BLOCKCHAIN TECHNOLOGY

IBM Project

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TEAM ID: NM2023TMID01196

Project: Climate Track Smart Using Blockchain

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CLIMATE TRACK SMART USING BLOCKCHAIN

CHAPTER - 1

1. INTRODUCTION

1.1 Project Overview

Climate tracking using blockchain technology is a groundbreaking approach that leverages the transparency, security, and immutability of blockchain to monitor and manage environmental data and initiatives in our day today life. Blockchain, a decentralized and tamper-resistant ledger, serves as the backbone for climate tracking by providing a trustworthy platform for recording, verifying, and sharing data related to the environment. This technology allows stakeholders, including governments, businesses, researchers, and individuals, to collaborate in a trustless ecosystem where data accuracy and integrity are paramount.

In this era of global climate crisis, the integration of blockchain technology offers the potential to revolutionize how we collect, manage, and share crucial climate data. Through smart contracts, decentralized applications, and the secure wallets like MetaMask, users can participate in climate initiatives, access real-time data, and contribute to a more sustainable future. As climate tracking using blockchain continues to evolve, it stands as a testament to our capacity to harness technology for the betterment of our planet and its inhabitants. Blockchain technology is employed to accurately monitor and manage various climate change issues in order to address environmental challenges effectively.

1.2 purpose

Blockchain technology can provide transparency and security, implementing such a system for climate tracking involves several technical, regulatory, and data quality challenges. Additionally, it requires the collaboration of various stakeholders, including climate scientists, data providers, and blockchain developers. The use of blockchain for climate tracking is a concept that is still in its early stages of development, and its effectiveness would depend on widespread adoption and data quality assurance.

CHAPTER - 2

2. LITERATURE SURVEY

2.1 Existing Problem

Data Integrity and Trust

Climate Track Smart collects and manages critical climate and environmental data from various sources, including sensors, satellites, and third-party contributors. Ensuring the integrity and trustworthiness of this data is crucial for their clients, who rely on accurate information for decision-making.

Data Sharing and Collaboration

Climate data often needs to be shared and collaborated upon by various stakeholders, including governments, researchers, and businesses. Traditional methods of data sharing can be slow, inefficient, and susceptible to errors.

Traceability and Accountability

Clients of Climate Track Smart may need to trace the source and history of environmental data, especially when it is used for regulatory compliance or reporting.

Ensuring data traceability and accountability is essential.

Data Monetization and Incentives

Climate Track Smart may want to incentivize data contributors and create a marketplace for climate data. However, ensuring fair compensation and incentivization can be complex.

2.2 References

Blockchain technology has the potential to address various challenges in climate tracking and contribute to more transparent, secure, and efficient solutions for monitoring and mitigating climate change. Here are some smart references and applications of blockchain in climate tracking:

1. **Carbon Credits and Emissions Trading**:
    - **Smart Contracts for Carbon Credits**: Smart contracts on a blockchain can automate the issuance, trading, and retirement of carbon credits, making it more transparent and reducing fraud.

- **Emissions Verification**: Blockchain can be used to verify emissions data from various sources, ensuring the accuracy of reported emissions and facilitating emissions trading.

2. **Supply Chain and Traceability**:
    - **Provenance Tracking**: Blockchain can be used to trace the origins and carbon footprint of products, helping consumers make informed choices and companies reduce emissions in their supply chains.
    - **Smart Labels**: QR codes or NFC tags linked to a blockchain can provide detailed information about a product's environmental impact.
3. **Renewable Energy Trading**:
    - **Peer-to-Peer Energy Trading**: Blockchain enables peer-to-peer trading of renewable energy, allowing individuals or entities to buy and sell excess energy production, thus promoting the use of green energy.
4. **Climate Finance and Investment**:
    - **Tokenization of Green Bonds**: Blockchain can tokenize green bonds, making it easier for investors to track and trade these bonds, thereby attracting more capital for climate-related projects.
    - **Decentralized Finance (DeFi) for Climate**: DeFi platforms can facilitate climate-related investments and lending, providing new avenues for funding renewable projects.
5. **Data Integrity and Transparency**:
    - **Immutable Data Storage**: Blockchain's immutability ensures that climate data remains tamper-proof, enhancing transparency and trust in climate tracking.
    - **Data Sharing and Collaboration**: Blockchain can facilitate secure and efficient data sharing among different stakeholders, including governments, researchers, and non-governmental organizations.
6. **Climate Smart Contracts and Incentives**:
    - **Smart Climate Contracts**: These could trigger predefined actions or incentives based on climate-related data. For example, insurance payouts in case of extreme weather events or automated subsidies for green energy production.

7. **Decentralized Autonomous Organizations (DAOs)**:
    - **Climate DAOs**: DAOs built on a blockchain can help coordinate and fund climate-related initiatives, with voting mechanisms for decision-making by stakeholders.
8. **IoT Integration**:
    - **IoT Devices and Sensors**: IoT devices can collect environmental data and directly input it into a blockchain, ensuring real-time, reliable climate tracking.
9. **Education and Awareness**:
    - **Blockchain for Climate Education**: Blockchain can be used to create digital certificates or badges for individuals who complete climate-related courses or take eco-friendly actions, promoting awareness and knowledge.

2.3 Problem statement definition:

Numerous organizations at the federal, state, and local levels have a stake in developing strategies to mitigate GHG emissions and adapt to climate changes. These organizations need to have supportive policies and collaborative approaches to improve their effectiveness in developing and implementing climate change strategies. There is a need to communicate, cooperate, and collaborate in efforts so that they are not duplicative or counterproductive. What is the problem statement of climate?

Climate Change is the defining issue of our time and we are at a defining moment. From shifting weather patterns that threaten food production, to rising sea levels that increase the risk of catastrophic flooding, the impacts of climate change are global in scope and unprecedented in scale.

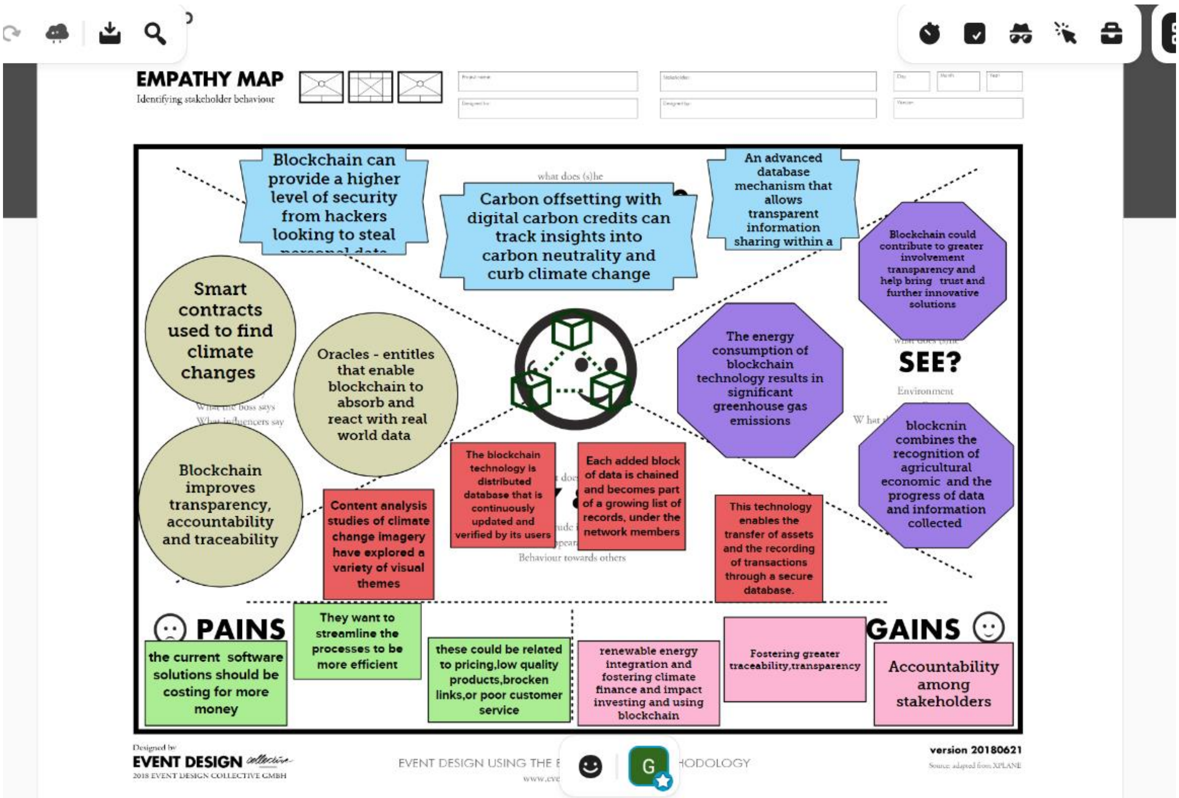
Ethereum is a blockchain platform that allows developers to create decentralized applications (DApps) and smart contracts. Remix is an integrated development environment (IDE) specifically designed for Ethereum smart contract development

CHAPTER – 3

IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas

An **empathy map** is a collaborative visualization used to articulate what we know about a particular type of user. It externalizes knowledge about users in order to 1) create a shared understanding of user needs, and 2) aid in decision making.

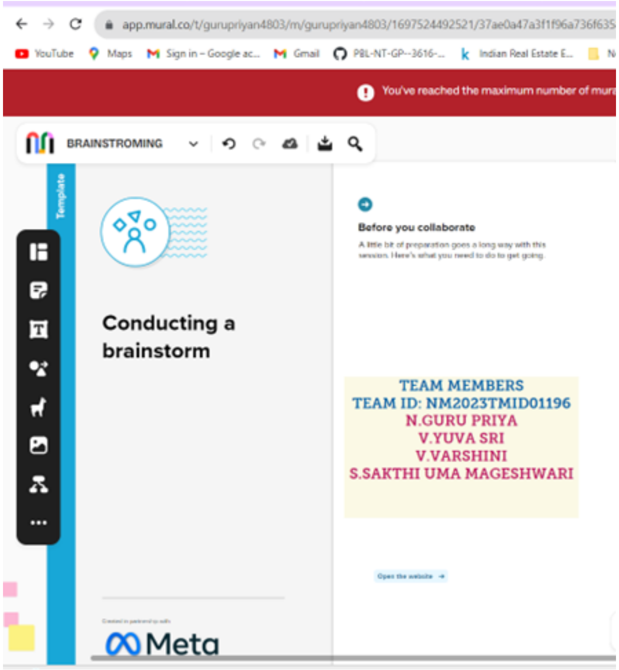


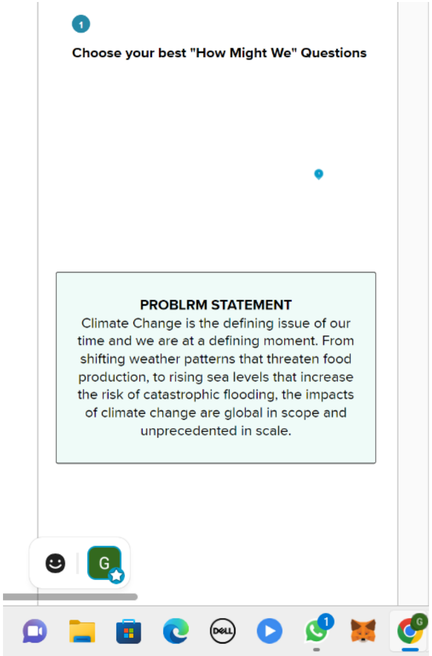
3.2 Brain storming and Ideation

Brainstroming is a creative problem-solving technique in which the problem is turned around and considered from a different point of view to spur new and different solutions.

3.2.1Define problem statement

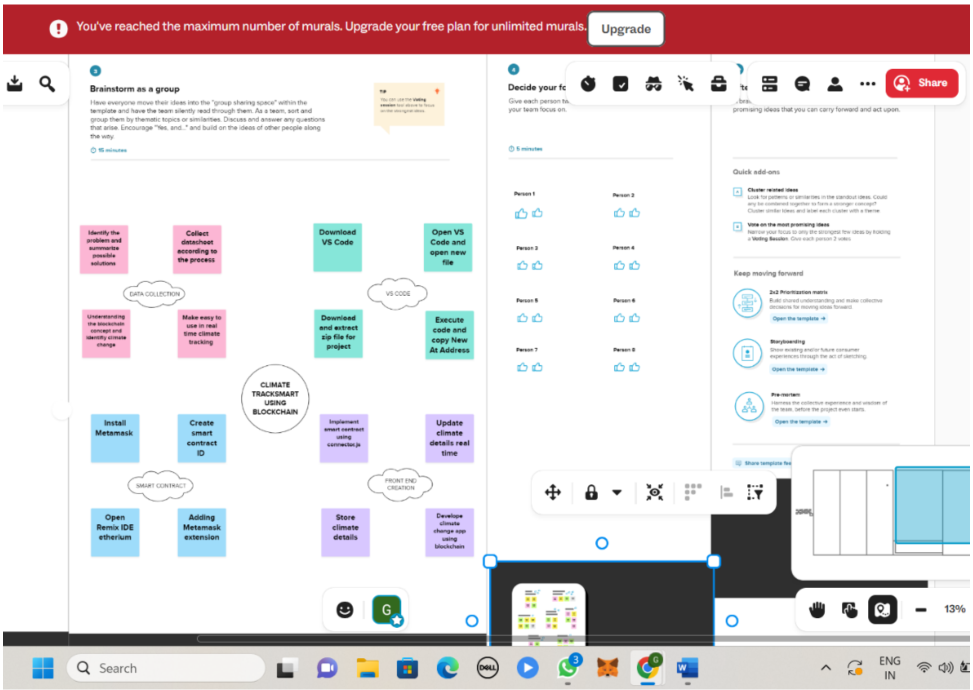
Weather is the single most events that affect the human life in every dimension, ranging from food to fly while on the other hand it is the most disastrous phenomena. Therefore, prediction of weather phenomena is of major interest for human society to avoid or minimize the destruction of weather hazards.





3.2.3 PROPOSED SOLUTION

This proposed project aims to leverage transfer learning and deep learning techniques for weather classification. By utilizing pre-trained models and fine-tuning them on weather-specific data, the project seeks to develop an accurate and efficient weather classification system. Such a system can have wide-ranging applications in various industries and contribute to improved weather monitoring and decision-making processes.



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4.REQUIREMENT ANALYSIS

4.1 Functional Requirements

Following are the functional requirements of the proposed solution.

s.no	Functional Requirement (Epic)	Sub Requirement (Story/Sub-task)
1.	**End user**	• The USER enter climate data, followed shortly by the climate history being registered in the Ethereum system (block chain) and the climate tracking app 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 implementation of code VS Code is used as a frontend to interact 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:

Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	**Security**	**Data Security**: Ensure that climate data stored on the blockchain is highly secure and protected from unauthorized access or tampering. **Identity Verification**: Implement robust identity verification mechanisms for users and devices to prevent unauthorized access to the system. **Encryption**: Data transmission and storage should be encrypted to protect against data breaches.
NFR-2	**Scalability**	The system should be able to handle a growing volume of climate data and transactions as it scales without a significant drop in performance.
NFR-3	**Performance**	**Transaction Throughput**: Define the expected number of transactions per second the blockchain should support to meet the application's needs. **Response Time**: Ensure that the system provides timely responses to user queries and transactions.
NFR-4	**Reliability**	Ensure that the blockchain network and associated applications are highly available and reliable, minimizing downtime and disruptions.
NFR-5	**Interoperability**	Design the blockchain system to be compatible with other systems and standards, ensuring seamless data exchange with external parties.
NFR-6	**Regulatory Compliance**	Adhere to relevant legal and regulatory requirements, such as data privacy laws and environmental regulations.
NFR-7	**Usability**	Create a user-friendly interface and user experience to ensure that users can easily interact with the application and understand the climate data presented.

NFR-8	**Auditability**	Enable auditing capabilities to track and monitor all actions and changes made within the blockchain system for compliance and accountability.
NFR-9	**Environmental Impact**	Consider the energy efficiency of the blockchain network to minimize the carbon footprint, especially when the system's purpose is to address climate issues.
NFR-10	**Cost Efficiency**	Optimize the use of resources and minimize operational costs, as blockchain systems can be resource-intensive.
NFR-11	**Data Retention and Archiving**	Define data retention and archiving policies to ensure that historical climate data is preserved for research and compliance purposes.
NFR-12	**Data Privacy**	Comply with data privacy regulations by implementing strong privacy controls, including user consent and data anonymization where needed.
NFR-13	**Disaster Recovery**	Implement disaster recovery and backup solutions to ensure data availability and system continuity in case of unexpected events.
NFR-14	**Support and Maintenance**	Define a clear support and maintenance plan to address software updates, bug fixes, and user inquiries promptly.
NFR-15	**Resilience**	Ensure the system can recover gracefully from failures and cyber-attacks, minimizing disruptions to climate data tracking and management.

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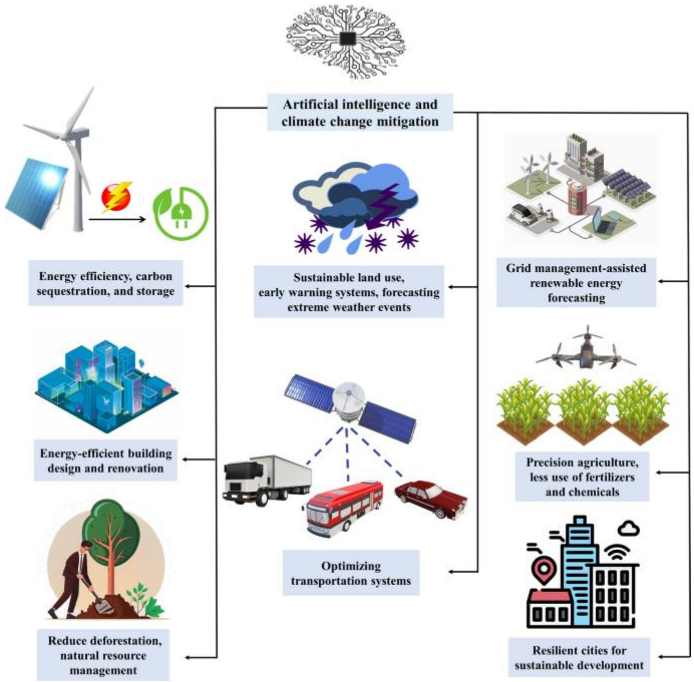
PROJECT DESIGN

5.1 Design flow diagrams

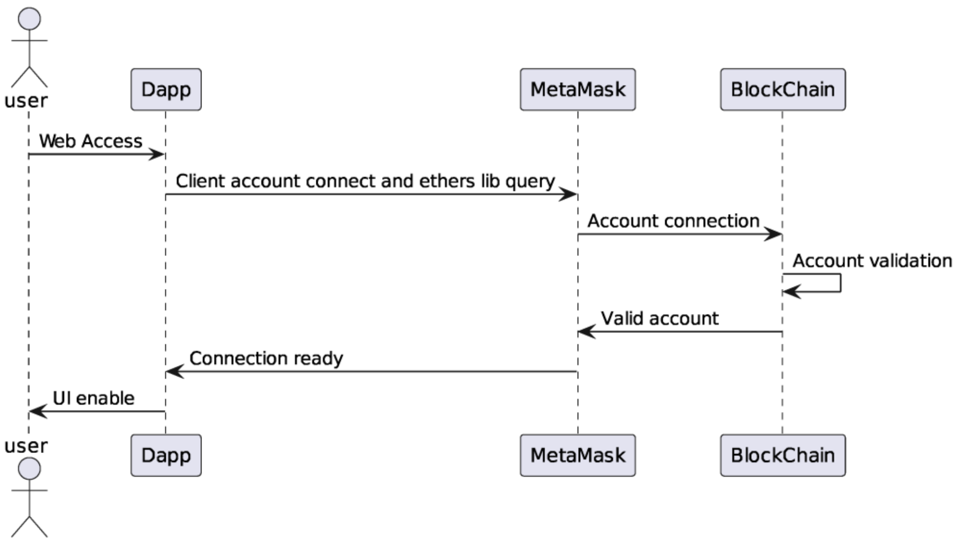


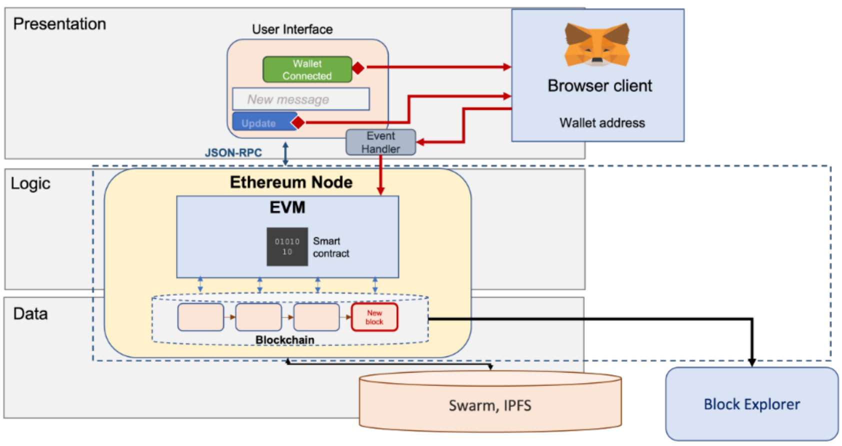
User stories:

User Type	User Story Number	User Story/Task
Climate-conscious individual	USN-1	track and visualize real-time environmental data (e.g., temperature, humidity, air quality) using a smart device to make informed decisions about their daily activities.
Farmer	USN-2	monitor soil moisture levels and weather conditions using a climate-tracking smart application, which will help farmer optimize irrigation and crop management.
Renewable energy enthusiast	USN-3	verify the source of the electricity I consume using blockchain technology, ensuring that it comes from sustainable sources.
City planner	USN-4	access historical climate data stored on a blockchain to make informed decisions about urban infrastructure and disaster preparedness.
Manufacturer	USN-5	trace the carbon footprint of manufacturer supply chain by recording and validating emissions data on a blockchain, which will help me reduce my environmental impact.
Environmental researcher	USN-6	access to a secure and tamper-proof database on the blockchain to store and share climate-related data for scientific analysis and policy development.

Government official	USN-7	ensure transparency and accountability in carbon trading by using blockchain to record and verify carbon credits and emissions reductions.
Homeowner	USN-8	offset my carbon emissions by investing in carbon credits through a climate-tracking smart app, which securely records and verifies my contributions on the blockchain.
Wildlife conservationist	USN-9	monitor and track the migration patterns of endangered species using blockchain and IoT (Internet of Things) devices for better protection and conservation efforts.
Climate change advocate	USN-10	share personal carbon footprint reduction achievements on social media platforms via a blockchain-based climate-tracking app.

5.2 Solution Architecture





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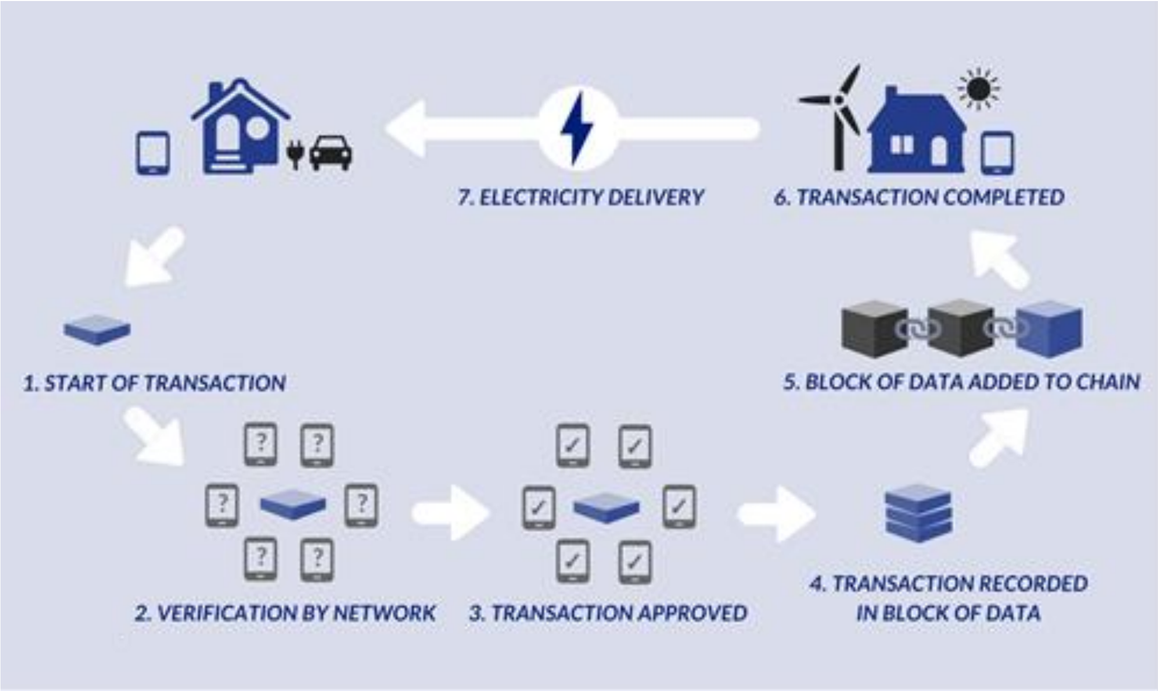
PROJECT PLANNING & SCHEDULING

6.1 Technical Architecture



Technical architecture of climate track using blockchain

Technical architecture:

Blockchain is the term that is used to describe distributed-ledger technology that uses smart contracts to share multi-party transactions with the member organizations of a business network.

The blockchain architecture is divided into three main components: the network layer, the consensus layer, and the application layer. The network layer is responsible for communication between nodes on the network. The consensus layer ensures that all nodes on the network agree on the state of the blockchain.

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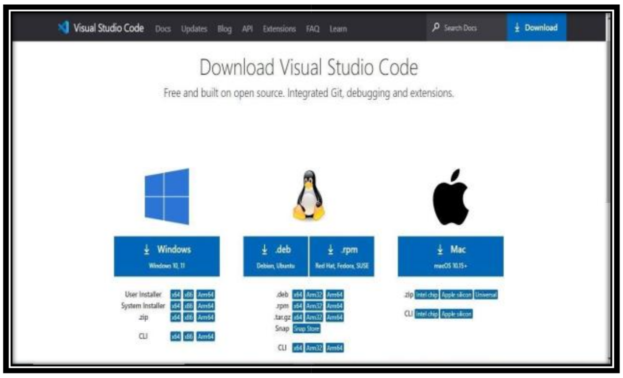
CODING & SOLUTIONING

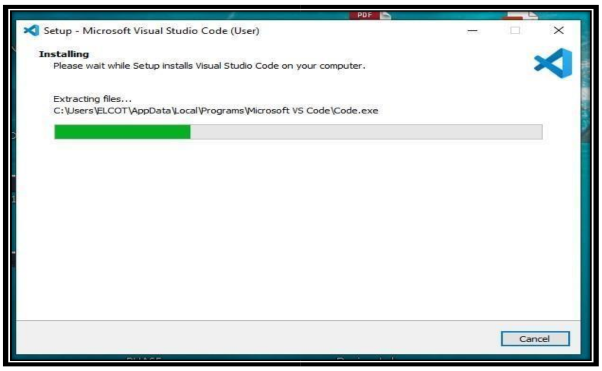
Climate track smart using blockchain coding

Step 1: Download VS Code

- To install the VS Code follow the steps below

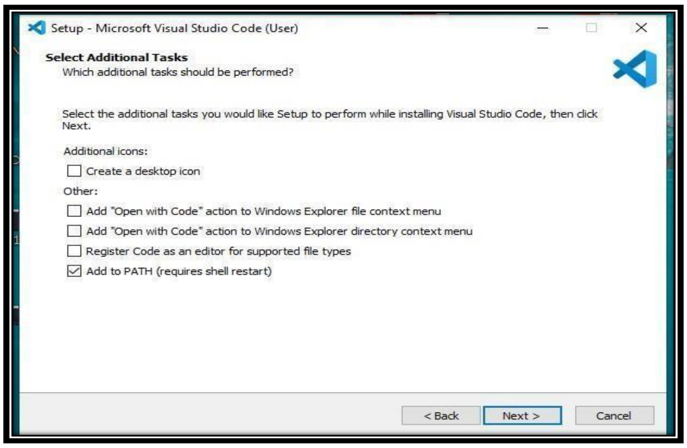


STEP 2: Download the Visual Studio Code installer for Windows

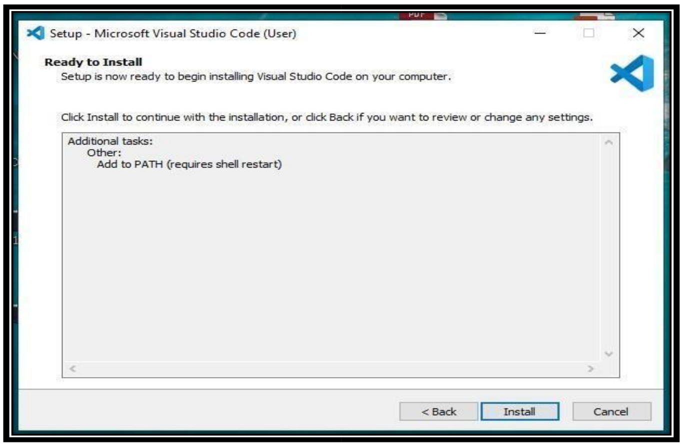


STEP 3: Once it is downloaded, run the installer (VSCodeUserSetup-{version}.exe). This will only take a minute.

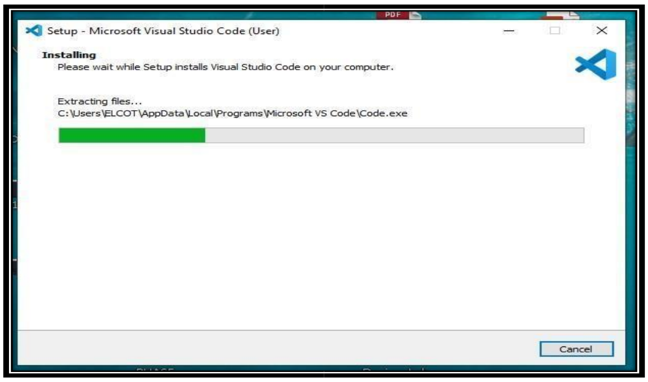
Step 4: click on Next



STEP 5: Click on install



STEP 6: Installing



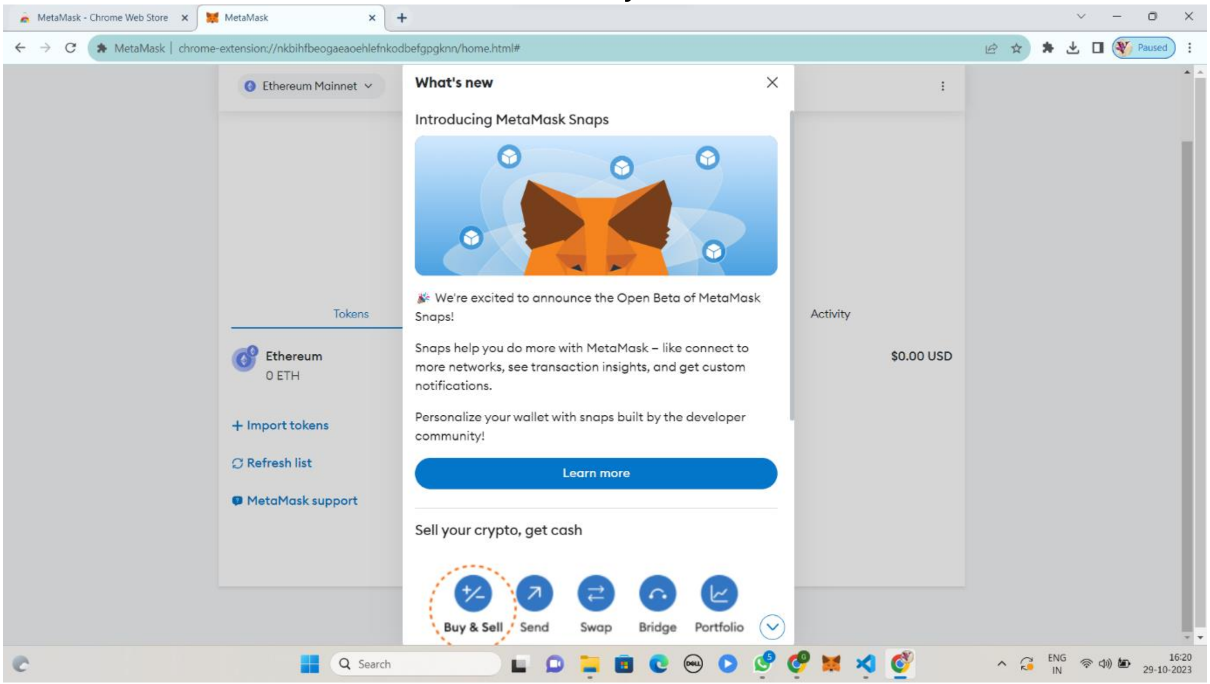
STEP 7: Click on finish

CHAPTER – 8
PERFORMANCE TESTING

Implementation Of Smart Contract

Step 1: Get the Smart Contract Address:

- Obtain the new smart contract address that you want to use.



Step 2: Locate the Connector.js File:

- Open your terminal or code editor.
- Navigate to the "Bank" project directory using the command cd path/to/Bank.

Step 3: Edit the Connector.js File:

- Use a text editor or code editor to open the Connector.js file. You mentioned the path as "Bank/src/utils/connector.js", so ensure you navigate to the correct path.

Step 4: Update the Contract Address:

- Inside the Connector.js file, you should see the old contract address. Replace it with the new contract address.

Step 5: Save the File:

- After making the change, save the Connector.js file.

Step 6: Interact with the Frontend:

- To interact with the frontend, you might need to run your application. Depending on your setup, you may use a development server or other tools.
- If it's a web application, you'd typically open it in a web browser and use the UI to perform the various functionalities related to the "Ban" project.

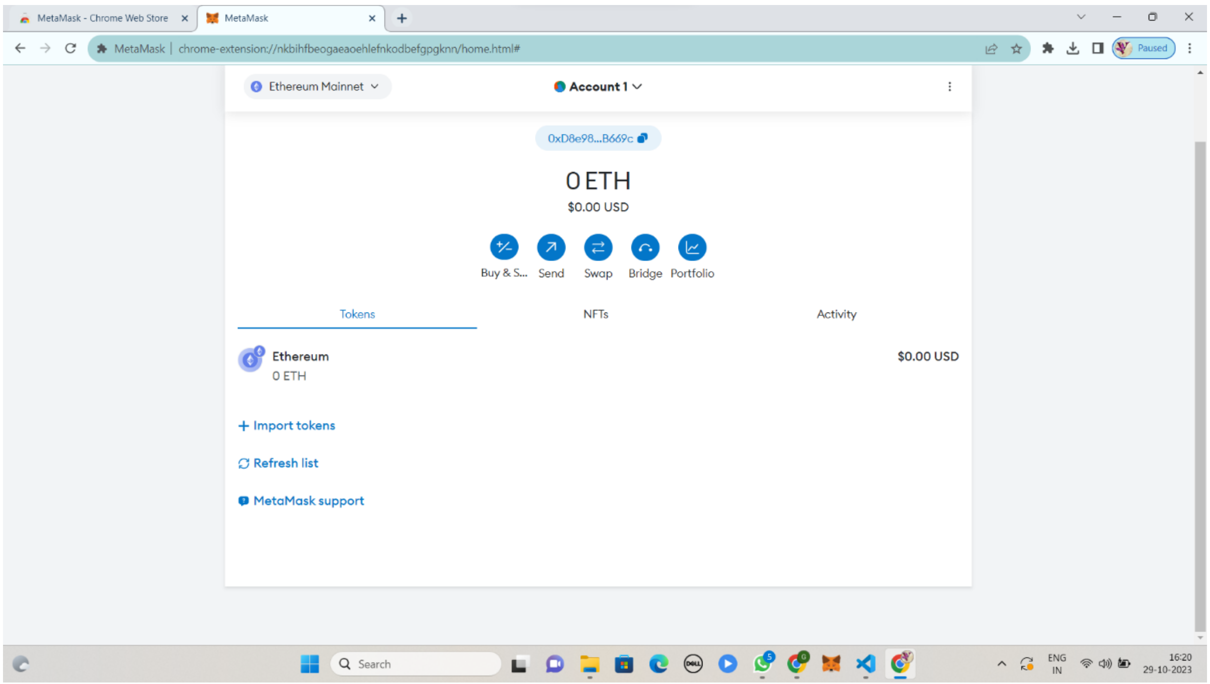
Solidity code index.html

```
<!DOCTYPE html>
<html lang="en">
  <head>
    <meta charset="utf-8" />
    <link rel="icon" href="%PUBLIC_URL%/favicon.ico" />
    <meta name="viewport" content="width=device-width, initial-scale=1" />
    <meta name="theme-color" content="#000000" />
    <meta
      name="description"
      content="Web site created using create-react-app"
    />
    <link rel="apple-touch-icon" href="%PUBLIC_URL%/logo192.png" />
https://developers.google.com/web/fundamentals/web-app-manifest/
    -->
    <link rel="manifest" href="%PUBLIC_URL%/manifest.json" />
    <!--
      Notice the use of %PUBLIC_URL% in the tags above.
      It will be replaced with the URL of the `public` folder during the build.
      Only files inside the `public` folder can be referenced from the HTML.

      Unlike "/favicon.ico" or "favicon.ico", "%PUBLIC_URL%/favicon.ico" will
      work correctly both with client-side routing and a non-root public URL.
      Learn how to configure a non-root public URL by running `npm run build`.
    -->
    <title>React App</title>
  </head>
  <body>
    <noscript>You need to enable JavaScript to run this app.</noscript>
    <div id="root"></div>
    <!--
      This HTML file is a template.
      If you open it directly in the browser, you will see an empty page.

      You can add webfonts, meta tags, or analytics to this file.
      The build step will place the bundled scripts into the <body> tag.

      To begin the development, run `npm start` or `yarn start`.
      To create a production bundle, use `npm run build` or `yarn build`.
    -->
  </body>
</html>
```

VS CODE

Extract and run code in Remix Ethereum IDE

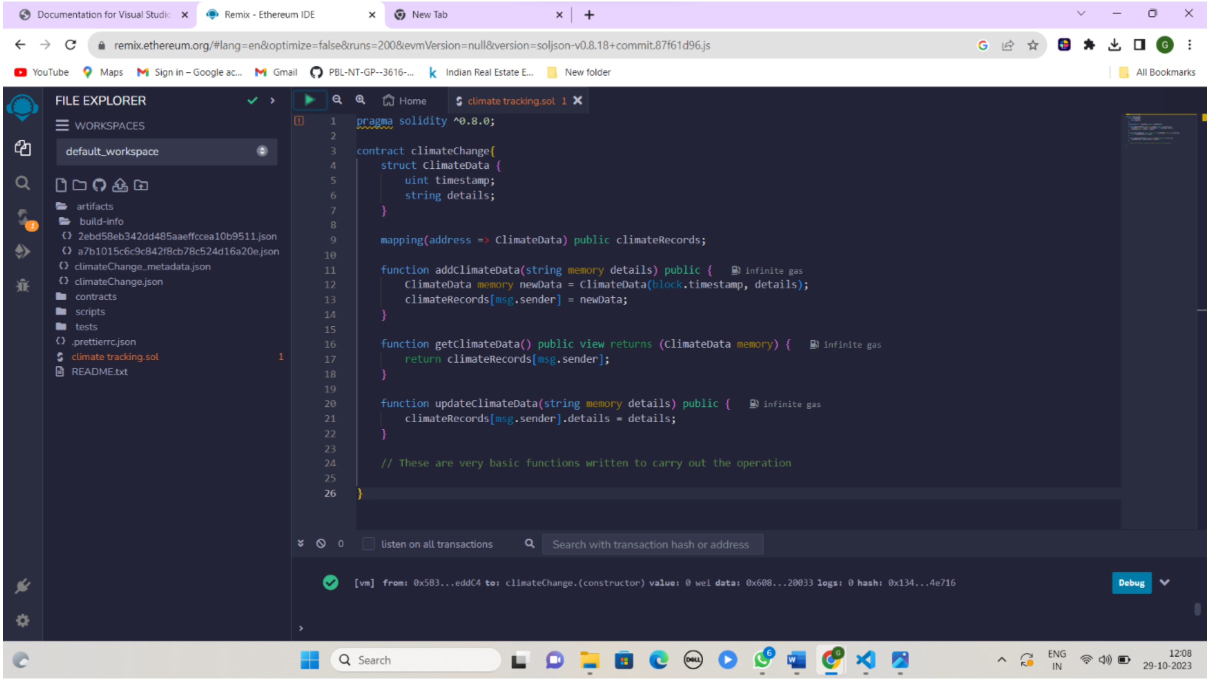
```
pragma solidity ^0.8.0;

contract climateChange{
    struct ClimateData {
        uint timestamp;
        string details;
    }

    mapping(address => ClimateData) public climateRecords;

    function addClimateData(string memory details) public {
        ClimateData memory newData = ClimateData(block.timestamp, details);
        climateRecords[msg.sender] = newData;
    }

    function getClimateData() public view returns (ClimateData memory) {
        return climateRecords[msg.sender];
    }

    function updateClimateData(string memory details) public {
        climateRecords[msg.sender].details = details;
    }
```

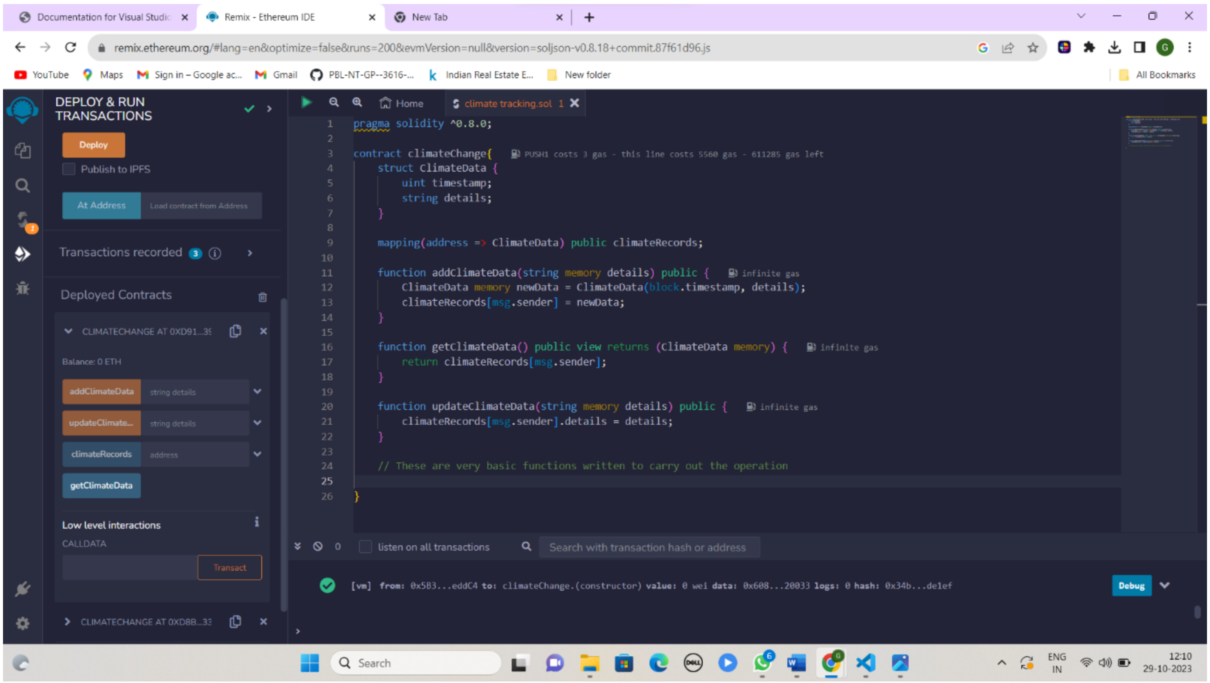


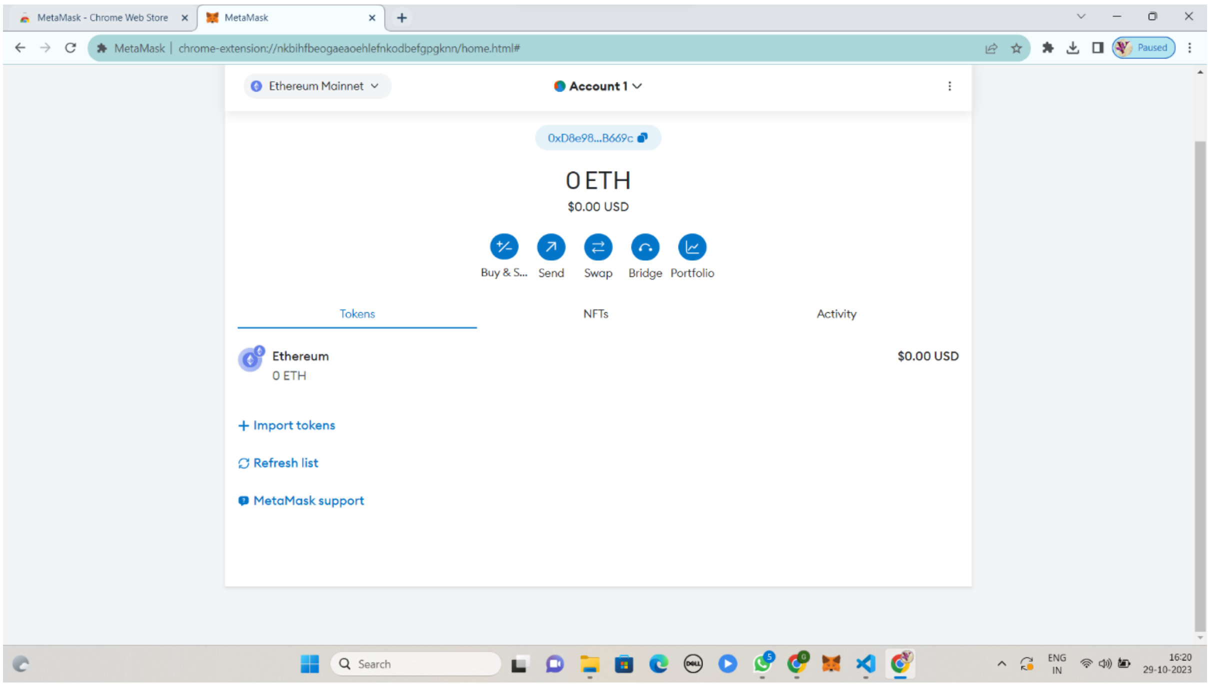
CHAPTER – 9

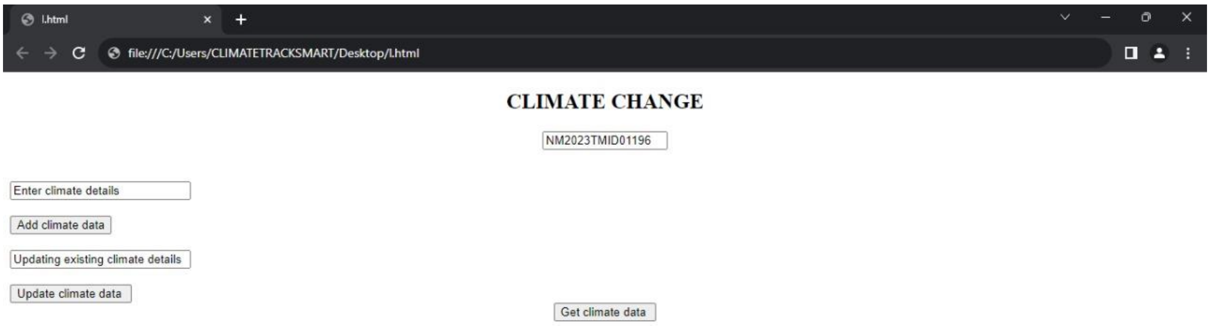
RESULTS

OUTPUT






MetaMask - Chrome Web Store
MetaMask
chrome-extension://nkbihfbeogaeaoehlefnkodbefgpgknn/home.html#
Ethereum Mainnet
Account 1
0xD8e98...B669c
0 ETH
$0.00 USD
Buy & S...
Send
Swap
Bridge
Portfolio
Tokens
NFTs
Activity
Ethereum
0 ETH
$0.00 USD
+ Import tokens
Refresh list
MetaMask support


l.html
file:///C:/Users/CLIMATETRACKSMART/Desktop/l.html
CLIMATE CHANGE
NM2023TMID01196
Enter climate details
Add climate data
Updating existing climate details
Update climate data
Get climate data

CHAPTER – 10

ADVANTAGES AND DISADVANTAGES

Advantages:

1. Transparency and Trust: Blockchain's decentralized and immutable nature ensures that climate data and transactions are transparent and tamper-proof. This can enhance trust among stakeholders.
2. Data Integrity: Data stored on the blockchain is highly secure and resistant to alteration, making it ideal for recording and verifying climate-related information.
3. Decentralization: It reduces the need for a central authority, giving more control to individuals and organizations when it comes to tracking and managing climate data.
4. Smart Contracts: Blockchain allows for the creation of smart contracts that can automate climate-related processes, such as carbon trading, ensuring accurate and efficient transactions.
5. Supply Chain Transparency: Blockchain can be used to track and verify the environmental impact of products throughout the supply chain, providing consumers with more information about the sustainability of products.
6. Incentives for Sustainability: Blockchain-based token systems can reward individuals and organizations for sustainable practices, creating incentives for reducing carbon emissions.
7. Data Sharing: Researchers, governments, and other stakeholders can securely share

climate data, fostering collaboration and better decision-making.

Disadvantages:

1. Energy Consumption: Some blockchain networks, like Bitcoin, require significant energy for mining and maintenance, contributing to their carbon footprint. This is counterproductive when the goal is reducing carbon emissions.
2. Scalability: Blockchain networks can struggle with scalability issues, which may hinder their ability to handle the massive amounts of data generated in climate tracking.
3. Complexity: Implementing and using blockchain technology can be complex and may require specialized knowledge, making it less accessible for some users.
4. Data Privacy: While blockchain offers security, it's not inherently private. Climate data recorded on a public blockchain may raise privacy concerns, especially when dealing with sensitive information.
5. Regulatory Challenges: The legal and regulatory framework for blockchain in the context of climate tracking is still evolving and can pose uncertainties and obstacles.
6. Initial Costs: Developing and maintaining a blockchain-based climate tracking system can be costly, particularly for smaller organizations or governments with limited resources.
7. Adoption Barriers: Getting all relevant stakeholders to adopt a blockchain-based system can be a challenge, as it requires consensus and changes in established practices.

CHAPTER – 11
CONCLUSION

The implementation of blockchain technology in climate tracksmart has the potential to revolutionize the way we address climate change and track carbon emissions. By providing a transparent and immutable ledger, blockchain ensures the accuracy and integrity of data, enabling better monitoring and verification of carbon reduction efforts.

With blockchain, climate tracksmart can create a decentralized system that allows for real-time tracking of emissions, making it easier to identify sources of pollution and take appropriate actions. This technology can also facilitate the trading of carbon credits, incentivizing companies and individuals to reduce their carbon footprint and contribute to global climate goals.

Furthermore, blockchain can enhance trust and collaboration among stakeholders, as it eliminates the need for intermediaries and ensures data security. This can foster greater cooperation between governments, businesses, and individuals, leading to more effective and coordinated climate action.

Climate TrackSmart, utilizing blockchain technology, offers immense potential for revolutionizing the way we monitor and address climate change. By ensuring data integrity, promoting transparency, and improving efficiency in climate initiatives, Climate TrackSmart can empower stakeholders to make informed decisions and take timely action towards a sustainable future. The use of blockchain in climate tracking brings numerous benefits, including increased trust among participants, accurate, and streamlined processes. It has the potential to enhance carbon offset verification, improve sustainable supply chains, and enable more effective climate-related interventions. However, the implementation of Climate TrackSmart using blockchain is not without its challenges.

CHAPTER – 12

FUTURE SCOPE

The future scope of Climate TrackSmart, powered by blockchain technology, holds significant potential in addressing the challenges of climate change and creating a sustainable future. Here are some aspects to consider:

1. Enhanced Data Accuracy and Transparency:

As blockchain technology continues to evolve, Climate TrackSmart can further improve data accuracy and transparency. Advanced data collection methods, such as Internet of Things (IoT) devices and satellite imaging, can be integrated into the platform, providing real-time and highly accurate environmental data. This will enable better analysis, prediction, and decision-making in climate-related initiatives.

2. Expansion of Applications:

While Climate TrackSmart currently focuses on carbon offset verification and sustainable supply chains, its future scope is vast. The integration of additional environmental metrics, such as air quality, water quality, and biodiversity, could provide a comprehensive and holistic approach to climate monitoring. This expansion would enable stakeholders to address multiple environmental concerns simultaneously, leading to more effective climate change mitigation strategies.

3. Global Collaboration and Standardization:

To fully harness the potential of Climate TrackSmart, global collaboration and standardization are essential. Establishing common protocols, data formats, and reporting frameworks can ensure interoperability and seamless integration across different regions and sectors.

5. Policy and Regulatory Support:

For Climate TrackSmart to reach its full potential, supportive policies and regulations are crucial. Governments need to encourage the adoption of blockchain technology and provide incentives for organizations to participate in climate-related initiatives. Additionally, regulatory frameworks should be established to ensure data privacy, security, and ethical use of blockchain technology

Github link: https://github.com/ngurupriya/NM2023TMID01196

Demo video link: **https://youtu.be/1NvopZBcr_M?si=Gj10-fWnIGcg8fE5**