CLIMATE TRACKSMART USING BLOCKCHAIN

PROJECT REPORT

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CONTENT

1.Introduction:

Blockchain is a distributed ledger technology that allows for secure, transparent, and tamper-proof transactions. It is a system of recording information in a way that makes it difficult or impossible to change, hack, or cheat the system.

Blockchain is made up of blocks, which are chained together using cryptography. Each block contains a timestamp, a list of transactions, and a cryptographic hash of the previous block. This makes it very difficult to alter any data in the blockchain without being detected.

Climate Track Mart (CTM) is a new platform that uses blockchain technology to track and manage climate action. It was developed by a team of experts in climate change, blockchain, and finance.

1.1.Project overview:

The objective of Climate Tracks Mart is to accelerate climate action by using blockchain technology to improve transparency, efficiency and accessibility in global carbon markets.

It is a platform that uses distributed ledger technology (DLT) to provide a transparent, efficient, and accessible marketplace for climate action. It helps users to track and manage their carbon footprint, purchase and sell carbon offsets, and invest in sustainable projects.

Climate Tracks Mart is designed to address the following challenges in the global carbon market:

- Transparency: The current carbon market is opaque and complex, making it difficult for buyers and sellers to trust each other. Climate Tracks Mart uses blockchain technology to provide a transparent and verifiable record of all transactions.
- Efficiency: The current carbon market is fragmented and inefficient, with many different registries and databases. Climate Tracks Mart provides a single platform for all climate action, making it easier for buyers and sellers to connect.
- Accessibility: The current carbon market is inaccessible to many people, due to high costs and complex regulations. Climate Tracks Mart aims to make climate action more accessible to everyone, by offering low-cost and easy-to-use tools.

1.2.Purpose:

The purpose of Climate Track Mart (CTM) is to accelerate climate action by usin blockchain technology improve transparency, efficiency, and accessibility in global carbon markets.

CTM is a platform that helps users to:

- Track and manage their carbon footprint
- Purchase and sell carbon offsets
- Invest in sustainable projects

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CTM is a platform that helps users to:

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- Purchase and sell carbon offsets
- Invest in sustainable projects

CTM uses blockchain technology to provide a transparent, efficient, and accessible marketplace for climate action.

Here are some of the specific ways that CTM can help to accelerate climate action:

- By making it easier for businesses to track and manage their carbon footprint, CTM can help them to reduce their emissions and invest in sustainable practices.
- By providing a transparent and efficient marketplace for carbon offsets, CTM can help to increase the supply of offsets and lower their price, making them more accessible to businesses and individuals.
- By making it easier to invest in sustainable projects, CTM can help to channel more capital into the development of renewable energy and other low-carbon technologies.

Overall, CTM is a powerful tool that can help to accelerate climate action and create a more sustainable future.

Here are some examples of how CTM is being used to accelerate climate action today:

- A large multinational corporation is using CTM to track and manage its carbon footprint across its global operations.

2.1.Existing problem:

- Lack of awareness: Many people are not yet aware of CTM or its potential benefits. This is a barrier to adoption and use of the platform.
- Regulatory uncertainty: The regulatory landscape for blockchain technology and carbon markets is still evolving. This can create uncertainty for businesses and individuals who are considering using CTM.
- Complexity: CTM is a complex platform with a wide range of features. This can be a barrier to adoption, especially for users who are not familiar with blockchain technology.

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2.2.Reference:

Climate Tracks Mart (CTM) is an open-source data platform that provides access to climate data and tools for scientists, policymakers, and businesses. CTM was developed by the World Resources Institute (WRI) and the University of Maryland, and it is supported by a consortium of partners including Google AI, Microsoft, and Amazon Web Services.

CTM provides access to a wide range of climate data, including:

- Historical and projected climate data from global and regional climate models
- Observations from ground-based stations, satellites, and other platforms
- Climate impacts data on human health, agriculture, water resources, and other sectors

CTM also provides a set of tools for analyzing and visualizing climate data, including:

- A graphical user interface for exploring and downloading data
- A programming interface for accessing and processing data
- A variety of pre-built visualizations for common climate data analysis tasks

CTM is a valuable resource for anyone who needs to access and analyze climate data. It is used by scientists to conduct research on climate change, by policymakers to develop climate adaptation and mitigation strategies, and by businesses to assess climate risks and opportunities.

Here are some examples of how CTM is being used today:

- The World Bank is using CTM to assess the climate risks to its investments in developing countries.
- The NASA Goddard Institute for Space Studies is using CTM to study the impacts of climate change on sea level rise.
- The National Oceanic and Atmospheric Administration (NOAA) is using CTM to develop new climate forecasting tools.
- The insurance industry is using CTM to assess climate risks to their portfolios.
- The agricultural sector is using CTM to develop climate-smart agricultural practices.

CTM is still under development, but it has already become a valuable tool for the climate community. As more data and tools are added to the platform, it will become even more useful for scientists, policymakers, and businesses.

2.3.Rroblem statement definition:

A problem statement definition for Climate Tracks Mart (CTM) should clearly articulate the challenges that CTM is designed to address. The problem statement should be specific, measurable, achievable, relevant, and time-bound.

Here is an example of a problem statement definition for CTM:

Climate Tracks Mart (CTM) is designed to address the challenge of making climate data more accessible and usable for scientists, policymakers, and businesses.

This problem statement is specific, measurable, achievable, relevant, and time-bound in the following ways:

- It is specific because it identifies the specific challenge that CTM is designed to address: making climate data more accessible and usable for scientists, policymakers, and businesses.
- It is measurable because it is possible to track the progress of CTM in addressing this challenge by measuring the number of users who access the platform, the amount of data that is downloaded, and the number of publications that cite CTM data.
- It is achievable because the WRI and its partners have the resources and expertise to develop and maintain CTM.
- It is relevant because climate data is essential for understanding and responding to climate change.
- It is time-bound because the WRI and its partners have committed to developing and maintaining CTM for at least the next five years.

The problem statement definition for CTM should be used to guide the development and implementation of the platform. By keeping the problem statement in mind, the WRI and its partners can ensure that CTM is meeting the needs of its users and making a real contribution to the fight against climate change.

3. Ideation& Proposed Solution

3.1 Empathy Map Canvas

Template

Brainstorm & idea prioritization

Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.

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

Before you collaborate

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

10 minutes

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 →

1 Define your problem statement

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

5 minutes

PROBLEM

Blockchain is a distributed ledger technology that allows multiple parties to access and verify data in a secure and transparent way

Key rules of brainstorming

To run an smooth and productive session

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

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 switch to start drawing!

Anusuya

Emma can use the blockchain-powered platform to transparently track her carbon emissions and assess her sustainability efforts.

The platform rewards her with tokens for reducing her carbon footprint. These tokens can be used to support eco-friendly projects or redeem discounts.

Ashika

increased public safety from improved lighting, safer traffic due to increased visibility of hazards.

Emma can access detailed data on her carbon footprint and receive recommendations on further improvements.

Divya

Climate TreckSmart enables Emma to educate her followers and inspire them to take climate action using the platform's tools and features.

She is well-versed in technology, especially blockchain and cryptocurrency, and understands their potential for tracking and incentivizing sustainable practices.

Manju

Emma believes in the power of data and metrics to drive change. She's keen on using data to understand and improve her eco-friendly practices.

She loves cycling, walking, and using public transport. Emma often participates in local clean-up events and volunteers at environmental organizations.

3 Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. Once all sticky notes have been grouped, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you and break it up into smaller sub-groups.

20 minutes

TIP
Add customizable tags to sticky notes to make it easier to find, browse, organize, and categorize important ideas as themes within your mural.

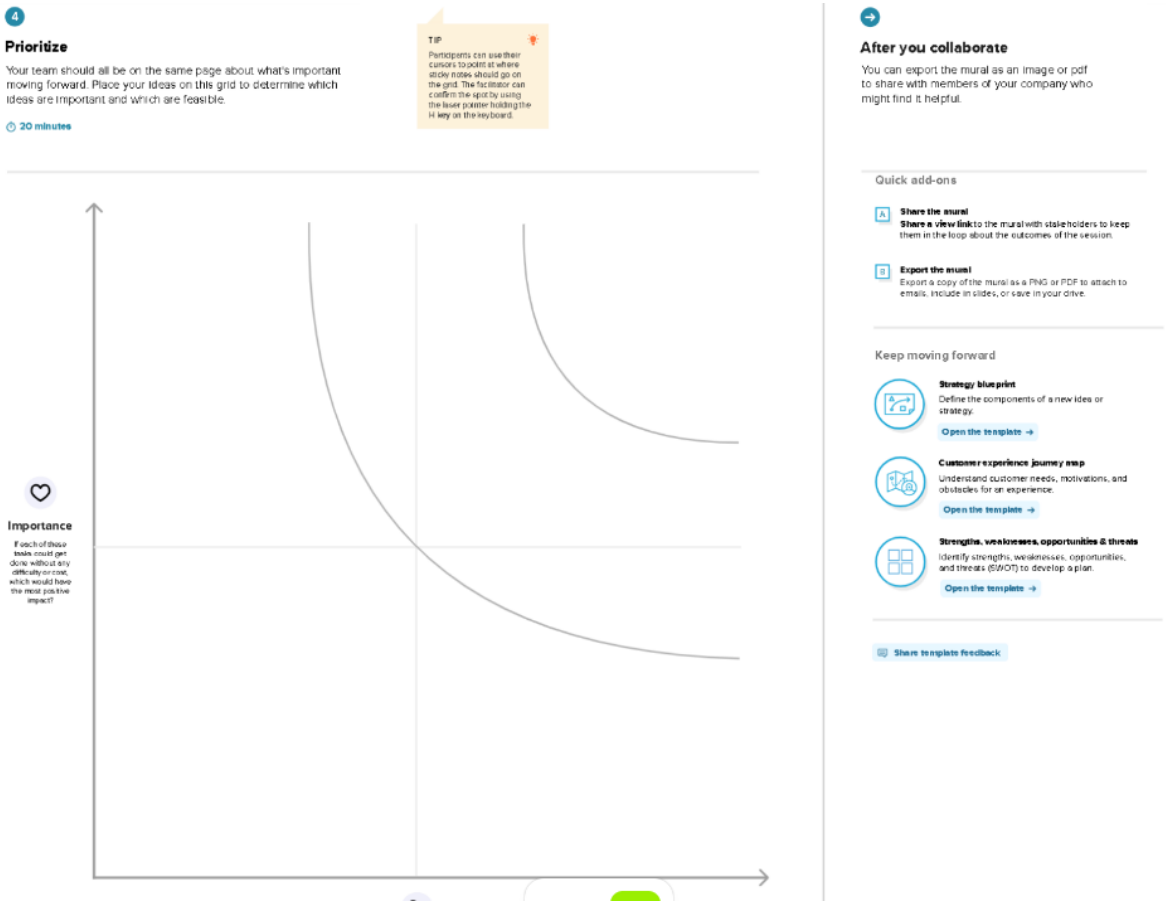
Utilize blockchain to securely and transparently record carbon emissions and eco-friendly actions. Implement smart contracts to automate tracking, verification, and reward distribution for climate-friendly behaviors.

Create a token-based rewards system to incentivize sustainable actions, where users earn tokens for eco-friendly behaviors.Build a marketplace where users can spend their earned tokens on eco-friendly products, services, or support for green initiatives.

Enable users to share their achievements and progress on social media, fostering a sense of community and encouraging others to join.Provide a space for users to discuss climate-related topics, share tips, and collaborate on local environmental initiatives.

Create user-friendly graphs and charts to help users understand and interpret their carbon data. Utilize artificial intelligence to suggest personalized actions for reducing one's carbon footprint based on their data.

ARS



4. Requirement Analysis

4.1 Functional Requirements

Improved carbon emission trading:

Blockchain could be used to improve the system of carbon asset transactions. For example, IBM and Energy Blockchain Lab are currently working together to develop a Blockchain platform for trading carbon assets in China. Recording carbon assets on a public Blockchain would also guarantee transparency and ensure that transactions are valid and settled automatically.

Facilitated clean energy trading:

The technology could also allow for the development of platforms for peer-to-peer renewable energy trade. Consumers would be able to buy, sell or exchange renewable energy with each

other, using tokens or tradable digital assets representing a certain quantity of energy production.

Enhanced climate finance flows:

Blockchain technology could help develop crowdfunding and peer-to-peer financial transactions in support of climate action, while ensuring that financing is allocated to projects in a transparent way.

4.2. Non-Functional Requirements

A constraint is a condition to make the requirements in line with quality expectations

It helps determine whether you have satisfied the non-functional requirements

NFR is always a constraint for other user stories

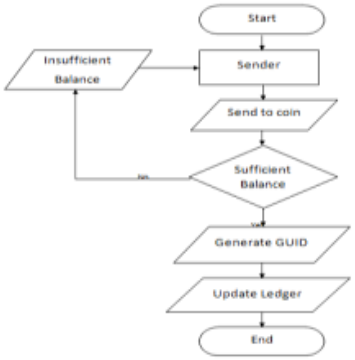
Any backlog item may be constrained by NFR

A constraint to be obeyed either during the implementation by the builders (internal quality) or at run time by the software (external quality)

5. Project Design

5.1. Data Flow Diagrams & User Stories

Blockchain data structure makes it hard or even impossible to remove or modify a block. When someone wants to change it, participants in the network who have a copy of the existing blockchain can evaluate and verify the proposed transaction. Therefore, transparency and accuracy in transactions are committed.



User Stories

1. As a climate researcher, I want to securely record and timestamp climate data on a blockchain so that the data remains immutable and tamper-proof for long-term analysis.

2. As a government agency, I want to access real-time climate data from various sources on Climate Track Smart to make informed policy decisions and respond to environmental crises effectively.
3. As a renewable energy company, I want to verify the origin and carbon footprint of energy sources using Climate Track Smart to provide transparent information to consumers.
4. As an environmental advocate, I want to track and share the progress of carbon reduction initiatives on Climate Track Smart to raise awareness and promote sustainable practices.
5. As a farmer, I want to log and access climate-related data on Climate Track Smart to make data-driven decisions about planting and harvesting times, ultimately improving crop yield.
6. As a consumer, I want to be able to trace the environmental impact of products I purchase through Climate Track Smart, helping me make more eco-conscious choices.
7. As a shipping company, I want to integrate Climate Track Smart into my supply chain management to monitor and reduce the carbon emissions associated with my logistics operations.

5.2. Solution Architecture

1. User Interface (UI):

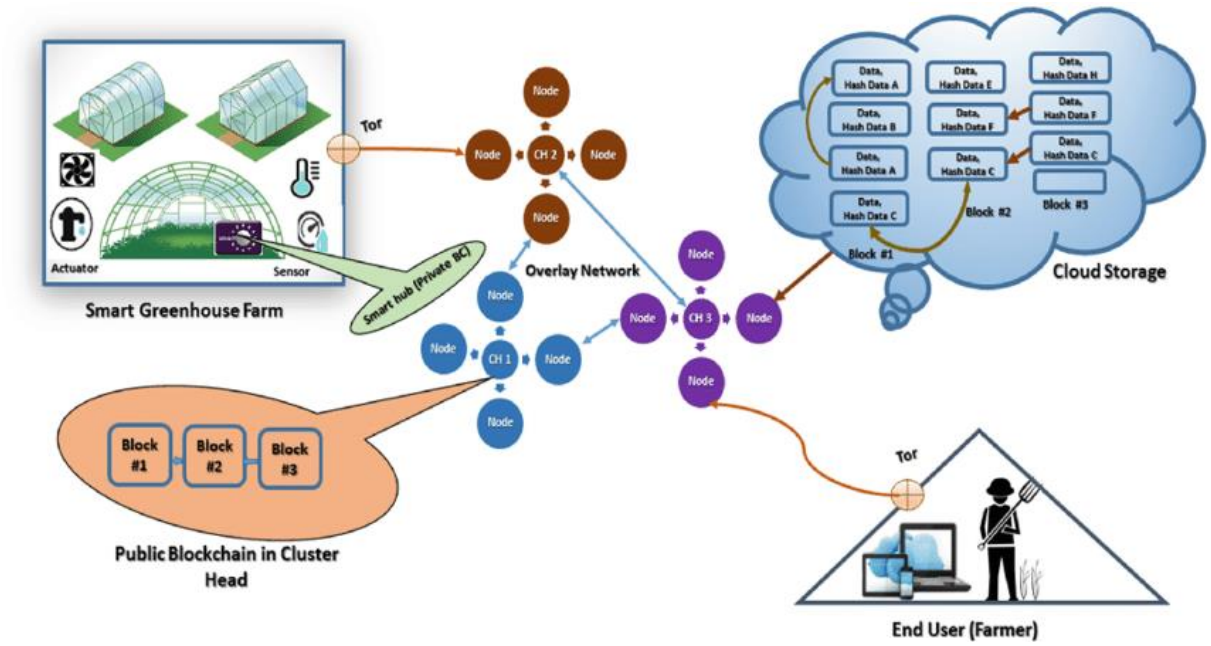
Web and mobile applications for users to access and interact with the system.

2. Frontend:

Frameworks like React, Angular, or Vue.js for building the user interface

3. Application Layer:

Handles user requests, authentication, and authorization. Orchestrates interactions between various components. May implement a microservices architecture for scalability.



APIs:

RESTful or Graph APIs to facilitate communication between the frontend and backend.

Authentication and authorization mechanisms to ensure data security.

Blockchain Integration:

Smart Contracts:

Implementing climate tracking logic using blockchain smart contracts (e.g., Ethereum, Biance Smart Chain, or a custom blockchain).

Interact with the blockchain to read and write climate data and transactions.

Business Logic:

Validate and process incoming climate data.

Implement data aggregation, indexing, and retrieval for efficient access.

Handle user notifications and events.

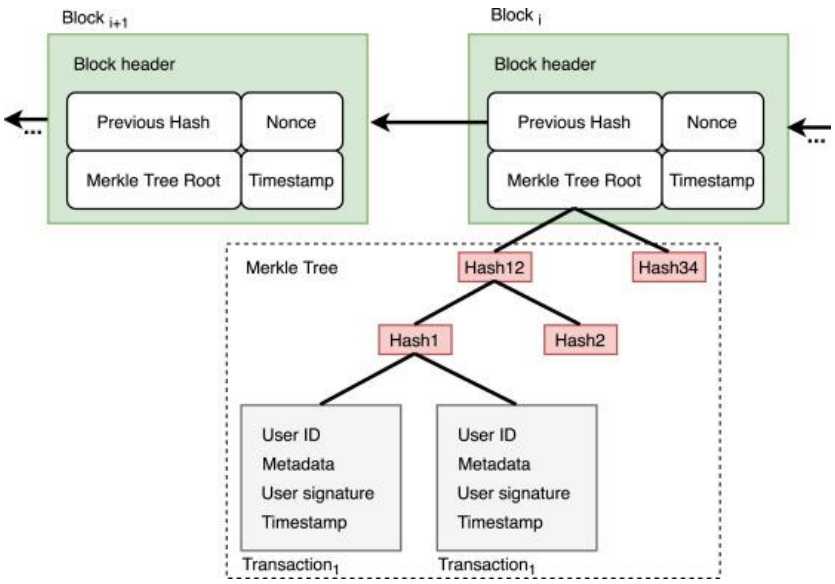
Data Storage:

Store metadata, transaction history, and off-chain data.

Use databases like PostgreSQL or NoSQL databases for this purpose.

Event Handling:

Implement event listeners to monitor changes on the blockchain and update the off-chain database accordingly.



4. Blockchain Layer:

Smart Contracts:

Deploy climate tracking smart contracts with functions to record, verify, and retrieve climate data.

Implement token omics for carbon credits if applicable.

Consensus Mechanism:

Choose a suitable consensus mechanism (e.g., Proof of Work, Proof of Stake, or Proof of Authority) based on the blockchain platform used.

Public or Private Blockchain: Decide whether Climate Track Smart will be built on a public blockchain (for transparency) or a private/consortium blockchain (for control and privacy).

5. Data Integration:

Climate Data Sources:

APIs and data feeds from weather stations, sensors, satellites, and environmental monitoring organizations.

Oracles for real-world data integration into the blockchain.

Data Validators:

Implement data validation and quality checks to ensure data accuracy before it's recorded on the blockchain.

6. Security: Implement robust security measures including encryption, access control, and blockchain security best practices.

Utilize private keys and digital signatures for user authentication and authorization.

7. Reporting and Analytics:

Provide tools for generating reports, visualizing climate data, and performing data analytics.

Use tools like Power BI, Tableau, or custom data visualization libraries.

8. DevOps and Infrastructure:

Continuous Integration/Continuous Deployment (CI/CD) pipeline for automated testing and deployment.

Cloud infrastructure or on-premises servers to host the solution.

9. External Integrations:

Integration with external services like payment gateways, geospatial services, and external databases if required.

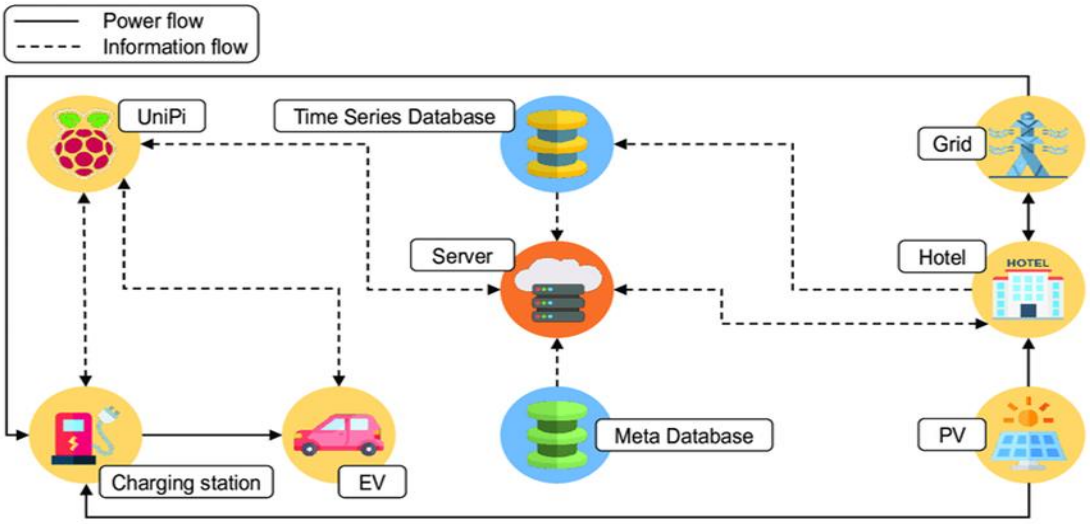
10. Compliance and Governance:

- Ensure adherence to legal and regulatory requirements related to climate data, data privacy, and block chain technology.

11. Monitoring and Logging:

- Implement monitoring tools to track system performance, detect anomalies, and maintain system health.

- Store logs for auditing and debugging.



12. Disaster Recovery and Backup:- Establish backup and disaster recovery procedures to ensure data and system availability in case of failures.

13. Scalability:

- Design the architecture with scalability in mind, allowing for the addition of more nodes, services, and features as the system grows.

14. Documentation:

- Maintain comprehensive documentation for developers, administrators, and users. This architecture is a general guideline for building Climate Track Smart on a block chain.

The specific block chain platform chosen, along with additional technologies, will depend on your project's requirements and constraints. It's essential to continually evaluate and adapt the architecture as the project evolves and new technologies emerge.

6. Project Planning &Scheduling

6.1. Technical Architecture

User Interface (UI): Web-based or mobile application for end-users to interact with the system. Dashboard for data visualization, analytics, and tracking.

Block chain Network: Use a permissioned block chain network for better control and scalability. Ethereum Hyper ledger Fabric, or other suitable block chain platforms.

Smart Contracts: Develop smart contracts to store climate-related data securely and transparently. Smart contracts can include functions to record emissions, environmental projects, and carbon credits.

Identity and Access Management:

Implement a robust authentication and authorization system for users and devices. Integrate with Single Sign-On (SSO) and Multi-Factor Authentication (MFA) for security.

Data Ingestion: Design APIs and data ingestion processes to accept data from various sources: IOT devices for real-time environmental data.

Manual data input by users or organizations. Data from government and environmental agencies.

Data Storage: Store all climate-related data on the block chain.

Use off-chain databases for larger datasets that might be impractical to store directly on the block chain.

6.2. Sprint Planning & Estimation

Sprint Planning: Hold a Sprint Planning meeting with your development team to decide which backlog items will be included in the upcoming sprint.

Select user stories or tasks that collectively form a coherent increment of functionality.

Ensure that the team understands the requirements for each selected item.

Estimate User Stories and Tasks:

Use story points or other estimation units (e.g., hours, t-shirt sizes) to estimate the effort required for each user story or task.

Consider complexity, dependencies, and risks when estimating.

Avoid overcommitting in a single sprint. Your team's capacity should guide how much work is planned.

5. Create a Sprint Backlog:

After estimating, add the selected user stories and tasks to the Sprint Backlog for the current sprint.

6. Define Sprint Goals: Establish clear sprint goals that define what you want to achieve by the end of the sprint. For example, by the end of the sprint, you may want to have a functional user registration system in place.

7. Daily Stand-Up Meetings:

Conduct daily stand-up meetings during the sprint to ensure team members are on track, discuss progress, and identify any obstacles.

8. Adjust as Necessary: Be flexible and willing to adjust the Sprint Backlog if unexpected issues or changes in priorities arise. This flexibility is a key principle of agile methodologies.

6.3. Sprint Delivery Schedule

Objective: Set up the foundational components of the project.

Tasks:

Create the project plan and timeline. Define roles and responsibilities. Set up the development environment. Establish the version control system. Define the initial architecture.

Sprint 2: Block chain Infrastructure

Objective: Set up the block chain infrastructure.

Tasks: Select and set up the block chain platform (e.g., Ethereum or Hyper ledger Fabric). Define the consensus mechanism (e.g., Proof of Work or Proof of Stake).Configure the initial network. Create the genesis block. Develop and deploy initial smart contracts for data storage.

Sprint 3: User Authentication and Onboarding

Objective: Implement user authentication and onboarding features.

Tasks:

Develop user registration and login functionality. Implement user profile management. Integrate authentication with the blockchain network. Conduct security testing and validation.

Sprint 4: Data Ingestion

Objective: Develop data ingestion and recording mechanisms.

Tasks: Create APIs for data ingestion. Integrate with IoT devices for real-time data collection. Implement manual data input features. Set up data validation and verification processes. Conduct performance testing.

Sprint 5: Data Visualization

Objective: Design and implement data visualization features.

Tasks: Develop a dashboard for users to visualize climate data. Create data visualization components. Implement real-time data updates. Ensure responsive design for mobile and web.

Sprint 6: Reporting and Analytics

Objective: Implement reporting and analytics functionality.

Tasks: Develop reporting features for emissions data and environmental impact.

Implement data analysis tools. Set up reporting templates. Conduct user testing and refinement.

Sprint 7: Interoperability and Oracles

Objective: Ensure interoperability with external data sources.

Tasks: Implement oracles for external data integration. Test and verify data accuracy and integrity. Integrate with relevant environmental agencies for data sharing.

Sprint 8: Tokenization

Objective: Implement tokenization of carbon credits or other assets (if applicable).

Tasks: Develop token creation and management functionality. Integrate token transfers and transactions. Implement token validation and auditing features.

Sprint 9: Final Testing and Optimization

Objective: Conduct final testing, optimization, and refinement.

Tasks: Comprehensive testing, including security, performance, and user acceptance testing. Optimize for scalability and resource efficiency. Refine the user interface and user experience.

Sprint 10: Documentation and Training

Objective: Create documentation and training materials.

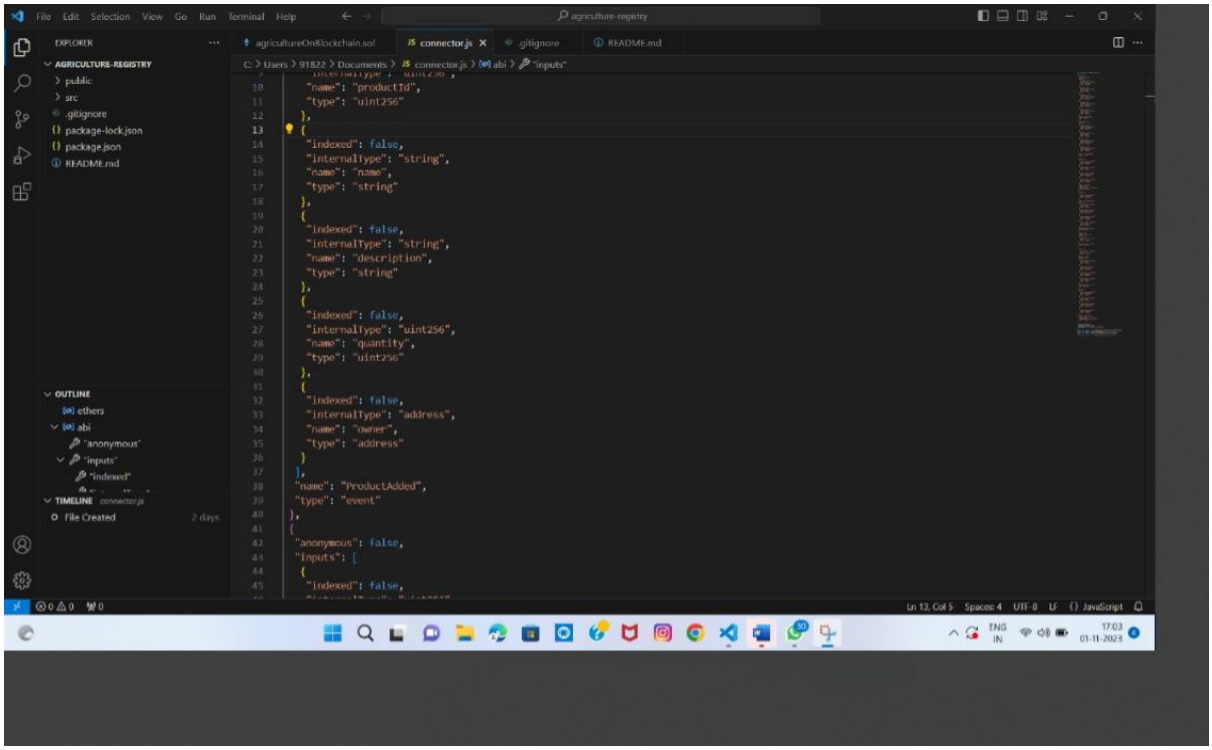
Tasks: Develop user guides and documentation for the system. Prepare training materials and resources for users and administrators.

Sprint 11: Project Closure and Deployment

Objective: Complete the project and prepare for deployment.

Tasks: Conduct a final code review and security audit. Prepare for deployment to a production environment. Plan and execute the project closure activities. This is a high-level sprint delivery schedule for "Climate Track Smart." The sprint durations and specific tasks may vary based on your team's capabilities and the project's requirements. Regular retrospectives and adjustments to the schedule will help you adapt to any unforeseen challenges and ensure the successful delivery of your block chain-based climate tracking system.

7. Coding & Solution:



8. Performance Testing

1. Define Performance Metrics:

   Identify the specific performance metrics to measure, such as transactions per second (TPS), response time, throughput, and resource utilization.
2. Environment Setup:

   Create a test environment that mirrors the production environment as closely as possible. Ensure block chain nodes, smart contracts, and supporting infrastructure are properly configured.
3. Workload Modeling:

   Define the workload scenarios that represent expected usage patterns. This includes the number of concurrent users, types of transactions, and data volume.
4. Performance Test Types:

   The appropriate types of performance tests, such as load testing (measuring system behaviour under expected load), stress testing (pushing the system to its limits), and scalability testing (determining how well the system scales).
5. Data Preparation:

   Populate the block chain with realistic data to simulate real-world scenarios. Ensure the data used is consistent with climate tracking needs.
6. Test Execution:

   Run performance tests using the defined workloads and scenarios. This involves executing block chain transactions, interacting with smart contracts, and monitoring system behavior.
7. Performance Monitoring:

Continuously monitor the system's performance during the test. Monitor key performance indicators (KPIs) in real-time and record data for analysis.

8. Analysis and Tuning:

   Analyze the collected data to identify bottlenecks, performance issues, and areas of improvement. This may involve adjusting
   system parameters, optimizing smart contracts, or scaling resources.

9. Resource Utilization:

   Monitor resource utilization, including CPU, memory, and network, to ensure the system is using resources efficiently.

10. Scalability Testing:

    Evaluate how the system scales by gradually increasing the load and measuring performance at various levels of load. Determine whether additional nodes or resources are needed for increased capacity.

11. Transaction Validation:

Ensure the integrity of transactions and data stored on the blockchain during testing. Verify that data remains consistent and accurate under various workloads.

12. Failover and Recovery:

Test the system's ability to recover from failures, including node failures or network disruptions. Ensure that data remains secure and intact.

13. Security Testing:

Include security testing to assess the system's resilience to potential attacks or vulnerabilities that might impact performance.

14. Benchmarking:

Compare the system's performance against industry benchmarks and standards to assess how it stacks up in terms of efficiency and scalability.

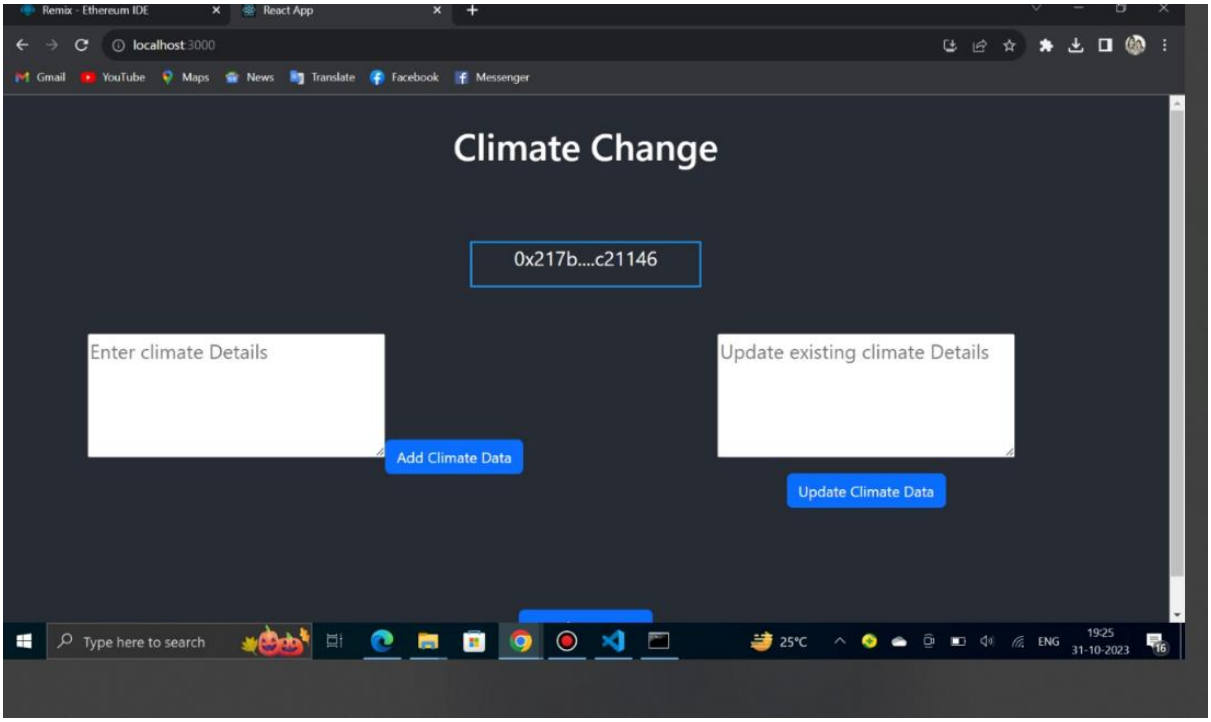
15. Reporting and Documentation:

Generate comprehensive reports summarizing the test results, including any performance bottlenecks, recommended optimizations, and resource scaling requirements.

16. Iterative Testing:

Continue to perform performance testing iteratively, especially as the system evolves or when major changes are introduced.

9. RESULT:



10.ADVANTAGES & DISADVANTAGES

Advantages

- Transparency and immutability: Blockchain is a distributed ledger technology, which means that all data is stored on multiple computers and cannot be easily tampered with. This makes CTS highly transparent and immutable, ensuring that carbon emissions data is accurate and reliable.
- Efficiency and automation: CTS automates many of the manual processes involved in carbon tracking, such as data collection, verification, and reporting. This can save organizations time and money, and reduce the risk of errors.
- Security and privacy: CTS uses advanced cryptographic techniques to protect data from unauthorized access and manipulation. This ensures that carbon emissions data is secure and private.

Disadvantages

- Energy consumption: Blockchain technology is known to be energy-intensive, which can be a concern for organizations that are looking to reduce their carbon footprint.
- Scalability: Blockchain networks can be slow and expensive to use, which could limit their scalability for large-scale climate tracking applications.
- Complexity: Blockchain technology can be complex and difficult to understand, which could make it challenging for some organizations to implement and use CTS.

11.CONCLUSION

Climate Track Smart (CTS) is a blockchain-based platform that helps organizations track and manage their carbon emissions. It offers a number of advantages over traditional carbon tracking systems, including transparency, immutability, efficiency, automation, security, and privacy. Additionally, CTS can help organizations to improve their carbon tracking and reporting, enhance carbon trading, and increase transparency and accountability in climate change mitigation efforts.

While there are a few disadvantages to using blockchain for climate tracking, such as energy consumption, scalability, and complexity, these challenges can be addressed through a variety of measures, such as using renewable energy sources, off-chain processing, sharding, user-friendly interfaces, documentation, standardization, regulatory engagement, and education and outreach programs.

12.FUTURE SCOPE

- Improved carbon accounting: CTS can help organizations to improve the accuracy and reliability of their carbon accounting. This is because CTS uses blockchain technology to create a tamper-proof record of emissions data. This data can then be used to identify areas where organizations can reduce their emissions and to report their emissions to stakeholders in a transparent manner.
- Enhanced carbon trading: CTS can facilitate carbon trading between organizations. This can help to reduce the cost of emissions reductions and accelerate the transition to a low-carbon economy. CTS can also be used to develop new carbon trading markets, such as markets for negative emissions credits.
- Increased transparency and accountability: CTS can help to increase transparency and accountability in climate change mitigation efforts. By making emissions data more accessible and verifiable, CTS can help to ensure that all stakeholders are held accountable for their emissions. This can help to build trust and cooperation between stakeholders, which is essential for effective climate action.

13.APPENDIX:

GIT HUB LINK:

https://github.com/ashikana03/Climate-tracksmart-using-blockchain