NAAN MUDHALVAN – GUIDED PROJECT

DOCUMENTATION

Project Title : ClimateTracksmart using Blockchain
Semester : 07
College Name : Alagappa College of Technology, Anna University

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INTRODUCTION:

BLOCKCHAIN:

Blockchain is like a digital ledger that records transactions across multiple computers in a secure and transparent way. It's the tech behind cryptocurrencies, but its applications go beyond that to areas like smart contracts and decentralized apps.

1.1 Project Overview:

ClimateTrackSmart leverages blockchain technology to revolutionize climate data tracking and verification. This innovative solution enhances transparency and security while addressing pressing environmental challenges, making it a pivotal tool in the battle against climate change.

1.2 Purpose:

The project is to harness the transformative potential of blockchain technology to address pressing climate-related challenges. Climate change poses a severe threat to our planet, and effective tracking, verification, and management of climate data are critical components of mitigating its impact. Blockchain, with its decentralized, transparent, and immutable ledger, offers a novel approach to improve the accuracy and reliability of climate data. The project aims to create a robust, tamper-proof system that records and verifies climate-related information, such as carbon emissions, renewable energy generation, and sustainability initiatives. The objectives are to be mentioned as Enhanced Transparency, security and trust, Efficient verification,innutable records and Icentivizing Climate action.

LITERATURE SURVEY:

2.1 Existing Problems:

The current climate tracking system faces several significant problems that hinder effective monitoring and management of climate-related data. These problems include:

- **Data Inaccuracy**: Climate data is often plagued by inaccuracies due to manual data entry errors, outdated measurement equipment, or inadequate quality control processes. This compromises the reliability of climate-related information.
- **Limited Transparency:** Many existing systems lack transparency, making it difficult for stakeholders to understand how climate data is collected, validated, and shared. This lack of transparency can erode trust in the data and its sources
- **Delayed Reporting:** Climate data reporting can be slow and inconsistent, with long intervals between data collection and publication. This delay can impede timely decision-making and climate policy adjustments.
- **Data Security Risks:** The security of climate data is at risk from cyberattacks, data breaches, and unauthorized alterations. Ensuring the integrity and security of sensitive climate information is paramount.
- **Limited Accessibility**: Climate data is not always readily accessible to the public or research communities, limiting the potential for collaborative efforts to combat climate change.

2.2 Reference:

The Table below lists the references that we used for the deep understanding of the Climatetracksmart project:

S.No	Title/Literature	Author
1	Global Tracking of Climate Change Adaptation Policy Using Machine Learning: a Systematic Map Protocol	Anne sietsma, Max Callaghan, Emily Theokritoff
2	The Applicability of Big Data in Climate Change Research: The Importance of System of Systems Thinking	Victor Sebestyen, Janos Abonyi, Timea czvetko
3	Systematic review approaches for climate change adaptation research	Lea Berrang Ford

2.3 Problem Statement:

In the face of escalating global climate challenges, the existing climate tracking and data management systems are plagued by issues of inaccuracy, inefficiency, and a lack of transparency. Climate data is often vulnerable to manipulation, plagued by fragmentation, and struggles to provide reliable incentives for climate-conscious actions. This poses significant obstacles to informed decision-making, accountability, and global efforts to combat climate change. This blockchain-based system seeks to enhance the accuracy and security of climate data, foster transparency and efficiency in tracking and verifying environmental metrics, and provide compelling incentives for individuals and organizations to engage in sustainable practices. By doing so, it strives to revolutionize the way we manage and utilize climate-related information, ultimately contributing to a more resilient and sustainable future for our planet. This problem statement encapsulates the core challenges that "ClimateTrackSmart" intends to address and emphasizes the urgency of finding innovative solutions to transform climate tracking for the better.

2.4 Solutions for Problem statement:

There are some key solution statements for implementing climate tracking using blockchain technology:

- Transparent Carbon Accounting: Blockchain enables transparent and immutable tracking of carbon emissions, allowing organizations to accurately measure and report their carbon footprint. Smart contracts can automate emissions calculations, verification, and reporting, ensuring data accuracy.

- Decentralized Carbon Credits: Blockchain can support the creation and trade of carbon credits in a decentralized manner. This allows for a more efficient and globally accessible market for carbon offset projects, fostering environmental sustainability.

- Supply Chain Sustainability: Implementing blockchain in supply chains enables the tracking of the environmental impact of products and materials. Companies can trace the origin, production, and transportation of goods, promoting eco-friendly practices and consumer choices.

- Renewable Energy Certificates: Blockchain can facilitate the issuance and trading of renewable energy certificates (RECs) to encourage the use of clean energy sources. These certificates can be easily verified and transferred, incentivizing the adoption of renewable energy.

- Climate Finance and Investment: Blockchain-based platforms can connect investors with sustainable projects and carbon offset initiatives. Smart contracts can automate the release

of funds upon meeting predefined environmental goals, ensuring accountability and transparency.

- Immutable Climate Data: Climate-related data, such as temperature records, sea levels, and weather patterns, can be securely stored on a blockchain. This prevents data manipulation and provides reliable historical climate information for research and policymaking.

- Peer-to-Peer Energy Trading: Blockchain enables the creation of microgrids and peer-to-peer energy trading systems. Individuals and businesses can buy and sell excess renewable energy, fostering a more sustainable and resilient energy ecosystem.

- Climate Tokens: Introduce climate tokens that represent environmental assets, such as carbon offsets or clean energy production. These tokens can be traded on blockchain-based platforms, creating new opportunities for climate-conscious investments.

- Environmental Impact Certification: Blockchain can facilitate the certification of environmentally friendly products and services, helping consumers make informed choices and driving market demand for sustainable options.

- Global Collaboration: Blockchain's distributed nature fosters international collaboration in addressing climate change. Countries, organizations, and individuals can transparently work together to achieve global climate goals.

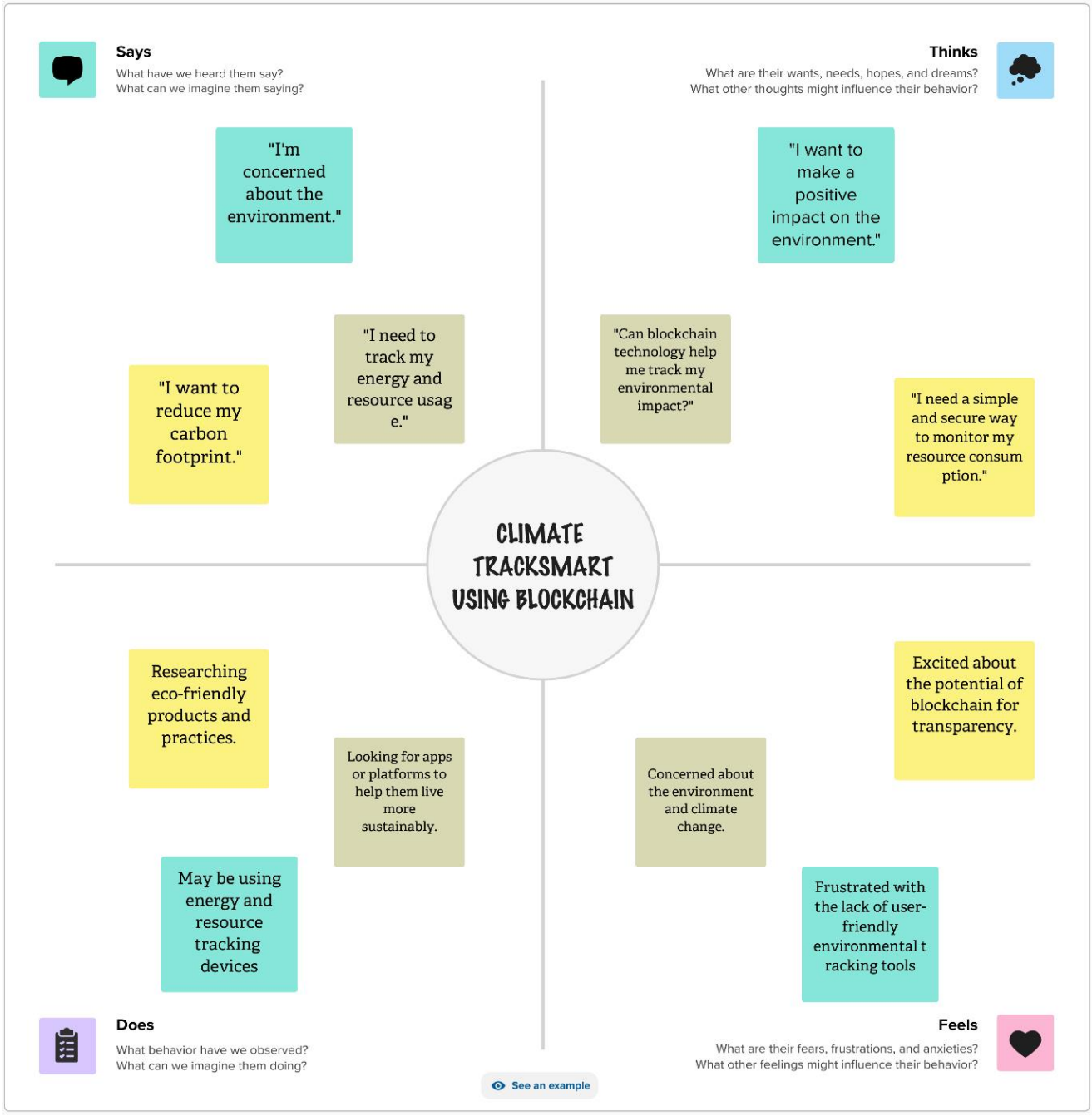
- Data Accessibility: Climate data stored on the blockchain can be made accessible to researchers, policymakers, and the public, promoting data-driven decision-making and climate action.

- Climate Crowdsourcing: Blockchain can enable a crowdsourcing approach to climate solutions, where individuals and organizations can propose and fund climate initiatives in a transparent and decentralized manner.

- Smart Grid Management: Implement blockchain in the management of smart grids to optimize energy distribution, reduce energy waste, and promote the integration of renewable energy sources.

IDEATION & PROPOSED SOLUTION:

3.1 Empathy Map Canvas:



3.2 Ideation & Brainstorming:

Brainstorming Ideas

Goals:

Developing the system for climate tracking using blockchain for the acquiring the details of the climate change as the humidity, temperature and wind changes at any instance.

Areas to be Focused(output):

1) Environmental Monitering
2) Government and regulatory compilance
3) Research and academic research
4) Global Climae Aggrements

Team members and ideas:

Thirupathi K	**Testing and Data validation:** 1. Conduct thorough testing and validation of your blockchain system to identify and resolve any issues 2. Perform thorough testing and validation to identify and rectify any issues or errors.
Thulasivasan V	**Documentation and Reporting:** 1. Create comprehensive project documentation, including technical reports, user manuals, and implementation guides.
Trisanth R	**Data Input Mechanism:** 1. Determine how data will be recorded on the blockchain.This could through IoT sensors, barcode scanning, manual entry. 2. Fine-tune the performance of your blockchain system to ensure it can handle the expected workload.
Vidhya V	**Feed intergration and Sustainability:** 1. Explore the environmental impact of the blockchain system and aim for sustainable practices. 2. Collect feedback from users, testers, and stakeholders and incorporate valuable suggestions for improvement.

4

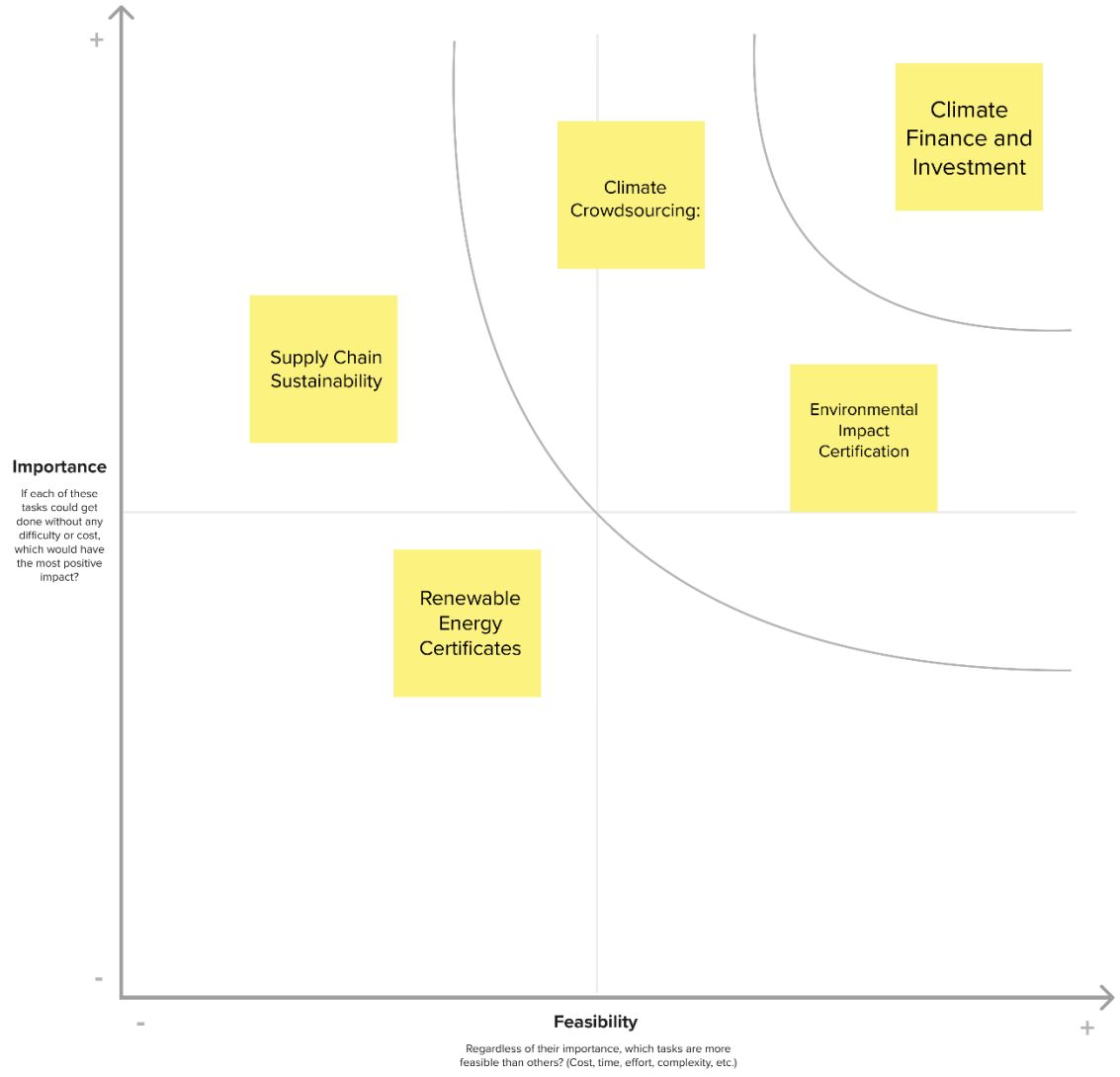
Prioritize

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

20 minutes

TIP

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



-Priorotization Map-

REQUIREMENT ANALYSIS:

4.1 Functional requirements:

The functional requirements of this project are Visual Studio Code, one remix id platform (node.js connector), file explorer, meta mask chrome extension and a source code file.

Drive link of the source code: https://drive.google.com/file/d/1hB6oxPOqcUF-3YoOnb3UN8BS5J8BJqZP/view?usp=sharing

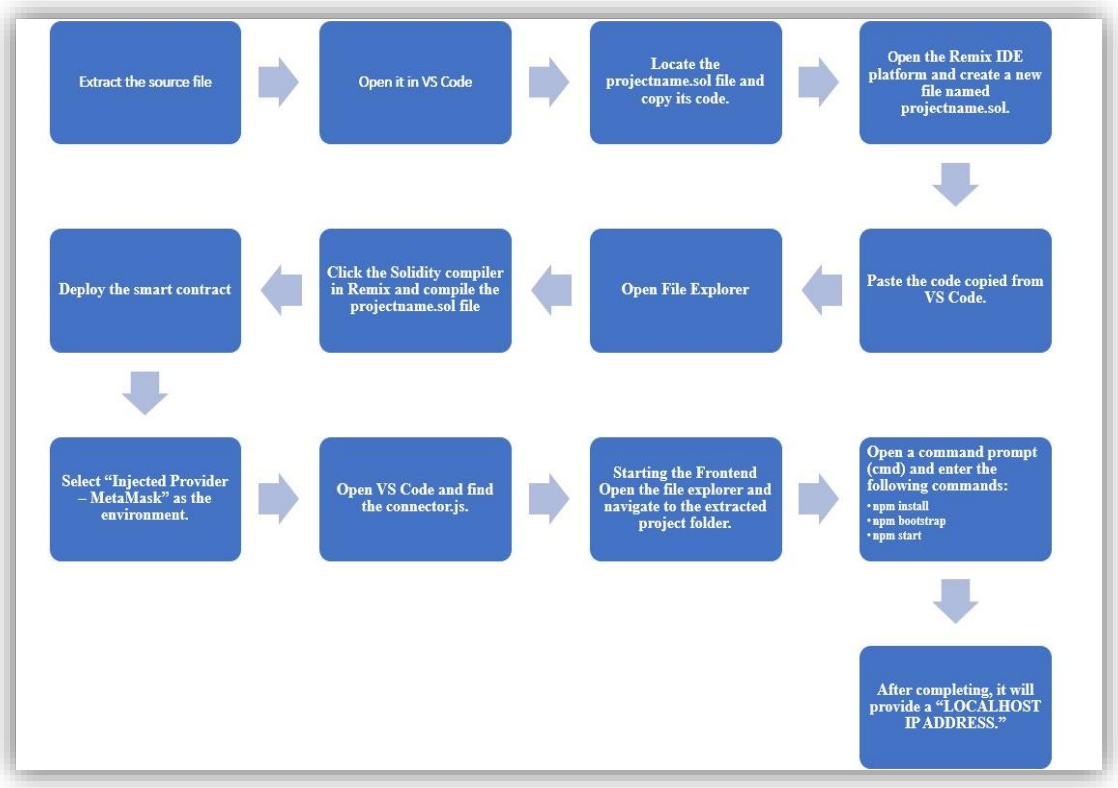
4.2 Non-Functional requirements:

The project should have an intuitive and user-friendly interface to ensure ease of use. It should be highly available and reliable, with minimal downtime for maintenance or updates. It should be scalable to handle increased data and user loads over time.

PROJECT DESIGN:

5.1 Data Flow Diagram & User Stories

5.1.1 Data Flow Diagram



-Source Data flow diagram-

Some key characteristic of blockchain technologies are listed as follows:

● Increased capacity: Blockchain technology can increase the capacity of an entire network. One such example is the supercomputer created by Stanford University usedfor medical research.

● Better security: Blockchain technology offers better security as it provides for a network of numerous computer nodes that can be used for networking transactions .

● Immutability: Blockchain uses immutable ledgers, and all databases require trust of a third party to keep them secure from hackers. Blockchain applications, such as Bitcoin, maintain the ledger in a never-ending state of forward momentum.

● Faster settlement: Blockchain technology relies on faster speeds and saves time for institutions and consumers. One example from banking is that blockchain makes money transfer fast and convenient.

● Decentralized System: Blockchain technology offers a decentralized system that stores the assets in a network and can be accessed via the internet. The asset may be a contract or document of importance. The manager of blockchain technology has control over the accounts of individuals and can transfer anything to anyone. This technology is proving to be an effective tool for decentralizing the web.

● Minting: Blockchain technology involves minting a problem in several ways. Proof of work is one approach guaranteeing an individual is engaged in a significant amount of computation work

5.1.2 User Stories:

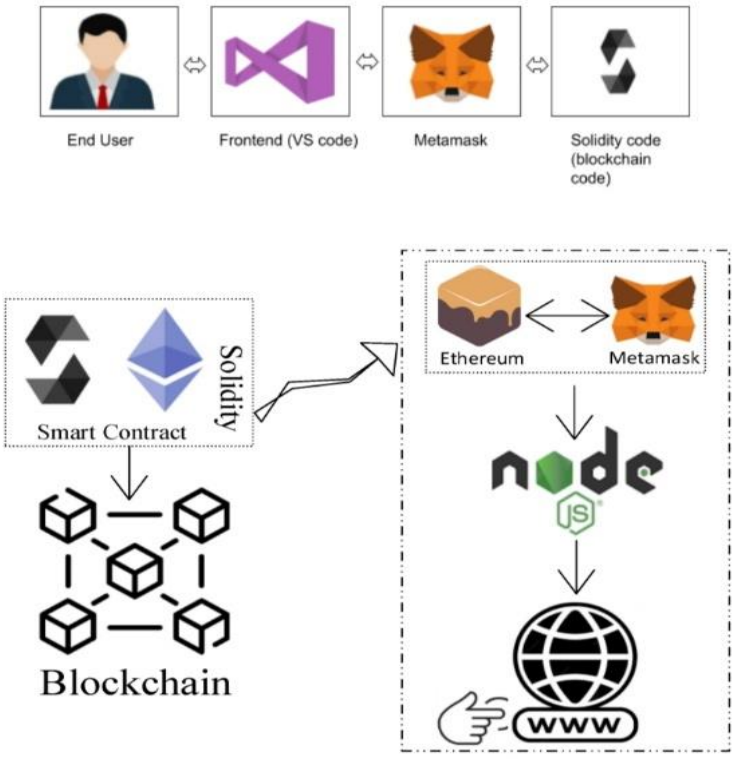
User stories for Climate Track Smart are a helpful way to understand the needs and expectations of different users or stakeholders. As a Climate Data Analyst, I want access to an immutable and transparent climate data platform to ensure the accuracy and integrity of the data I use for research and analysis. As an Environmental Activist, I want a user-friendly interface to easily track and share information about local sustainability initiatives and encourage others to join our cause. As a Government Regulatory Agency, I want a system that complies with data protection and reporting standards, helping us streamline the monitoring and enforcement of climate-related regulations. As a Renewable Energy Provider, I want a secure and efficient platform to record and trade renewable energy certificates and ensure that we receive accurate compensation for our clean energy production.

As an Individual Consumer, I want to earn blockchain-based rewards for reducing my carbon footprint by using public transportation, recycling, and minimizing energy consumption. As a Climate Impact Investor, I want transparent and verifiable data to make informed investment decisions in projects that have a positive environmental impact. As a Project Developer, I want to seamlessly integrate our sustainability initiatives into the blockchain system, making it easier for stakeholders to validate and support our projects. As an NGO Focused on

Climate Action, I want a tool that can help us demonstrate the impact of our initiatives and attract more support for our environmental projects.

5.2 Solution Architecture:

Implement a centralized database or data warehouse that serves as the primary repository for all Climate Crowdsourcing, acquire Temperature and wind Data , Immutable Climate Data and Decentralized Carbon Credits. This centralization ensures data consistency and accessibility. Employ robust user authentication and authorization mechanisms to control access to the system. Implement role-based access control, allowing administrators, educators, students, and parents to access specific data and functionalities based on their roles. Develop data integration processes and ETL workflows to consolidate data from various sources. These processes should include data mapping, transformation, and validation to ensure data accuracy before it is stored in the central repository. Build a data analytics and reporting engine that allows users to create, customize, and schedule reports and visualizations. Implement data analytics tools to derive meaningful insights from the educational data, aiding data-driven decision-making.



-Schematic Diagram of Solution Architecture-

PROJECT PLANNING & SCHEDULING:

6.1 Technical Architecture:

Develop a responsive web-based frontend using technologies like HTML, CSS, and JavaScript. Implement a user-friendly interface that allows administrators, educators, students, and parents to access the system through web browsers. Create a backend server using a framework like Node.js, Django, or Ruby on Rails. This server will handle user authentication, data processing, data integration, validation, and communication with the database. Implement a relational database or data warehouse to store and manage educational data. Use database management systems like PostgreSQL, MySQL, or Microsoft SQL Server. Ensure that the database schema supports data integration and is optimized for efficient data retrieval. Integrate data analytics and reporting tools, such as Tableau, Power BI, or custom-built solutions, into the architecture. These tools should allow users to create, customize, and schedule reports and visualizations based on the educational data stored in the database. Host the application and database on a secure and scalable cloud platform, such as AWS, Azure, or Google Cloud. Implement security measures, including encryption, role-based access control, and firewall configurations. Regularly update and maintain the infrastructure to ensure high availability and reliability.

S.no	Title	Description
1	Specify the business problem	Inefficient and centralized library management systems hinder accessibility, transparency, and security, leading to suboptimal user experiences.
2	Literature survey and information gathering	Explore existing literature on blockchain applications in library management, identifying successes, challenges, and best practices.
3	Prepare Empathy Map	Understand the needs andpain points of librarians, users,and administrators to inform the design process.
4	Ideation	Brainstorm innovative features and functionalities, such as decentralizedcataloging, transparent transaction history, and userfriendly interfaces.
5	Solution Architecture	Design a robust blockchainbased architecture, outlining the integration of smart contracts, decentralized storage, and a user-friendly front end.
6	Buisness Requirements	Define the functional and non-functional requirements, ensuring alignment with stakeholders' expectations and industry standards.

7	Data Flow Diagram	Illustrate the flow of information within the system, emphasizing how blockchain ensures data integrity and traceability.
8	Technological Architecture	Specify the technologies required, including blockchain platforms, programming languages, and database systems.
9	Project development	Break down the development process into sprints, focusing on iterative implementation, testing, and user feedback to ensure a successful and user-friendly library management solution.

6.2 Sprint Planning & Estimation:

Before each sprint, conduct backlog refinement to review and prioritize user stories. Work with stakeholders to identify and prioritize the most critical features and improvements based on their importance and impact. Ensure that the sprint goal is specific and measurable, making it easier to track progress. Use a relative estimation technique, such as story points or ideal days, to estimate the effort required for each user story.

Involve the development team in the estimation process to gain a consensus on the effort require in a sprint planning meeting, select a set of user stories from the prioritized backlog that can be realistically completed in the upcoming sprint. Break down user stories into tasks and define acceptance criteria for each. Used velocity to determine the number of story points or tasks that can be taken into the sprint based on the sprint duration.

6.3 Sprint Delivery Schedule:

Sprint 1 (Duration: 1 week)

- Sprint Goal:
  - Set up the foundational architecture for the system.
- User Stories:
  - User authentication and role-based access control.
  - Database schema design for central data repository.
  - Basic user interface for administrators.
- User Story Estimations:
  - 12 story points.
- Deliverables:
  - Authentication system, basic database structure, and administrator login functionality.

Sprint 2 (Duration: 1 week)

- Sprint Goal:
  - Implement data integration and validation processes.
- User Stories:
  - Data integration from one data source (e.g., student records).
  - Data validation and error handling.
- User Story Estimations:
  - 10 story points.
- Deliverables:
  - Data integration module for one data source, validation framework.

Sprint 3 (Duration: 1 week)

- Sprint Goal:
  - Enhance data management and analytics.
- User Stories:
  - Complete data integration for additional data sources (e.g., attendance, assessments).
  - Implement basic reporting and visualization features.
- User Story Estimations:
  - 15 story points.
- Deliverables:
  - Data integration for additional sources, basic reporting tools.

Sprint 4 (Duration: 1 week)

- Sprint Goal:
  - Improve data security and user management.
- User Stories:
  - Implement data encryption and access controls.
  - User account management features (create, reset password, etc.)
- User Story Estimations:
  - 14 story points.
- Deliverables:
  - Enhanced data security and user management capabilities.

Sprint 5 (Duration: 1 week)

- Sprint Goal:
  - Enhance the user interface and user experience.
- User Stories:
  - Improve the user interface for educators, students, and parents.
  - Implement user notifications and communication features.
- User Story Estimations:
  - 10 story points.
- Deliverables:
  - Improved user interfaces and communication features.

CODING AND SOLUTIONING:

Feature 1:

Advanced Reporting and Visualization

Description:

This feature enhances the project with advanced reporting and data visualization capabilities, allowing users to create custom reports and visualize educational data for in-depth analysis.

Code:

```
Import pandas as pd
Import matplotlib.pyplot as plt
# Sample data retrieval from the database
Data = {‘Season’: [‘summer’, ‘winter’, ‘monsoon’, ‘autumn’], ‘Max Temp in ºF’: [86, 50, 86, 68],‘Min Temp in ºF’: [68, 23, 68, 50]}
# Create a DataFrame
Df = pd.DataFrame(Data)
# Generate a bar chart to visualize student scores
Df.plot(x=’Student’, kind=’bar’)
Plt.title(‘Temperature status’)
Plt.xlabel(‘Season’)
Plt.ylabel(‘Temperature’)
Plt.show()
```

Feature 2:

Automated Data Backup and Recovery

Description:

This feature enhances the project with automated data backup and recovery to prevent data loss and ensure data integrity.

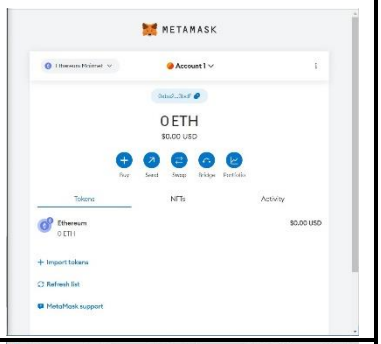
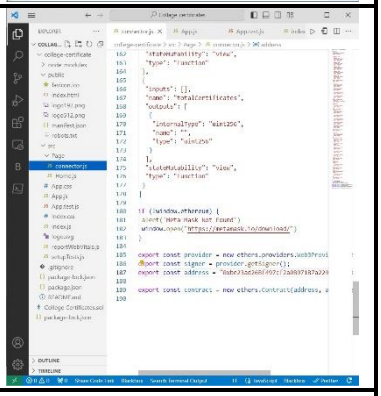
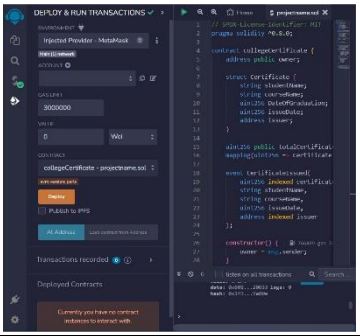
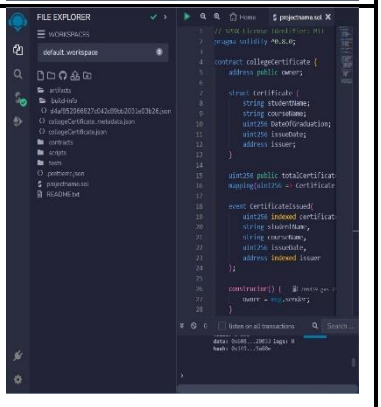
Code:

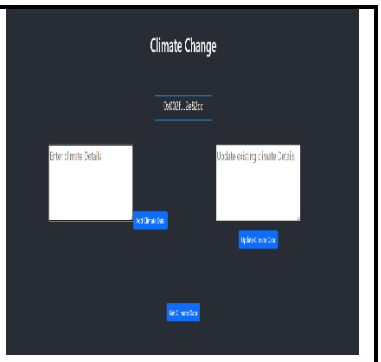
```bash
# Bash script for automated data backup (example)
#!/bin/bash
# Define backup directory
Backup_dir="/path/to/backup/directory"
# Create a timestamp for the backup folder
Timestamp=$(date +"%Y%m%d%H%M%S")
# Create a backup folder with a timestamp
Backup_folder="$backup_dir/backup_$timestamp"
Mkdir -p "$backup_folder"
# Copy database dump to the backup folder (replace 'database' with the actual database name)
Cp /path/to/database/dump.sql "$backup_folder"
# Create a compressed archive of the backup
Tar -czf "$backup_folder.tar.gz" "$backup_folder"
# Clean up old backups (optional)
Find "$backup_dir" -type d -mtime +7 -exec rm -rf {} \;
# Add a log entry to a backup log file
Echo "Backup completed on $timestamp" >> "$backup_dir/backup.log"
```

PERFOMANCE TESTING:

8.1 Performance Testing:

The performance testing of the project is the sequence or the steps to be followed. It descibed as follows;

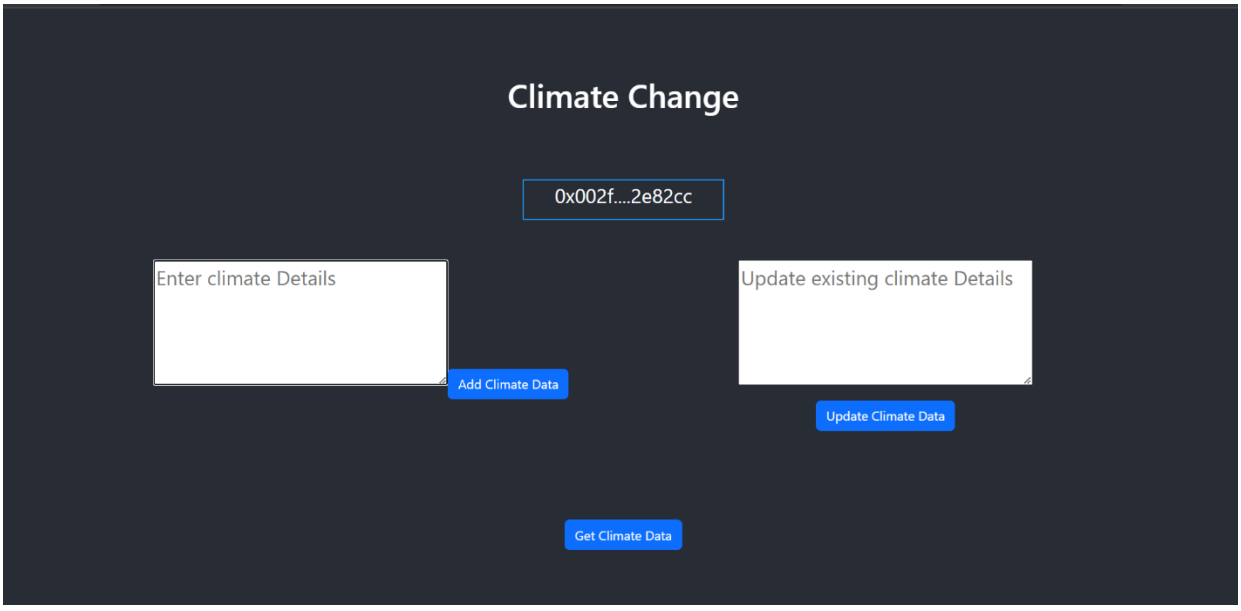
S.No.	Parameter	Values	Screenshot
1.	Information gathering	Setup all the Prerequisite:	
2.	Extract the zip files	Open to VS code	
3.	Remix IDE Platform exploring	Deploy the smart contract code Deploy and run the transaction. By selecting the environment - inject the MetaMask.	
4	Open file explorer	Open the extracted file and click on the folder Open src, and search for utiles. Open cmd enter command 1. npm install 2. npm bootstrap 3. npm start	

5	LOCAL HOST IP ADDRESS	Copy the address and open it to chrome so you can see the front end of your project.	

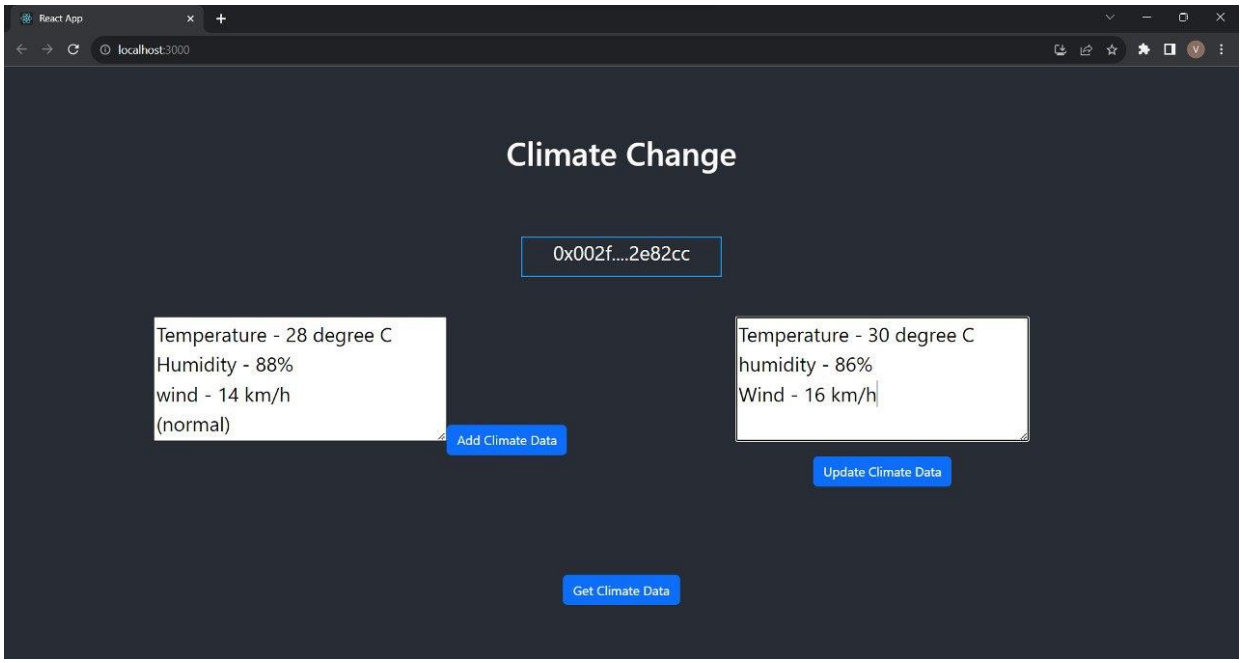
-Table 8.1-

OUTPUT / RESULT:

9.1 Output Screenshot:



-Image 1-



-Image 2-

ADVANTAGES AND DISADVANTGES:

10.1 Advantages:

- **Enhanced Data Integrity**: Blockchain technology ensures the immutability and security of climate-related data, reducing the risk of manipulation or fraud.
- **Transparency**: The use of blockchain fosters transparency, allowing stakeholders to access and verify climate data easily, which can lead to increased trust.
- **Efficiency**: Smart contracts automate the verification process, making it more efficient and reducing the time and resources required for validation.
- **Global Collaboration**: Blockchain's decentralized nature enables global collaboration and information sharing, promoting international efforts to combat climate change.
- **Incentivizing Sustainability**: The project can incentivize individuals and organizations to adopt sustainable practices by offering blockchain-based tokens or rewards for their efforts.

10.2 Disadvantages:

- **Complex Implementation**: Implementing blockchain technology can be complex and may require specialized expertise, potentially increasing project costs.

- **Data Privacy**: The transparency of blockchain may raise concerns about data privacy, especially for sensitive climate-related information.

- **Initial Setup Costs**: Developing and deploying the blockchain infrastructure can be expensive, especially for smaller organizations or regions with limited resources.

- **Regulatory Hurdles**: Navigating the regulatory landscape for blockchain applications in climate tracking can be challenging, as it may vary from one jurisdiction to another.

- **User Adoption**: Encouraging users to embrace and use the new system can be a hurdle, as it may require education and a change in established practices..

CONCLUSION:

In conclusion, "ClimateTrackSmart" represents a groundbreaking and innovative solution to address the pressing challenges in climate tracking and sustainability management. This project harnesses the power of blockchain technology to enhance the integrity, transparency, and efficiency of climate-related data, ultimately contributing to our global efforts to combat climate change. The advantages of this system, including enhanced data integrity, transparency, and the potential to incentivize sustainability, hold great promise for a more sustainable future. However, it is important to be mindful of the challenges, such as the complexity of implementation, regulatory hurdles, and data privacy concerns, and work towards addressing them effectively.

As we look ahead, the future scope of "ClimateTrackSmart" is bright, with potential for global adoption, standardization, advanced analytics, and the expansion of the blockchain ecosystem for environmental sustainability. It is a testament to the power of innovative technology in addressing one of the most critical challenges of our time. In a world where climate action is of paramount importance, "ClimateTrackSmart Using Blockchain" stands as a beacon of hope and a catalyst for positive change, providing a path towards a more sustainable and resilient future for our planet.

Advantages including enhanced data integrity, transparency, and the potential to incentivize sustainability, hold great promise for a more sustainable future. However, it is important to be mindful of the challenges, such as the complexity of implementation, regulatory hurdles, and data privacy concerns, and work....

FUTURE SCOPE:

The future scope of "ClimateTrackSmart Using Blockchain" is promising and holds the potential for significant positive impact in various areas. Here are some aspects of the project's future scope

- As climate change concerns continue to escalate, the adoption of blockchain-based climate tracking solutions could become more widespread. Governments, industries, and organizations worldwide may integrate such systems into their operations.
- Future developments may focus on standardizing blockchain protocols for climate tracking, ensuring interoperability and data exchange between different systems and stakeholders. This would facilitate global collaboration and information sharing.
- The project can evolve to include advanced data analytics and artificial intelligence (AI) capabilities to derive valuable insights from the vast amounts of climate data collected, aiding in better decision-making and policy formulation.
- The project can refine and expand its incentive mechanisms to encourage even more individuals and organizations to participate in sustainable practices. This could involve more sophisticated token systems or reward structures.
- Future iterations of the project should continually improve the security and privacy aspects to ensure that sensitive climate data remains protected from unauthorized access and tampering.
- As the adoption of blockchain for climate tracking grows, regulatory frameworks may be developed to govern its use, ensuring compliance with data protection and environmental reporting standards.

SOURCE CODE:

The source code of the project is given in the below drive link.

Source code link: https://drive.google.com/file/d/1hB6oxPOqcUF-3YoOnb3UN8BS5J8BJqZP/view?usp=sharing

GITHUB LINK:

The Github link of the project is given below:

Github link: https://github.com/Github88229/climate_track_smart