PROJECT REPORT

Date	29 Oct 2023
Team ID	NM2023TMID04066
Project Name	TRANSPARENT TOLL-FREE DATA MANAGEMENT

TRANSPARENT TOLL-FREE DATA MANAGEMENT

1.Introduction

1.1Project overview

Transparent toll-free data management using blockchain technology revolutionizes traditional toll collection systems by ensuring absolute transparency, security, and efficiency. With blockchain's immutable ledger and smart contracts automating toll transactions, this innovative solution eradicates fraud, minimizes disputes, and enhances the overall user experience, paving the way for a future where toll-free systems operate seamlessly and with the utmost integrity.

1.2 Purpose

The Transparent Toll-Free Data Management Using Blockchain Project is an initiative that leverages blockchain technology to create a more secure, transparent, and efficient toll collection system. It aims to enhance transparency, reduce fraud, streamline operations, and improve the overall user experience while also encouraging innovation and supporting sustainability goals.

2.Literature survey

2.1 Existing problem

The existing problem in transparent toll-free data management lies in the lack of transparency, accountability, and security within conventional toll collection systems. Traditional systems are often marred by fraud, manual errors, and disputes, making it challenging to maintain trust between operators and users. These issues hinder operational efficiency and lead to increased costs. Blockchain technology addresses these challenges by providing an immutable ledger and smart contracts, thereby mitigating fraud, ensuring transparency, and streamlining the toll collection process.

2.2 References

1. Antonopoulos, A. M. (2014). "Mastering Bitcoin: Unlocking Digital Cryptocurrencies." O'Reilly Media.

2. Mougayar, W. (2016). "The Business Blockchain: Promise, Practice, and Application of the Next Internet Technology." Wiley.

3. Tapscott, D., & Tapscott, A. (2016). "Blockchain Revolution: How the Technology Behind Bitcoin is Changing Money, Business, and the World." Penguin.

4. Gipp, B., Kosti, D., & Breitinger, C. (2018). "Demystifying Blockchain: A Comprehensive Selection of Cryptocurrency Tools for Systematic Analysis." Journal of King Saud University - Computer and Information Sciences.

5. Pratap, A. (2018). "Blockchain Basics: A Non-Technical Introduction in 25 Steps." Apress.

2.3 Problem Statement Definition

In today's data-driven world, the management of toll-free data, often critical for businesses and governments, faces significant challenges related to transparency, security, and trust. Existing systems for toll-free data management are often plagued by issues of data tampering, unauthorized access, and lack of accountability, which can result in financial losses and breaches of privacy. To address these issues, there is a pressing need for a robust and transparent toll-free data management system that leverages blockchain technology.

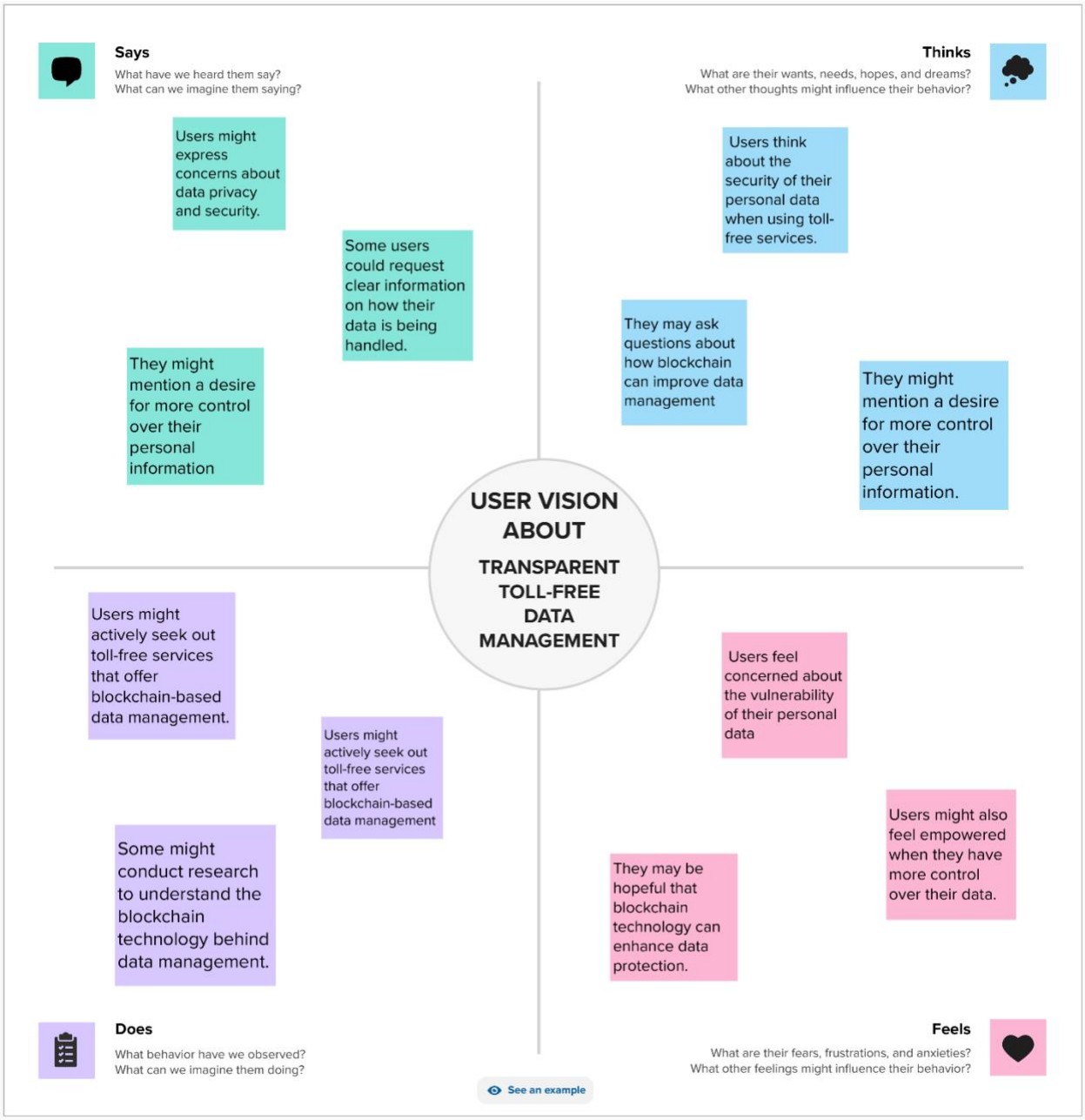
This project aims to design and implement a blockchain-based solution that ensures the secure and immutable storage of toll-free data, allowing for transparent and accountable data management while eliminating the risks associated with conventional centralized systems.

By doing so, it seeks to revolutionize the way toll-free data is handled, ultimately leading to increased efficiency, trust, and security in the management of this critical information.

3.Ideation and Proposed Solution

3.1 Empathy Map Canvas

An empathy map is a collaborative tool teams can use to gain a deeper insight into their customers. Much like a user persona, an empathy map can represent a group of users, such as a customer segment. The empathy map was originally created by Dave Gray and has gained much popularity within the agile community.



3.2 Ideation and Brainstroming

A group problem-solving technique that involves the spontaneous contribution of ideas from all members of the group

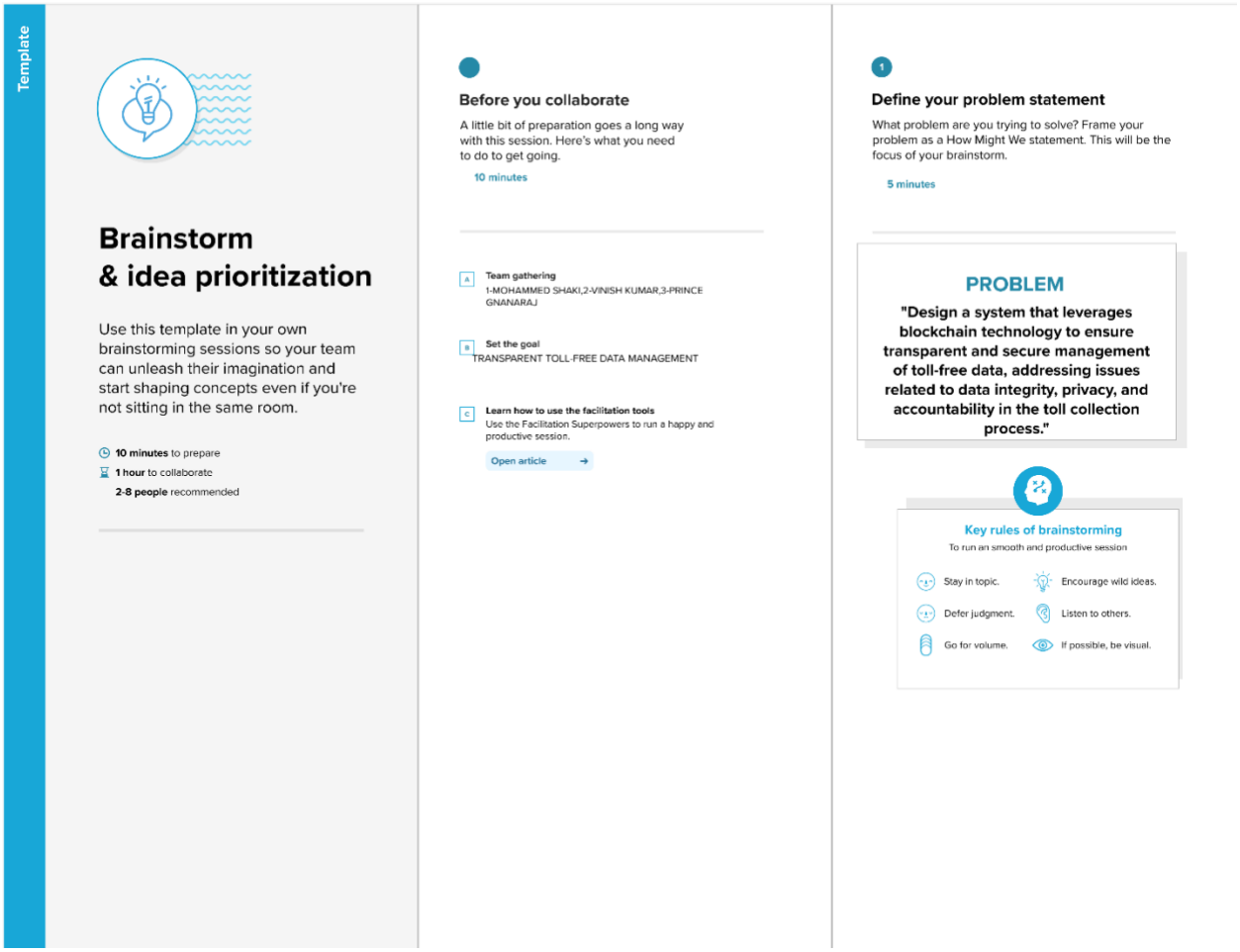
RULES:

1.Lay out the problem you want to solve. ...

2.Identify the objectives of a possible solution. ...

3.Try to generate solutions individually. ...

4.Once you have gotten clear on your problems, your objectives and your personal solutions to the problems, work as a group.



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 sketch] icon to start drawing!

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.

Person 1

"Immutable Record Keeping:" Blockchain ensures that all data transactions are stored in an immutable and transparent ledger, reducing the risk of data manipulation or fraud.

Enhanced Security:" With cryptographic algorithms, blockchain technology provides a higher level of security, protecting sensitive data from unauthorized access.

Cost Reduction:" Toll-free data management can become more cost-effective as intermediaries are eliminated, and trust is established through blockchain's decentralized nature

Person 3

Data Ownership and Control:" Blockchain allows individuals to have more control over their data, deciding who can access it, which enhances privacy and transparency.

Smart Contracts:" The use of smart contracts in blockchain technology can automate toll-free data management processes, reducing administrative overhead.

Auditability:" Every data transaction is recorded and timestamped, enabling easy auditing and compliance verification, which is crucial for transparency.

Person 3

Accessibility:" Blockchain technology is accessible globally, making it an ideal solution for toll-free data management that transcends geographical boundaries

Data Integrity:" Through consensus mechanisms, blockchain verifies the integrity of data, ensuring that only accurate and valid data is added to the ledger.

Global Accessibility:" Blockchain technology is accessible globally, making it an ideal solution for toll-free data management that transcends geographical boundaries.

Person 4

Decentralization:" By eliminating central authorities, blockchain technology ensures that data management is not controlled by a single entity, reducing the risk of data manipulation and ensuring transparency.

Real-time Data Sharing:" Blockchain facilitates real-time data sharing, which is particularly beneficial for toll-free data management, allowing instant access to critical information.

Global Accessibility:" Blockchain technology is accessible globally, making it an ideal solution for toll-free data management that transcends geographical boundaries.

Cost Reduction:" Toll-free data management can become more cost-effective as intermediaries are eliminated, and trust is established through blockchain's decentralized nature

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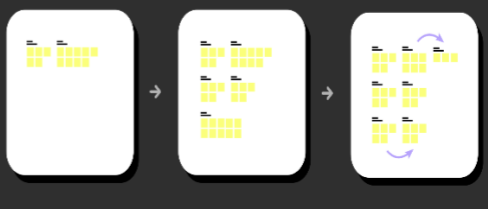
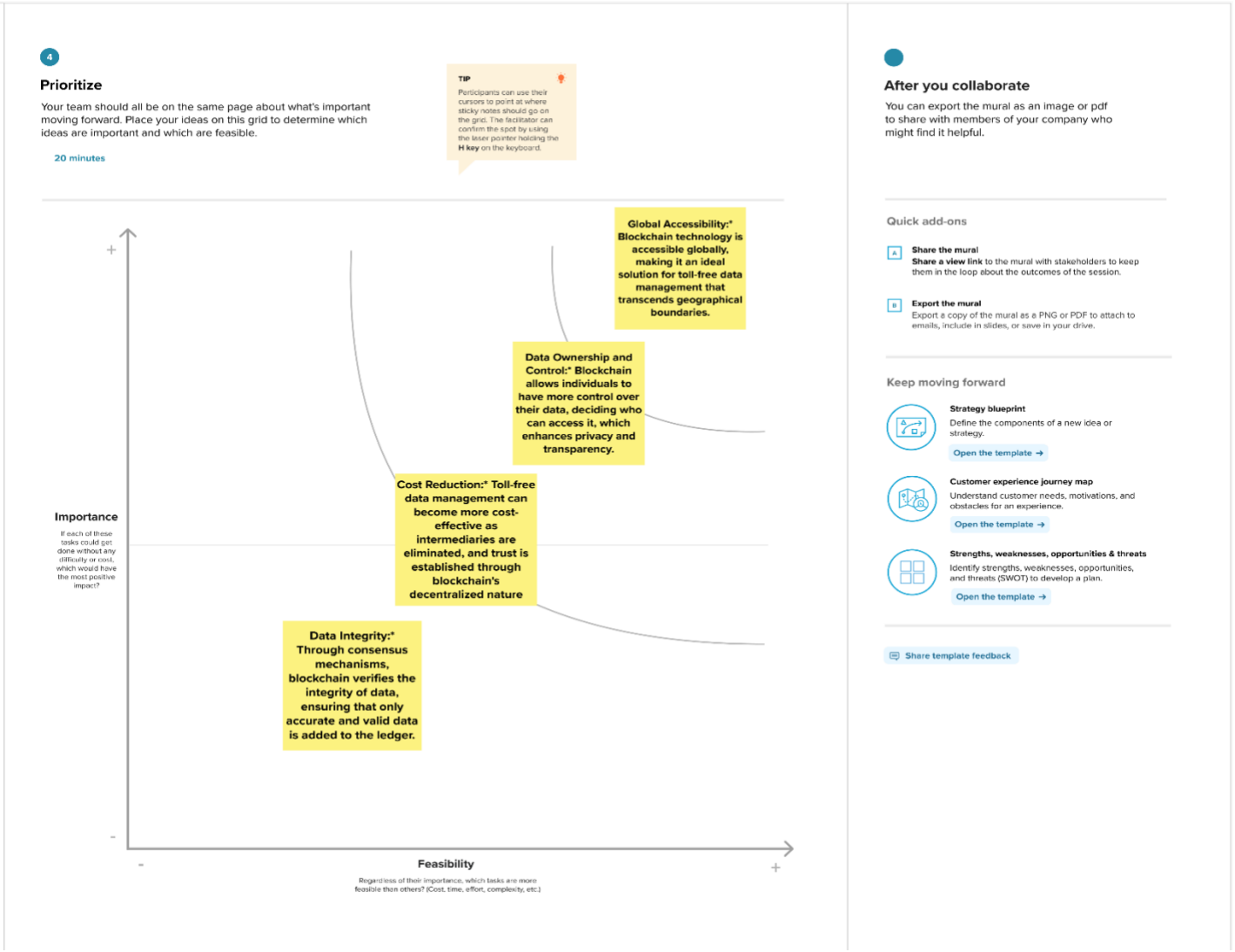




4.Requirement Analysis

4.1 Functional Requirements

Requirements are traced forward through other development artifacts, including test cases, test runs, and issues. Requirements are traced backward to the source of the requirement, such as a stakeholder or a regulatory compliance mandate.

The purpose of requirements traceability is to verify that requirements are met. It also accelerates development. That's because it's easier to get visibility over your requirements.

Traceability is also important for analysis. If a requirement changes, then you can use traceability to determine the impact of change. You'll see what the requirement is connected to. And you'll be able to see how changing that requirement will impact related issues or tests.

4.2 Non Functional Requirements

For the technical requirements, the results of literature research, workshops and expert interviews are transformed into functional and non-functional user stories and summarized into application-oriented requirements. They contain a short description of the requirement: acceptance criteria describing which conditions the BBTS has to fulfill and other marginal data.

Data collected from the information sources "stakeholders", "documents" and "existing systems" are also systematically analyzed for the interoperability requirements. The analysis aims at an investigation of the systems already in use with regard to data and service interfaces for coupling with a blockchain. The interoperability requirements serve to incorporate all demands for digital frameworks.

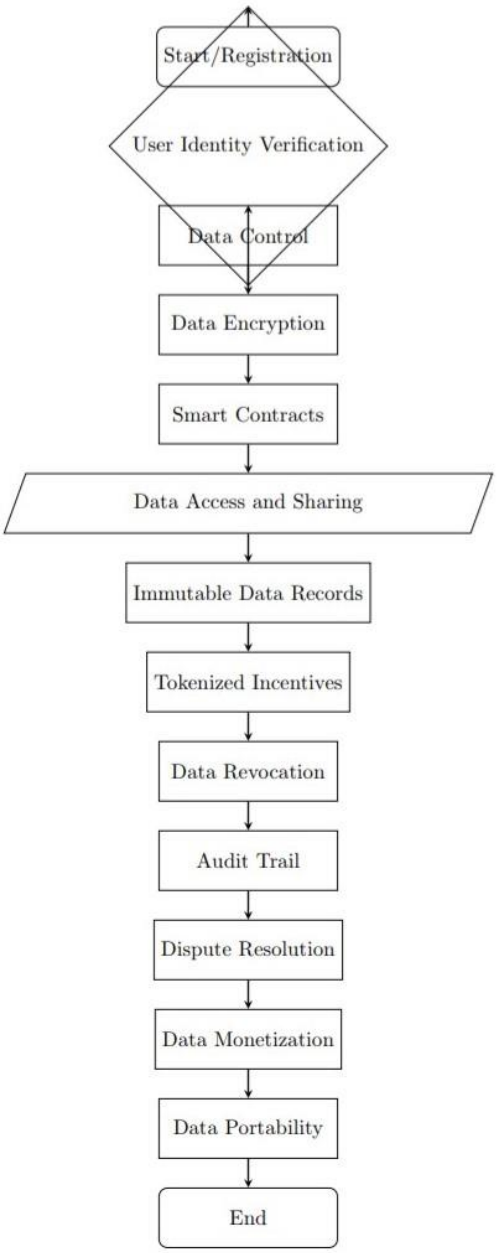
When establishing the requirements, it must be ensured that the named aspects are objectively determined, validated and not contradictory. First, the objectivity of a usage requirement is ensured when several stakeholders / persons / sources formulate the same requirement for a specific usage context. Furthermore, the raised requirements must be traceable to the requirements of the context of use. To ensure that the requirements elicitation is done in the most unbiased way, an aspect is only declared as a fundamental requirement if at least two groups of stakeholders demand for it.

Second, the collected requirements must be valid, i.e. the data must be confirmed or, if necessary, corrected by representatives working in this context. In this paper, workshops with different participants of the supply chain were conducted as well as guideline-based interviews. The results can therefore be considered as valid.

5.Project Design

5.1 Data Flow Diagrams & User Stories

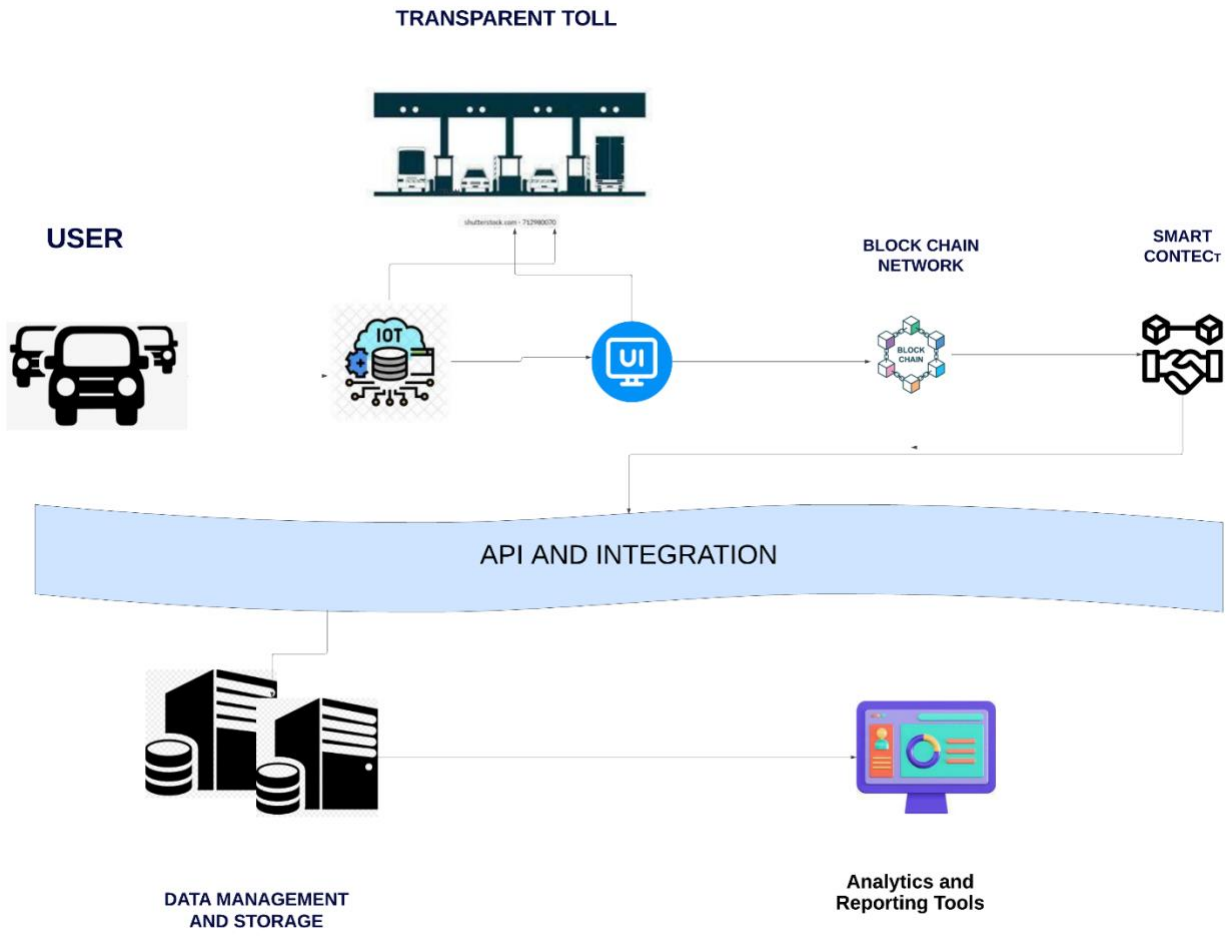
Data flow diagram


Start/Registration
User Identity Verification
Data Control
Data Encryption
Smart Contracts
Data Access and Sharing
Immutable Data Records
Tokenized Incentives
Data Revocation
Audit Trail
Dispute Resolution
Data Monetization
Data Portability
End

User Type	User Story Number	User type/task	Priority
Toll-free operator	USN-1	As a driver, I want a seamless experience when passing through toll booths without incurring charges.	High
	USN-2	As a government regulator, I need an unalterable record of toll-free transactions to ensure compliance.	High
	USN-3	As an auditing agency, I want efficient access to toll-free data for accurate audits.	High
	USN-4	As a privacy-conscious individual, I demand the highest level of data security for toll-free transactions.	High
	USN-5	As a frequent traveler, I require a straightforward process to verify my eligibility for toll-free passage.	Medium
Customer	USN-1	As a toll booth operator, I want an intuitive system to validate vehicles for toll-free passage.	High
	USN-2	As a toll booth operator, I need a secure blockchain solution to prevent fraudulent toll-free claims.	High
	USN-3	As a toll booth operator, I require a reliable and efficient way to record toll-free transactions.	Medium
	USN-4	As a toll booth operator, I should have access to a user-friendly interface for data management.	High

	USN-5	As a toll booth operator, I must maintain data accuracy and integrity while upholding user privacy.	Medium

5.2 Solution Architecture



6.Project Planning & Scheduling

6.1 Technical Architecture

TRANPARENT TOLL-FREE DATA MANAGEMENT

USER

Toll Payment Request

A user initiates a toll payment for a specific route.

Smart Contract Verification

A blockchain smart contract checks if the user has sufficient funds for the toll.

Transaction Recording

The successful toll payment is recorded on the blockchain for transparency.

User Confirmation

The user receives confirmation of a successful toll payment.

Consensus Validation

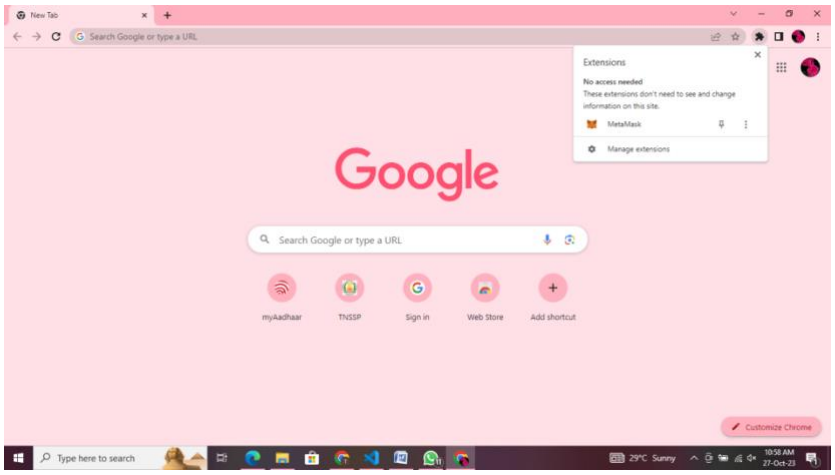
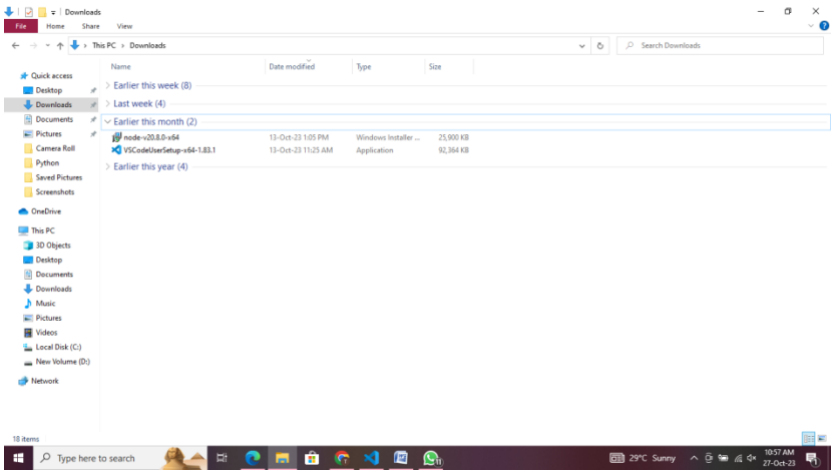
The blockchain's consensus mechanism validates the transaction for security.

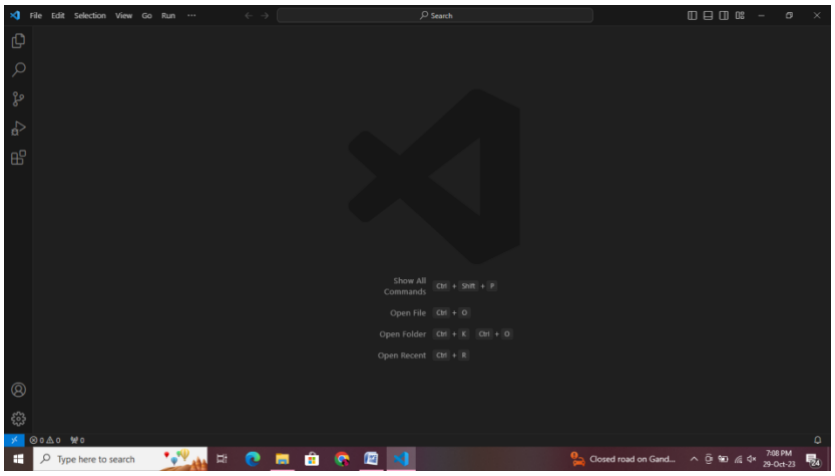
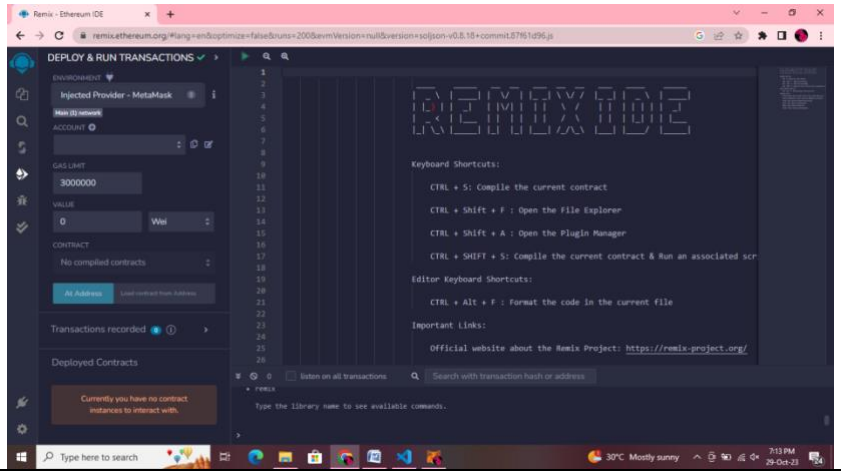
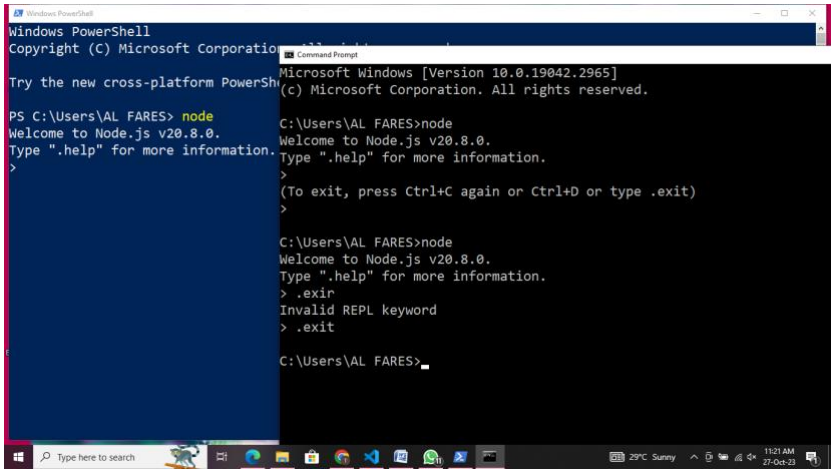
Transaction Settlement

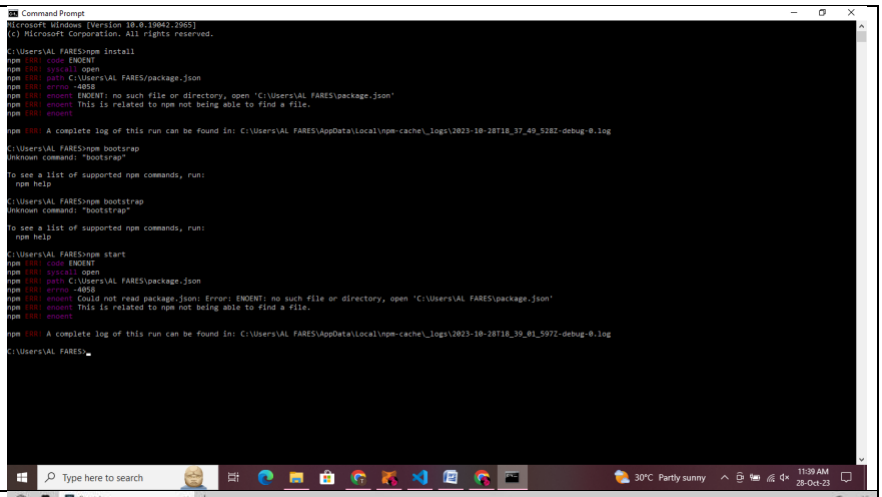
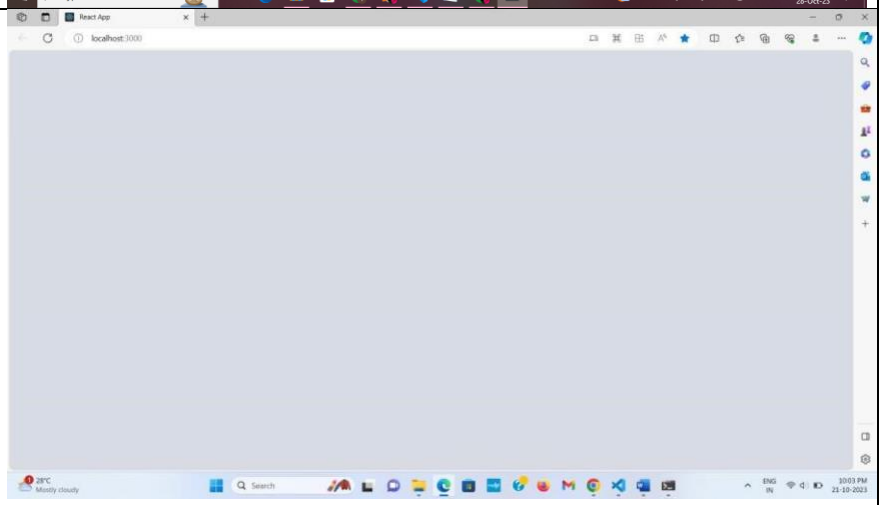
If the toll payment is valid, the user's account is debited, and the toll entity's account is credited.

7.Performance Testing

7.1 Performance Metrics

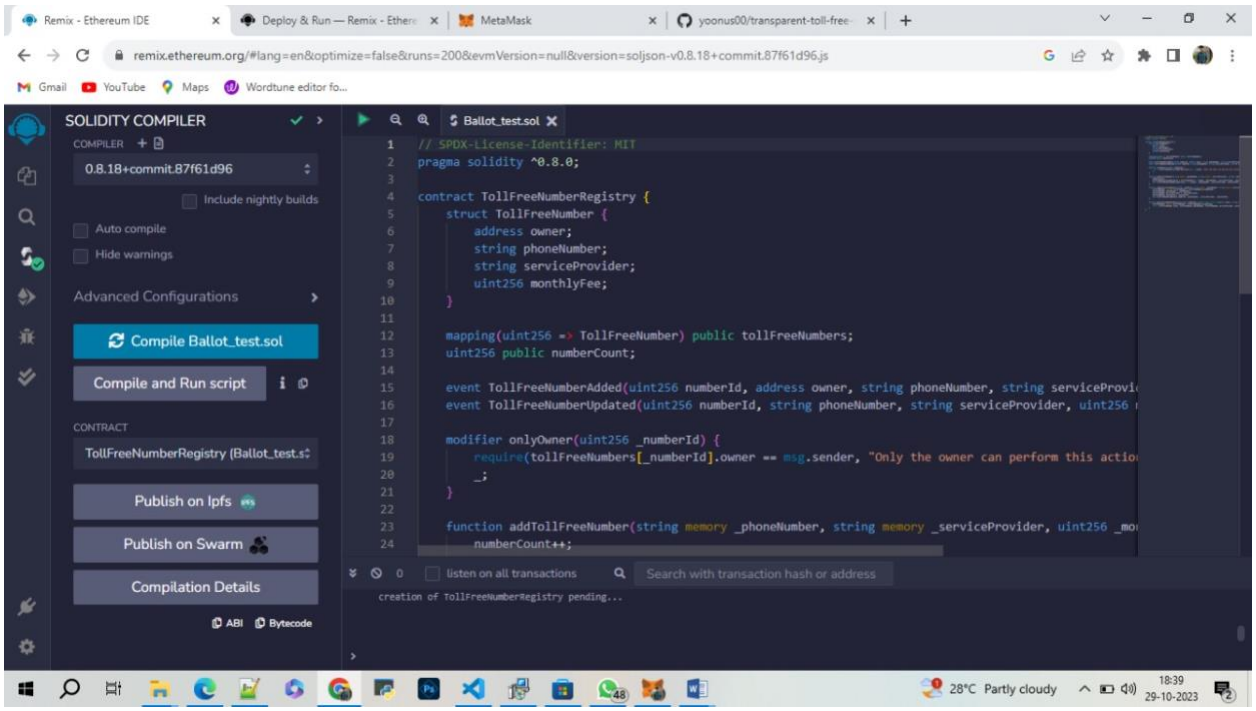
S.No	Parameter	Values	Screenshot
1	Information Gathering	Setup all the prerequisite	 Metamask  VS code & node js

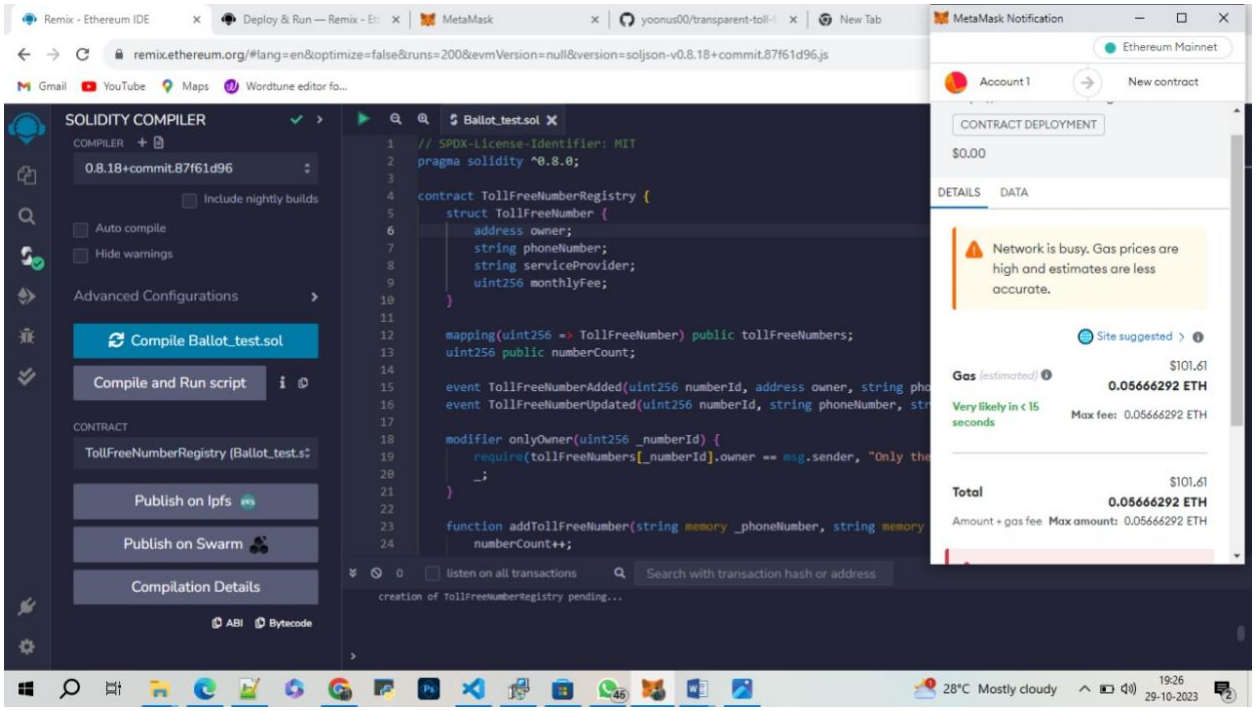
2	Extract the zip file	Open to vs code	
3.	Remix ide platform explorating	Deploy the smart contract code Deploy and run the transaction. By selecting the environmen t - inject the MetaMask.	
4	Open file explorer	Open the extracted file and click on the folder. Open src, and search for utiles. Open cmd enter commands 1.npm install 2.npm bootstrap 3. npm start	

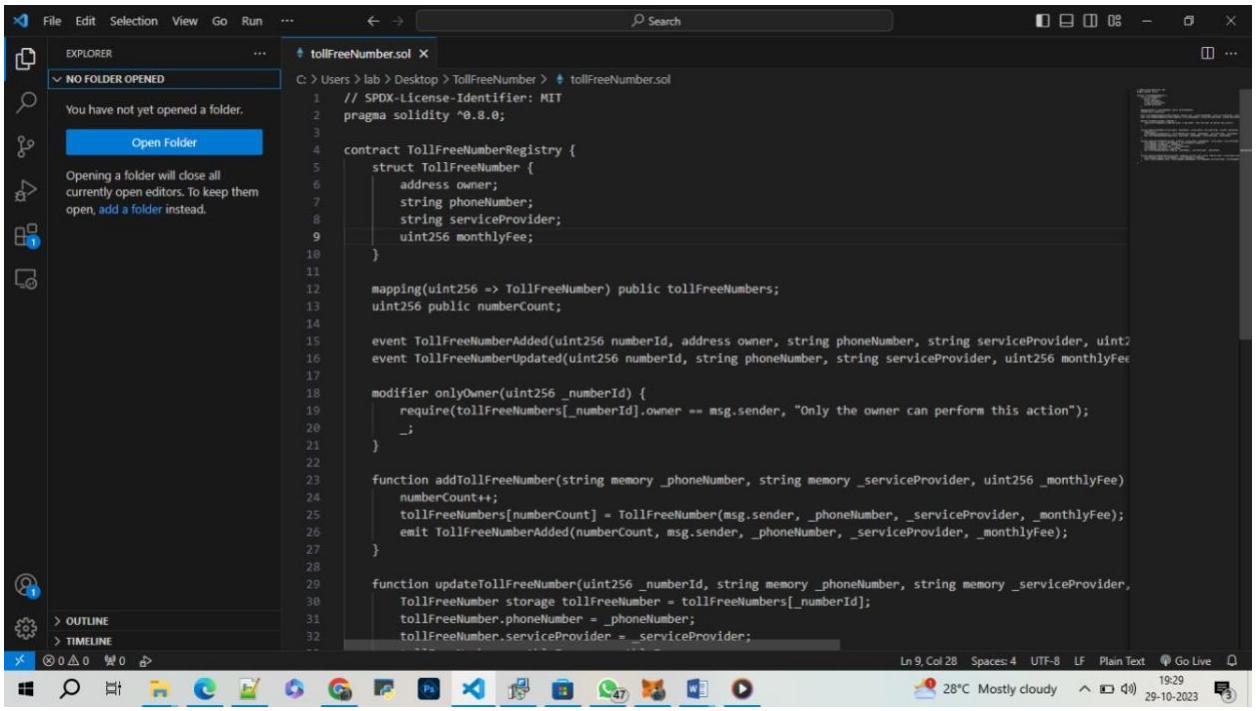
			
5	Local host IP address		

8.Results

8.1 Output screenshots


Remix - Ethereum IDE
Deploy & Run — Remix - Ethere
MetaMask
yoonus00/transparent-toll-free
remix.ethereum.org/#lang=en&optimize=false&runs=200&evmVersion=null&version=soljson-v0.8.18+commit.87f61d96.js
Gmail
YouTube
Maps
Wordtune editor fo...
SOLIDITY COMPILER
COMPILER
0.8.18+commit.87f61d96
Include nightly builds
Auto compile
Hide warnings
Advanced Configurations
Compile Ballot_test.sol
Compile and Run script
CONTRACT
TollFreeNumberRegistry (Ballot_test.s
Publish on Ipfs
Publish on Swarm
Compilation Details
ABI
Bytecode
Ballot_test.sol
// SPDX-License-Identifier: MIT
pragma solidity ^0.8.0;
contract TollFreeNumberRegistry {
struct TollFreeNumber {
address owner;
string phoneNumber;
string serviceProvider;
uint256 monthlyFee;
}
mapping(uint256 => TollFreeNumber) public tollFreeNumbers;
uint256 public numberCount;
event TollFreeNumberAdded(uint256 numberId, address owner, string phoneNumber, string serviceProvi
event TollFreeNumberUpdated(uint256 numberId, string phoneNumber, string serviceProvider, uint256
modifier onlyOwner(uint256 _numberId) {
require(tollFreeNumbers[_numberId].owner == msg.sender, "Only the owner can perform this actio
_;
}
function addTollFreeNumber(string memory _phoneNumber, string memory _serviceProvider, uint256 _mo
numberCount++;
listen on all transactions
Search with transaction hash or address
creation of TollFreeNumberRegistry pending...
28°C Partly cloudy
18:39
29-10-2023


Remix - Ethereum IDE
Deploy & Run — Remix - Et
MetaMask
yoonus00/transparent-toll-f
New Tab
remix.ethereum.org/#lang=en&optimize=false&runs=200&evmVersion=null&version=soljson-v0.8.18+commit.87f61d96.js
Gmail
YouTube
Maps
Wordtune editor fo...
SOLIDITY COMPILER
COMPILER
0.8.18+commit.87f61d96
Include nightly builds
Auto compile
Hide warnings
Advanced Configurations
Compile Ballot_test.sol
Compile and Run script
CONTRACT
TollFreeNumberRegistry (Ballot_test.s
Publish on Ipfs
Publish on Swarm
Compilation Details
ABI
Bytecode
Ballot_test.sol
// SPDX-License-Identifier: MIT
pragma solidity ^0.8.0;
contract TollFreeNumberRegistry {
struct TollFreeNumber {
address owner;
string phoneNumber;
string serviceProvider;
uint256 monthlyFee;
}
mapping(uint256 => TollFreeNumber) public tollFreeNumbers;
uint256 public numberCount;
event TollFreeNumberAdded(uint256 numberId, address owner, string pho
event TollFreeNumberUpdated(uint256 numberId, string phoneNumber, str
modifier onlyOwner(uint256 _numberId) {
require(tollFreeNumbers[_numberId].owner == msg.sender, "Only the
_;
}
function addTollFreeNumber(string memory _phoneNumber, string memory
numberCount++;
listen on all transactions
Search with transaction hash or address
creation of TollFreeNumberRegistry pending...
MetaMask Notification
Ethereum Mainnet
Account 1
New contract
CONTRACT DEPLOYMENT
$0.00
DETAILS
DATA
Network is busy. Gas prices are high and estimates are less accurate.
Site suggested
Gas (estimated)
$101.61
0.05666292 ETH
Very likely in < 15 seconds
Max fee: 0.05666292 ETH
Total
$101.61
0.05666292 ETH
Amount + gas fee
Max amount: 0.05666292 ETH
28°C Mostly cloudy
19:26
29-10-2023



9.Advantages & Disadvantages

Advantages:

- **Data Safety:** Blockchain ensures that once data is saved, it can't be changed or deleted, making toll-free data more trustworthy.
- **No Central Control:** It's not controlled by one company, which means it's less likely to be hacked and is more secure
- **Trust and Honesty:** Anyone can check the data to see if it's accurate, making people trust the toll-free system more.
- **Automatic Help:** Blockchain can automatically handle toll-free tasks, reducing mistakes and making things work faster.
- **Lower Costs:** It can make toll-free services cheaper for both companies and customers by cutting down on extra costs.

Disadvantages:

- **Hard to Start**: Getting everyone to use blockchain for toll-free data can be tricky, as it needs support and agreement from many different groups.
- **Unclear Rules:** There are still many unclear rules and laws for using blockchain in toll-free systems, which can be confusing for companies and government agencies.
- **Energy Waste:** Certain blockchains use a lot of energy, which is not good for the environment, especially in areas with lots of toll-free usage.

- **Hard to Start:** Getting everyone to use blockchain for toll-free data can be tricky, as it needs support and agreement from many different groups.
- **Privacy Concerns:** While blockchain is open, it can be tricky to protect private toll-free information. Extra technology may be needed to keep this data safe.

10.Conclusion

In conclusion, the implementation of blockchain technology for transparent toll-free data management offers significant promise in enhancing trust, security, and accountability in various sectors. By providing an immutable ledger and decentralized consensus mechanism, blockchain ensures that data related to toll-free services is securely recorded and accessible to all relevant parties. This transparency not only reduces the potential for fraud and errors but also fosters a more efficient and accountable system. As this technology continues to evolve and gain traction, it has the potential to revolutionize the way toll-free data is managed, ultimately leading to more seamless and trustworthy services for all stakeholders involved.

11.Future Scope

The future of transparent toll-free data management using blockchain technology looks really promising. This technology can make toll collection and data management much better. It offers a few key benefits. First, it makes everything more transparent, so you can trust that toll data is accurate and not tampered with. It also reduces the cost of managing tolls because it automates many tasks and eliminates the need for middlemen.

Security is another big advantage. Blockchain keeps toll data super safe from hackers and unauthorized access. Plus, it's decentralized, meaning there's no single point that can fail, making the system more reliable.Smart contracts in blockchain can automate toll payments, making it easier for vehicles to pay as they go through toll booths. It can work globally, making it convenient for travelers in different places. And the data it collects can be analyzed to improve traffic management.When combined with other technologies like IoT and AI, it can become even smarter. IoT sensors can track vehicles, and AI can help optimize toll booths.Blockchain also respects your privacy.

You can control your own data and who uses it. It's also good for the environment because it reduces the need for manual toll collection and helps traffic flow better, saving fuel and lowering emissions.It's also great for following the rules and regulations, which makes governments and toll operators happy. And because it's so transparent, people can trust that they're being charged fairly.In the end, blockchain is poised to transform toll collection and data management by making things more transparent, secure, and efficient. It benefits both the authorities and the public, and we can expect to see even more improvements as technology advances.

12.Appendix

Source code

```
// SPDX-License-Identifier: MIT

pragmasolidity^0.8.0;


contract TollFreeNumberRegistry {

   struct TollFreeNumber {

      address owner;

      string phoneNumber;

      string serviceProvider;

      uint256 monthlyFee;

   }


   mapping(uint256 => TollFreeNumber)public tollFreeNumbers;

   uint256public numberCount;


   event TollFreeNumberAdded(uint256 numberId,address owner,string phoneNumber,string
serviceProvider,uint256 monthlyFee);

   event TollFreeNumberUpdated(uint256 numberId,string phoneNumber,string serviceProvider,uint256
monthlyFee);


   modifier onlyOwner(uint256 _numberId){

require(tollFreeNumbers[_numberId].owner ==msg.sender,"Only the owner can perform this action");

      _;

   }
```

```
    function addTollFreeNumber(stringmemory _phoneNumber,stringmemory _serviceProvider,uint256
_monthlyFee)external{

        numberCount++;

        tollFreeNumbers[numberCount]= TollFreeNumber(msg.sender, _phoneNumber, _serviceProvider,
_monthlyFee);

        emit TollFreeNumberAdded(numberCount,msg.sender, _phoneNumber, _serviceProvider,
_monthlyFee);

    }


    function updateTollFreeNumber(uint256 _numberId,stringmemory _phoneNumber,stringmemory
_serviceProvider,uint256 _monthlyFee)external onlyOwner(_numberId){

        TollFreeNumber storage tollFreeNumber = tollFreeNumbers[_numberId];

        tollFreeNumber.phoneNumber = _phoneNumber;

        tollFreeNumber.serviceProvider = _serviceProvider;

        tollFreeNumber.monthlyFee = _monthlyFee;

        emit TollFreeNumberUpdated(_numberId, _phoneNumber, _serviceProvider, _monthlyFee);

    }


    function getTollFreeNumberDetails(uint256 _numberId)externalviewreturns(address
owner,stringmemory phoneNumber,stringmemory serviceProvider,uint256 monthlyFee){

        TollFreeNumber memory tollFreeNumber = tollFreeNumbers[_numberId];

return(tollFreeNumber.owner, tollFreeNumber.phoneNumber, tollFreeNumber.serviceProvider,
tollFreeNumber.monthlyFee);

    }

}
```

GitHub link

https://github.com/yoonus00/transparent-toll-free-.git

Project Demo link

https://drive.google.com/file/d/1iGkHTy0giSmm_PfiLQ3DOCJF36-xtvbh/view?usp=drive_link