TRACKING PUBLIC INFRASTRUCTURE AND TOLL PAYMENT USING BLOCKCHAIN

PROJECT REPORT

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TRACKING PUBLIC INFRASTRUCTURE AND TOLL PAYMENT USING BLOCKCHAIN

1.INTRODUCTION:

In today's rapidly evolving digital landscape, the utilization of cutting-edge technology has become paramount in enhancing the transparency, security, and efficiency of various sectors, including public infrastructure and financial transactions. Block chain technology, originally created to underpin crypto currencies like Bit coin, has since evolved into a powerful tool with the potential to transform how we track and manage public infrastructure projects and streamline payment processes.

Public infrastructure, ranging from transportation networks and utilities to public buildings and healthcare facilities, constitutes the backbone of any modern society. However, the lack of transparency and accountability in the management of public infrastructure projects often leads to inefficiencies, delays, cost overruns, and, in some cases, corruption. Moreover, the payment tools used in these projects are often riddled with complexities and inefficiencies.

Project overview

The "Tracking Public Infrastructure and Tool Payment Using Block chain" project aims to leverage block chain technology to improve the transparency, efficiency, and security of managing public infrastructure projects and tool payments. Public infrastructure development and maintenance play a crucial role in the socio-economic development of a region. However, the existing systems often face issues related to transparency, accountability, and delayed payments. This project proposes a solution to address these challenges by implementing block chain technology.

1.2 Purpose

Transparency and Accountability:

- Blockchain provides a transparent and immutable ledger of all transactions related to public infrastructure projects and tool payments. This transparency can help prevent corruption, fraud, and embezzlement by making all transactions visible to relevant stakeholders, including the public.

Cost Reduction:

- Blockchain can reduce the administrative costs associated with managing and tracking payments for public infrastructure projects. Smart contracts can automate payment disbursements, reducing the need for intermediaries and streamlining the payment process.

Real-time Tracking:

- Blockchain technology allows for real-time tracking of payments and project progress. This can help government agencies and stakeholders monitor project milestones, expenditures, and adherence to budgets more effectively.

2.LITERATURE SURVEY:

Existing problem:

Scalability: Blockchain networks like Bitcoin and Ethereum often face scalability issues. When tracking public infrastructure and tool payments on a large scale, the current blockchain infrastructure may not handle the volume of transactions required. This results in slow transaction processing times and high fees, making it impractical for everyday use.

Energy Consumption: Many blockchain networks, especially proof-of-work networks like Bitcoin, consume significant amounts of energy. As the demand for blockchain-based infrastructure tracking and payment tools grows, so does the environmental impact. Transitioning to more energy-efficient consensus mechanisms like proof-of-stake can help mitigate this issue.

Interoperability: There are numerous blockchain platforms, and they often do not communicate well with each other. When tracking public infrastructure, which may span different geographical regions, or tool payments that involve various industries, interoperability between different blockchain networks is crucial. Developing standards and protocols for cross-chain communication is necessary.

Regulatory Challenges: Governments and regulatory bodies have not yet fully addressed how to regulate and tax transactions conducted on blockchain networks. There's a need for clear regulatory frameworks to ensure compliance, transparency, and fair taxation, especially when it comes to public infrastructure and payments.

References :

Academic Databases: Start by searching in academic databases such as Google Scholar, IEEE Xplore, JSTOR, and ACM Digital Library. Use keywords like "public infrastructure," "tool payment," and "blockchain" to narrow down your search. You can also include related terms like "government projects" or "smart contracts."

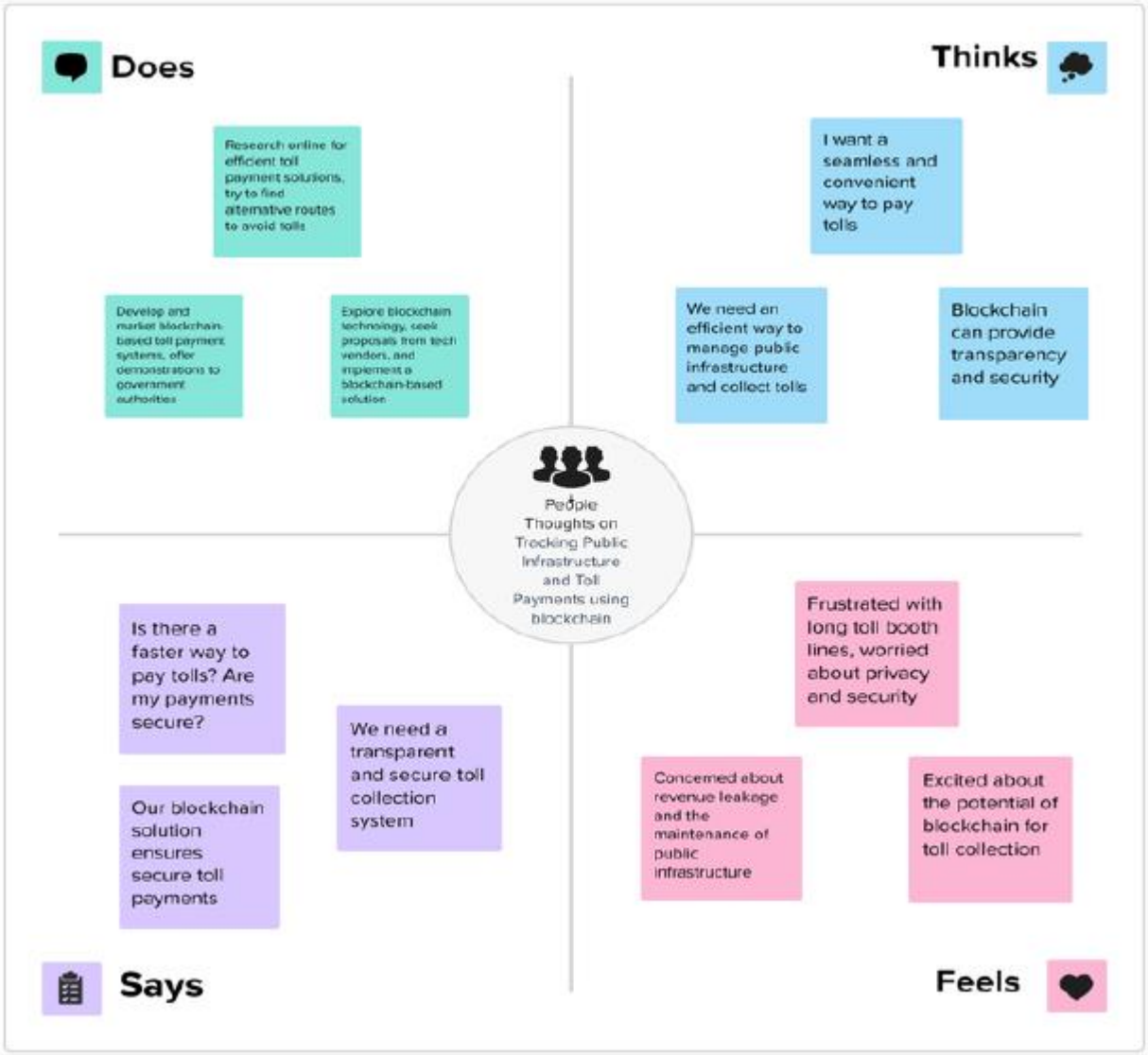
Government Reports: Government agencies often publish reports and studies related to infrastructure and financial management. Check websites of government departments related to infrastructure, finance, and technology. These reports can provide valuable insights and references.

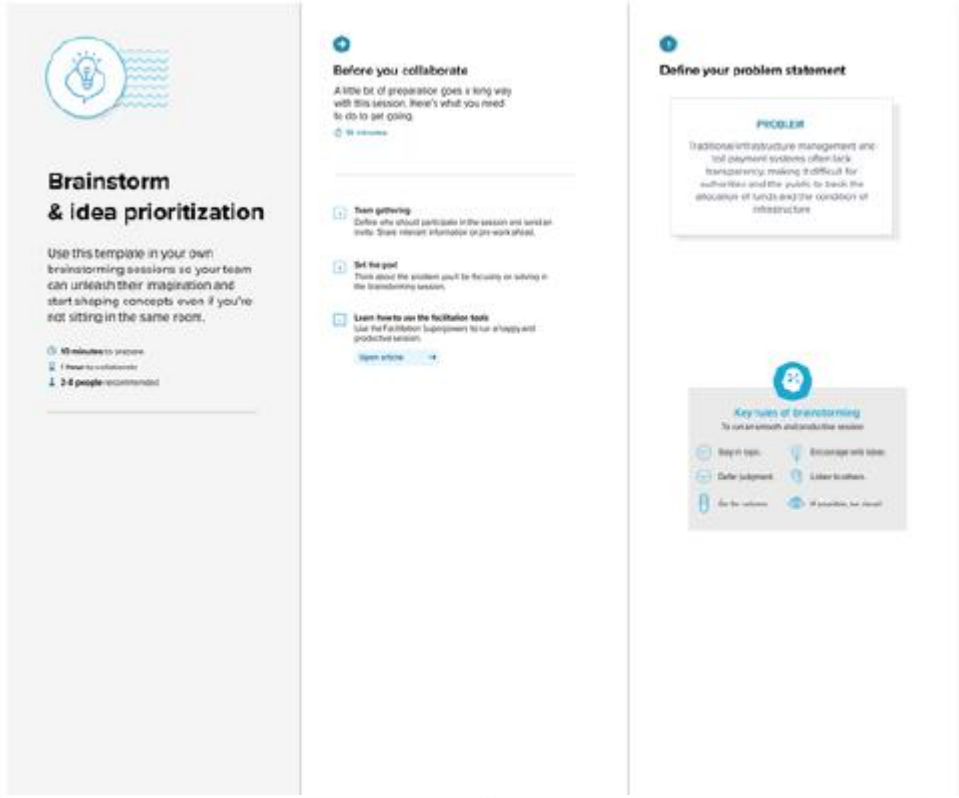
Problem statement definition:

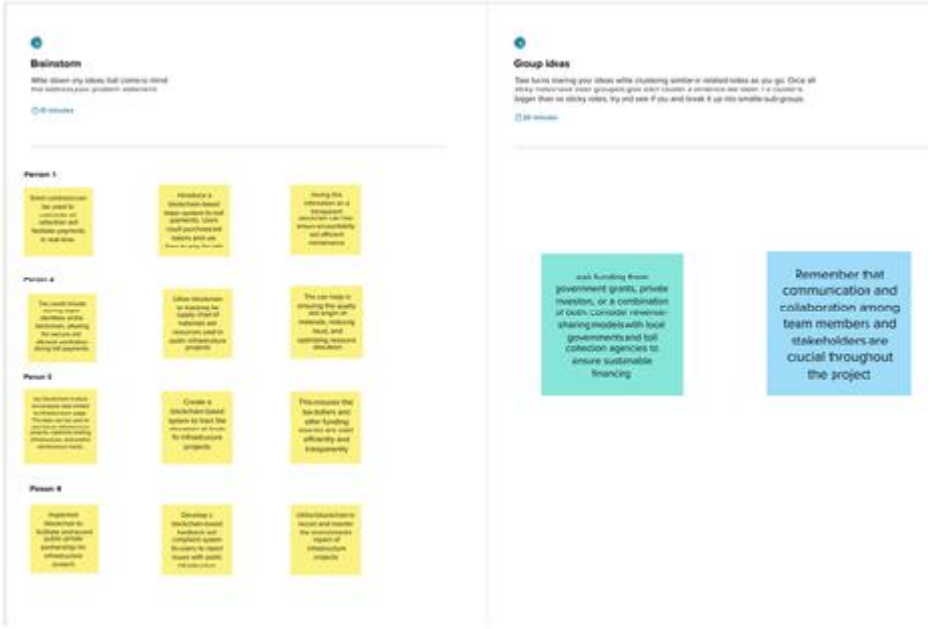
Public infrastructure, such as roads, bridges, public buildings, and utilities, play a crucial role in the functioning of a society. Governments allocate significant budgets for the construction, maintenance, and operation of these infrastructures. Additionally, public utilities like water supply, electricity, and telecommunications services require efficient payment systems for users.

3.IDEATION & PROPOSED SOLUTION:

Empathy Map Canvas


Does
Thinks
Research online for efficient toll payment solutions, try to find alternative routes to avoid tolls
Develop and market blockchain-based toll payment systems, offer demonstrations to government authorities
Explore blockchain technology, seek proposals from tech vendors, and implement a blockchain-based solution
I want a seamless and convenient way to pay tolls
We need an efficient way to manage public infrastructure and collect tolls
Blockchain can provide transparency and security
People Thoughts on Tracking Public Infrastructure and Toll Payments using blockchain
Is there a faster way to pay tolls? Are my payments secure?
Our blockchain solution ensures secure toll payments
We need a transparent and secure toll collection system
Frustrated with long toll booth lines, worried about privacy and security
Concerned about revenue leakage and the maintenance of public infrastructure
Excited about the potential of blockchain for toll collection
Says
Feels


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.
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
Define your problem statement
PROBLEM
Traditional infrastructure management and toll payment systems often lack transparency, making it difficult for authorities and the public to track the allocation of funds and the condition of infrastructure
Key rules of brainstorming
To run an smooth and productive session
Stay in topic.
Encourage wild ideas.
Defer judgment.
Listen to others.
Go for volume.
If possible, be visual.


Brainstorm
Write down any ideas that come to mind that address your problem statement
10 minutes
Person 1
Person 2
Person 3
Person 4
Group ideas
Time to start 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 header for a cluster that is bigger than six sticky notes. Try and see if you and break it up into smaller sub-groups.
20 minutes
government grants, private investors, or a combination of both. Consider revenue-sharing models with local governments and toll collection agencies to ensure sustainable financing
Remember that communication and collaboration among team members and stakeholders are crucial throughout the project

3.2 Ideation & Brainstorming

Ideation and brainstorming for tracking public infrastructure and tool payment using blockchain can lead to innovative solutions that improve transparency, efficiency, and accountability in the management of public projects. Here are some ideas and steps to consider during the ideation and brainstorming process:

Define the Problem:

- Clearly define the problem you aim to solve. This could include issues related to misallocation of funds, lack of transparency, or delays in public infrastructure projects.

Identify Stakeholders:

- Determine the key stakeholders involved, such as government agencies, contractors, and the public, and understand their needs and concerns.

Blockchain Technology:

- Explore the capabilities of blockchain technology and how it can address the identified problems. Highlight the key features of blockchain, such as immutability, transparency, and decentralization, that can be leveraged.

Smart Contracts:

- Consider implementing smart contracts to automate payment processes. Smart contracts can release funds upon the completion of predefined project milestones, ensuring that payments are made only when work is validated.

Data Sources:

- Identify the sources of data that will be recorded on the blockchain. This could include project milestones, budgets, expenditure, and payment records.

4. REQUIREMENT ANALYSIS:

4.1 Functional requirement:

User Registration and Authentication:

- Users should be able to register on the platform with their personal information.
- Secure authentication methods such as username/password, two-factor authentication, or biometrics should be implemented.

User Roles and Permissions:

- Define different user roles (e.g., administrators, contractors, government officials, and the public) with varying levels of access and permissions.

Project Creation:

- Authorized users should be able to create new infrastructure projects and provide project details.
- Assign project managers and stakeholders to each project.

4.2 Non-Functional requirement:

a. **Data Protection**: Ensure that sensitive payment and infrastructure data is securely stored and transmitted using encryption techniques like SSL/TLS.
b. **Access Control**: Implement strict access controls and authentication mechanisms to prevent unauthorized access to the blockchain.
c. **Smart Contract Security**: Audit and secure smart contracts to prevent vulnerabilities and potential exploitation.

d. **Compliance**: Ensure compliance with data protection and financial regulations, such as GDPR or KYC (Know Your Customer).

5. PROJECT DESIGN:

Data Flow Diagrams & user stories:

Security: Given the sensitivity of tracking public infrastructure and payments, security is paramount. The system should have robust security mechanisms to protect data, user identities, and transactions. This includes encryption, authentication, and authorization mechanisms.

Performance: The system must be able to handle a significant number of transactions efficiently, given the potential volume of public infrastructure tracking and tool payment processing. Response times should be reasonable, and the system should be scalable to accommodate increased usage.

5.2 Solution architecture:

User Interface (UI):

- Web or mobile application for users to interact with the system.
- User registration, login, and profile management.

Smart Contracts:

- Smart contracts will be deployed on the blockchain to handle payments and infrastructure tracking.
- Separate smart contracts for different types of infrastructure (e.g., roads, bridges, public buildings).
- Define the rules and conditions for payment and maintenance.

6. PROJECT PLANNING & SCHEDULING:

Technical architecture:

Choose an appropriate blockchain platform based on the specific requirements of your project. Popular options include Ethereum, Hyperledger Fabric, Binance Smart Chain, and more. The choice may depend on factors such as scalability, consensus mechanism, and privacy features.

Sprint Planning & Estimation:

- In sprint planning meetings, select a set of user stories from the prioritized backlog to be worked on during the upcoming sprint.
- Ensure that the selected user stories align with the project's overall goals and the incrementally building blockchain infrastructure.

6.3 Sprint Delivery Schedule:

With the backlog in place, conduct sprint planning meetings to select user stories for the upcoming sprint. The selection should be based on the priority and complexity of the stories. Ensure that the scope of the sprint is achievable within the sprint's time frame.

7. CODING & SOLUTIONING:

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


const abi = [
 {
  "inputs": [
   {
    "internalType": "uint256",
    "name": "highwayId",
    "type": "uint256"
   }
  ],
  "name": "getToll",
  "outputs": [
   {
    "components": [
     {
      "internalType": "uint256",
      "name": "timestamp",
      "type": "uint256"
     },
     {
      "internalType": "address",
      "name": "collectedBy",
      "type": "address"
```

```
    },
    {
     "internalType": "uint256",
     "name": "amount",
     "type": "uint256"
    }
   ],
   "internalType": "struct tollCollection.TollData",
   "name": "",
   "type": "tuple"
  }
 ],
 "stateMutability": "view",
 "type": "function"
},
{
 "inputs": [
  {
   "internalType": "uint256",
   "name": "highwayId",
   "type": "uint256"
  },
  {
   "internalType": "uint256",
   "name": "_amount",
```

```
   "type": "uint256"
  }
 ],
 "name": "payTollAmount",
 "outputs": [],
 "stateMutability": "nonpayable",
 "type": "function"
},
{
 "inputs": [
  {
   "internalType": "address",
   "name": "",
   "type": "address"
  },
  {
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   "name": "",
   "type": "uint256"
  }
 ],
 "name": "tolls",
 "outputs": [
  {
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```

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    "type": "uint256"
   },
   {
    "internalType": "address",
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   },
   {
    "internalType": "uint256",
    "name": "amount",
    "type": "uint256"
   }
  ],
  "stateMutability": "view",
  "type": "function"
 }
]
```
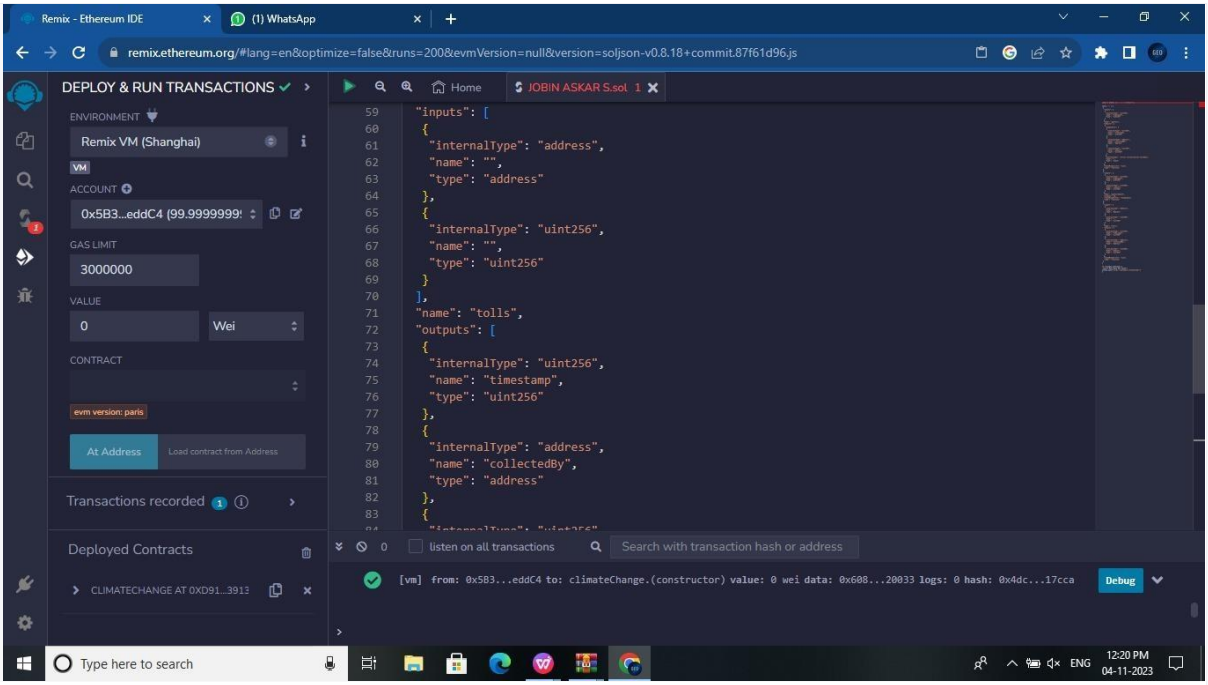
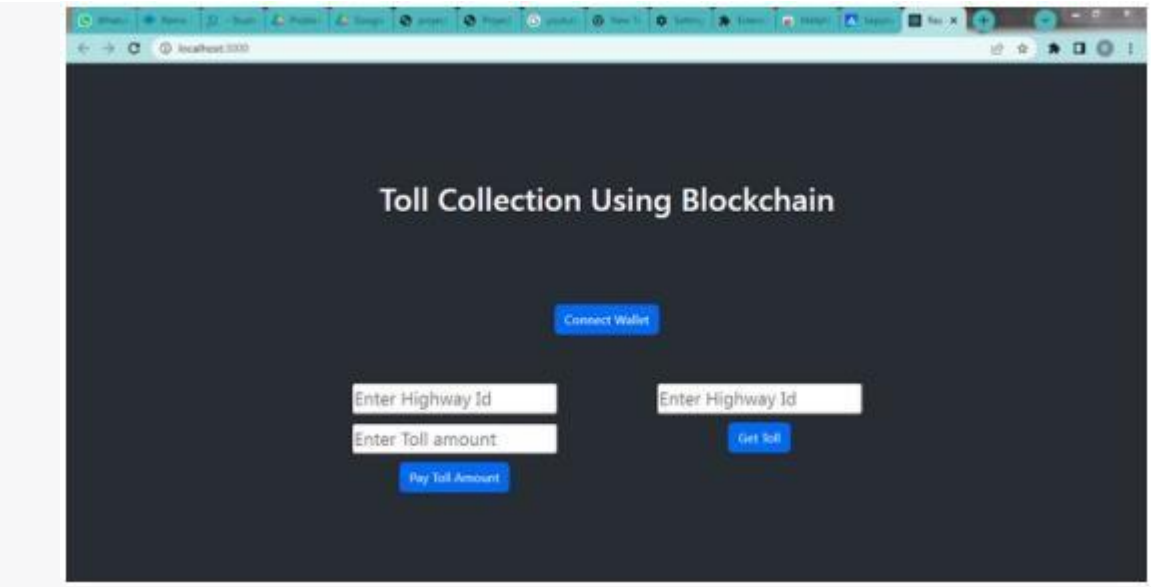



8. PERFORMANCE TESTING:

8.1 performance metrics:

Tracking public infrastructure and tool payments using blockchain can offer transparency, security, and efficiency in managing financial transactions related to such projects. To assess the performance of a blockchain system in this context, you can use a variety of metrics. Here are some relevant performance metrics

9.RESULT:



10. ADVANTAGE & DISADVANTAGES:

Advantages:

Transparency and Accountability:

- Blockchain provides a transparent and immutable ledger of all transactions. This transparency can enhance accountability as every payment and transaction can be traced and audited, reducing the potential for corruption or misuse of funds.

Reduced Fraud:

- Blockchain's cryptographic security features make it difficult for unauthorized parties to manipulate payment records. This can reduce the risk of fraudulent activities in public infrastructure and tool payment systems.

Efficiency:

- Smart contracts on the blockchain can automate payment processes, reducing the need for intermediaries, paperwork, and delays. This can result in faster and more efficient payment disbursements.

Cost Savings:

- By eliminating intermediaries and streamlining processes, blockchain can potentially reduce administrative costs associated with payment tracking and processing.

Trust:

- Blockchain can help build trust among stakeholders, as the technology ensures the integrity of payment records, making disputes less likely.

Real-time Tracking:

- Public infrastructure and tool payments can be tracked in real-time, allowing for better project management and resource allocation.

Disadvantages:

Technical Complexity:

- Implementing blockchain technology requires technical expertise, and not all government agencies or organizations may have the necessary resources or skills to set up and maintain a blockchain system.

Scalability Issues:

- Blockchain networks can face scalability challenges when handling a large number of transactions simultaneously. This can be a concern when dealing with a high volume of public payments.

Privacy Concerns:

- While blockchain is secure, it is also highly transparent. In some cases, privacy concerns may arise when sensitive payment information is visible to all participants on the network.

Regulatory Challenges:

- Governments may need to adapt or create new regulations to accommodate blockchain-based payment systems, which can be a lengthy and complex process.

Initial Costs:

- Implementing blockchain technology can be costly, and it may take some time to see a return on investment.

Irreversible Transactions:

- The immutability of blockchain means that once a transaction is recorded, it cannot be easily reversed. This can be a disadvantage if there are errors or disputes that need to be corrected.

Adoption Hurdles:

- Encouraging all stakeholders to adopt and use blockchain-based systems may face resistance, as people and organizations may be resistant to change or may lack the necessary infrastructure and tools.

11. CONCLUSION:

Transparency and Trust: Blockchain technology provides a transparent and tamper-proof ledger, which ensures that all transactions related to public infrastructure and tool payments are recorded and verifiable. This transparency fosters trust among stakeholders, including governments, contractors, and the public.

Reduced Fraud and Corruption: The immutable nature of blockchain records minimizes the risk of fraud and corruption in public infrastructure projects and tool payments. Smart contracts can automate payments when predetermined conditions are met, reducing the opportunity for financial misconduct.

12. FUTURE SCOPE:

Transparency and Accountability: Blockchain's immutable ledger ensures that all transactions and data related to public infrastructure are transparent and tamper-resistant. This can help in tracking the allocation of funds, construction progress, and maintenance activities, thereby enhancing accountability in public projects.

Reduced Corruption: Blockchain can mitigate corruption by providing a transparent and auditable record of all financial transactions. It makes it difficult for individuals or entities to engage in fraudulent activities, siphon off funds, or manipulate financial data.

Efficient Payment Processing: Smart contracts on the blockchain can automate payment processing. Contractors and subcontractors can be paid automatically based on predefined conditions or milestones. This reduces delays and administrative costs associated with manual payment processing.

13. APPENDIX

GitHub link: https://github.com/jobinas/TRACKING-PUBLIC-INFRASTRUCTURE-AND-TOLL-PAYMENT-USING-BLOCKCHAIN.git