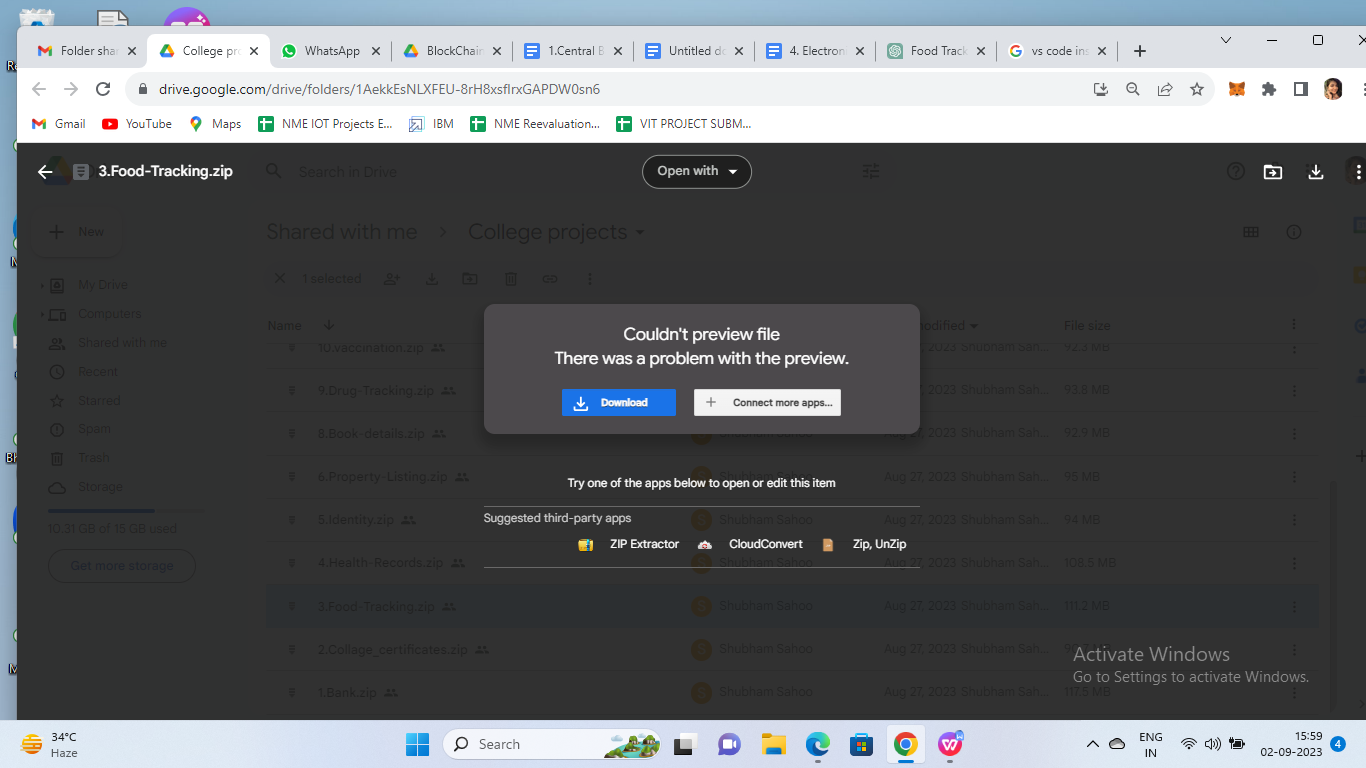
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**STEP 8 : Click on finish**

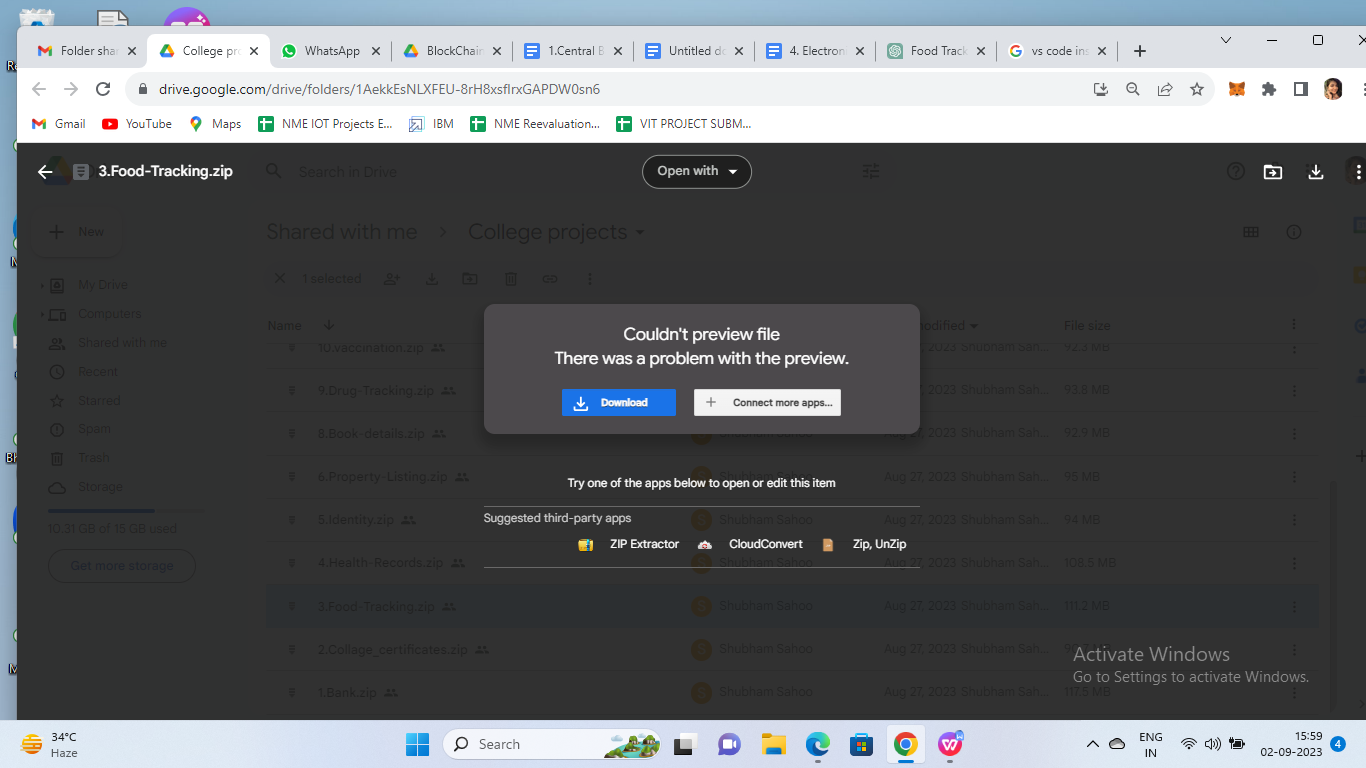
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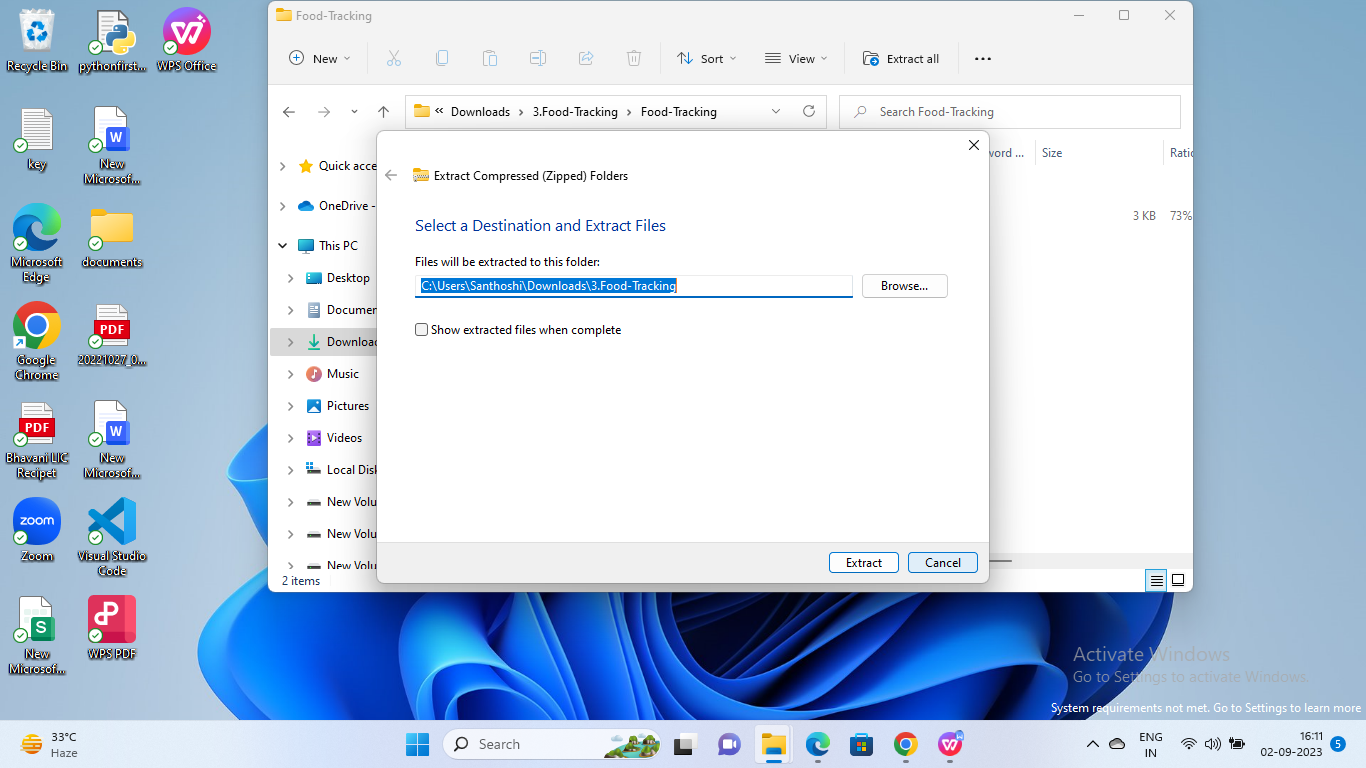
**6.2 SPRINT DELIVERY SCHEDULE**

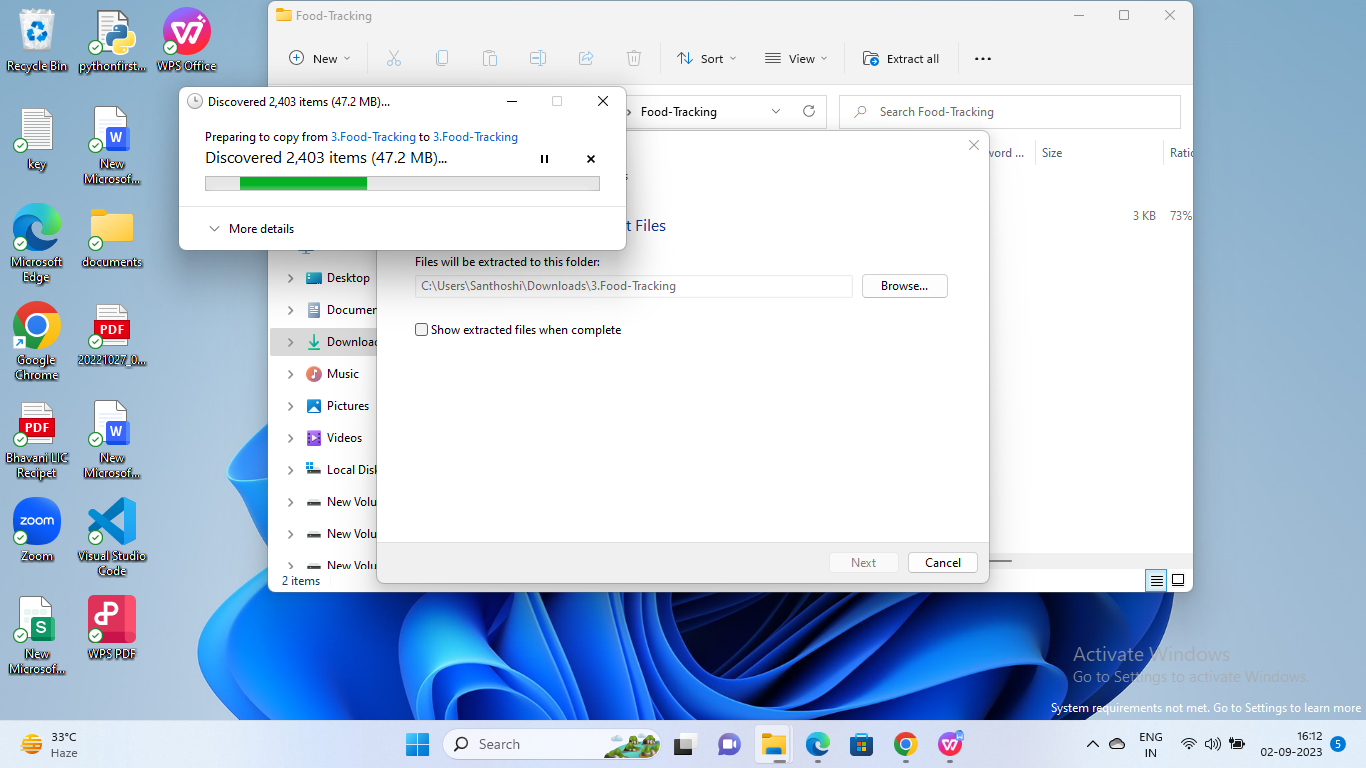
STEP 1: Open the zip file of the project



STEP 2:  Extract it and open in VS Code







**CODING AND SOLUTION**

// 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);

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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);

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Traditionally, vaccines take over a decade to research, develop, and be confirmed as safe for use in humans. For many years, scientists have recognized that this process is not fast enough to respond to novel infectious diseases. Before emerged, scientists had been working on cutting-edge platform technologies to change the vaccine development landscape. In particular, a team at Imperial College London had been working on a groundbreaking new platform known as Rapidvac that aimed to develop new vaccines in months instead of years. When became a global pandemic, scientists were under immense pressure to develop a new vaccine in a short timeframe. Thanks to developments like Rapidvac, scientists were equipped with the tools to create new vaccinations in record-breaking times. Before 2020, the fastest development of a vaccine had been the four years it had taken to get the mumps vaccine approved back in the 1960s.