IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 11, Issue 7, July 2023

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.379

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 |

|| Volume 11, Issue 7, July 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1107020 |

Blockchain based Peer to Peer Carpooling

Prof. Deepali Jawale, Snehal Ghule, Gaurav Ghyar, Rohit Shigvan

Professor, Dept. of Computer Engineering, DYPIEMR, SPPU, Pune, India

UG Student, Dept. of Computer Engineering, DYPIEMR, SPPU, Pune, India

UG Student, Dept. of Computer Engineering, DYPIEMR, SPPU, Pune, India

UG Student, Dept. of Computer Engineering, DYPIEMR, SPPU, Pune, India

UG Student, Dept. of Computer Engineering, DYPIEMR, SPPU, Pune, India

ABSTRACT: The peer-to-peer carpooling system is a revolutionary solution to transportation issues, providing a cost-effective and eco-friendly alternative to traditional modes of transport. However, trust and transparency are major concerns in peer-to-peer transactions. Our project addresses these concerns by implementing a blockchain-based carpooling system that ensures secure and transparent transactions. The use of blockchain technology allows for decentralized management and tracking of carpooling activities, ensuring the authenticity and immutability of data. The system uses smart contracts to enable automatic payments, reducing the need for intermediaries and providing a faster and more efficient service. Our project aims to provide a safe, reliable, and sustainable solution to transportation issues, while also promoting the use of blockchain technology in the transportation industry

KEYWORDS: Carpooling**,** MetaMask, Blockchain, Tracking, Sepolia, Authentication, Carbon emissions, Car sharing, Security

I. INTRODUCTION

Car sharing is becoming increasingly popular in urban areas to reduce traffic congestion and air pollution. By sharing a car, fewer cars are on the road, which can help reduce traffic and greenhouse gas emissions [1]. Car-sharing companies such as car2go, Zipcar, and others provide users with access to vehicles for short periods of time, allowing them to use a car only when they need it, rather than owning one themselves [4]. Car sharing has several benefits, including reducing the number of cars on the road, promoting more sustainable transportation options, and reducing greenhouse gas emissions. Additionally, car sharing can be an affordable and convenient option for individuals who do not want the hassle or expense of owning a car. However, some people
may not be comfortable sharing a car with a stranger or may prefer the privacy of owning their own car. Additionally, car sharing services typically require users to pay a membership fee and hourly or daily rates, which may not be cost-effective for everyone. Overall, car sharing can be a great way to promote sustainable transportation and reduce the environmental impact of transportation. However, it is important to consider the individual preferences and needs of users when implementing car sharing programs. Additionally, transitioning to electric or hybrid vehicles for car sharing services can further reduce the environmental impact of transportation [2].

The use of blockchain technology in car sharing can address some of the security concerns associated with centralized car-sharing systems. By using a decentralized, immutable, and public ledger, blockchain technology provides increased security and transparency, making it difficult for hackers to attack the system or for car owners to misuse customer data. In a blockchain-based car-sharing system, the use of smart contracts can help to automate the rental process and ensure that all transactions are transparent and secure. Smart contracts are self-executing contracts with the terms of the agreement between buyer and seller being directly written into lines of code. This can help to reduce costs associated with intermediaries, and increase efficiency. The use of tokens in a blockchain-based car-sharing system can also help to facilitate transactions and enable business-to-business (B2B) and business-to-customer (B2C) use cases. For example, tokens can be used to pay for car rentals, track usage, and provide incentives for car owners to participate in the system [3],[5]. In these car-sharing models involve a service provider serving as an intermediary and supplying the tools necessary to facilitate the exchange, such as an online platform and customer assistance [6]. In a conventional car-sharing system, a centralized service server can store and manage user data as well as service data. A centralized server, however, is vulnerable to a hostile attacker's single point of failure. For instance, if the service server is compromised and all the sharing records are erased, the user won't be able to access the earlier data related to the information about the used cars when something is missing from the cars. Additionally, if the user engaged in fraudulent activity during

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 |

|| Volume 11, Issue 7, July 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1107020 |

car-sharing, or if the sharing records are altered. Finding the user's evidence of a crime from these recordings is challenging.

Additionally, if the information that has been stored has been compromised, it poses a major risk to user privacy. Therefore, the aforementioned issues brought on by a centralized organization must be addressed. A chain of transactions is maintained and established using the blockchain technology, which is linked by hash values. To tackle the a forementioned issue, blockchain is regarded as a reliable distributed ledger that enables the decentralization and integrity of information. A blockchain system's tamperproof and traceable features guarantee the auditability of data operation, hence guaranteeing data security. In order to ensure security, integrity, and decentralization, this study suggests a decentralized car-sharing system model and a secure authentication mechanism using blockchain.

II. LITERATURE SURVEY

1. Design of Secure Decentralized Car-Sharing System Using Blockchain. By giving people access to shared vehicles and limiting the use of private vehicles, car-sharing programs can help with a number of urban challenges. People can now simply use a shared car by performing basic operations on their mobile devices thanks to the growth of the Internet of Things. However, there are security issues with the car-sharing program.

2. Blockchain Based Car-Sharing Platform. The market for automobile sharing is constantly expanding, and lately it surpassed private auto ownership in popularity. The centralized database server that the traditional car-sharing system is based on, however, frequently invites hacker assaults or password breaches. Additionally, under a traditional car-sharing scheme, the proprietors of the vehicles may abuse client information. The ideal way to resolve these challenging problems, as demonstrated in today's many application cases, is to leverage blockchain technology.

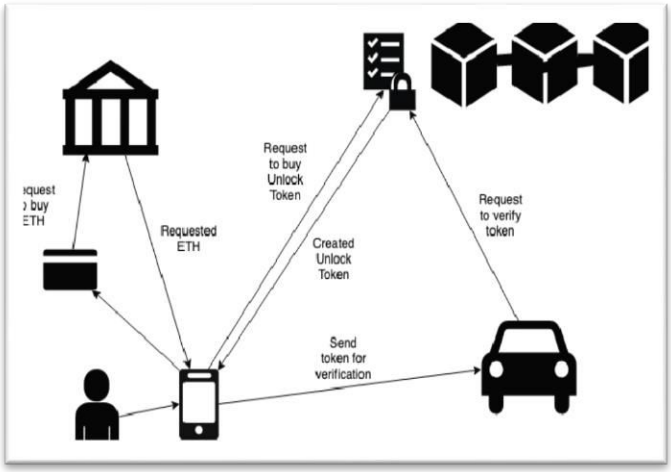

Fig.1. Existing system

3. Car-sharing services: An annotated review. Private mobility is changing from ownership to service use as a result of the expansion of car-sharing services as a fresh and environmentally friendly mode of transportation. To the best of the authors' knowledge, no thorough and organized analysis has been carried out to classify the research and identify the mainstreams, despite the growing importance of this kind of mobility and the substantial number of publications existing in the scientific literature.

4. Analyzing the effects of car sharing services on the reduction of greenhouse gas (GHG) emissions. By examining travel behaviours, this study investigates the environmental effects of roundtrip vehicle sharing services. Car sharing should help reduce greenhouse gas GHG emissions; however, such programmes have both positive and negative environmental effects, including: (1) reduced CO2e (carbon dioxide equivalent) from substituting more fuel-efficient car sharing vehicles for private vehicle use, (2) increased CO2e as car-less people switch from public transportation to car sharing vehicles, and (3) reduced CO2e due to fewer vehicles.

5. A blockchain framework for securing connected and autonomous vehicles. Recently, connected vehicles (CV) are becoming a promising research area leading to the concept of CV as a Service (CVaaS). With the increase of connected

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 |

|| Volume 11, Issue 7, July 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1107020 |

vehicles and an exponential growth in the field of online cab booking services, new requirements such as secure, seamless and robust information exchange among vehicles of vehicular networks are emerging. In this context, the original concept of vehicular networks is being transformed into a new concept known as connected and autonomous vehicles. Autonomous vehicular use yields a better experience and helps in reducing congestion by allowing current information to be obtained by the vehicles instantly. However, malicious users in the internet of vehicles may mislead the whole communication where intruders may compromise smart devices with the purpose of executing a malicious ploy. In order to prevent these issues, a blockchain technique is considered the best technique that provides secrecy and protection to the control system in real time conditions.

6. Management and Monitoring of IoT Devices Using Blockchain In this paper, a private blockchain-based better administration and monitoring architecture for IoT devices is presented. The majority of their system is based on chain code, which manages access control, encryption, and CRUD (Create, Read, Update, Delete) operations. The blockchain stores configuration files for hardware. When a change is made, the device quickly downloads a new configuration. If setup was successful, the chain code is notified, and administrators can see this history. Results from systems demonstrate that such a system is feasible, and the blockchain can secure the distribution of configuration changes to IoT devices.

7. Blockchain: A Potential Disruptor in Car Rental and Leasing Industry. The demand for easy mobility and advancing transportation technology are driving a global expansion of the car rental and leasing industries. The rise of the automobile rental and leasing businesses is being driven by a movement in consumer demand away from car ownership and towards car sharing (which should not be confused with ride-sharing services like Uber or Lyft). The procedure of renting a car is heavily centralised, with the automobile rental agency serving as the driver's primary point of contact. The majority of a car rental company's operating expenses go towards maintaining a fleet of vehicles, as well as car stations, employees, and personnel. These expenses are covered by the (high) rental charges that car rental businesses charge their clients.

III. PROBLEM STATEMENT

The inflation in the trend of using personal vehicles for every movement involved in day-to-day life has been created an alarming condition for traffic management systems worldwide. One man one car keeps the other seats unoccupied and unused increasing the traffic volume. To reduce the congestion, car sharing is only option. Thus, the problem of traffic congestion is reduced to the problem of car sharing. The suggested system is a carpooling application built on the blockchain that enables users to find other users for carpooling or sharing.

IV. BLOCKCHAIN TECHNOLOGIES

4.1] Blockchain: The distributed ledger known as blockchain provides decentralisation, integrity, and tamper resistance. Three types of blockchain exist: consortium, private, and public (both of which are permissioned). Public blockchain is also known as permissionless blockchain[16],[17]. Every node on a public blockchain maintains the ledgers, takes part in the consensus, and has access to read and write data. As a result, finding a consensus soon becomes difficult and incurs hefty maintenance expenses. Additionally, any node on the public blockchain can simply join or leave the network without authorization, making it simple for an adversary to do so. In light of the fact that the privacy of users is tied to the car-sharing data, a public blockchain is inappropriate for use in a car-sharing system. On the other hand, with a consortium blockchain and private blockchain, only authorised nodes can access the blockchain. An authorised organisation controls a private blockchain, which has centralised features [18]. A consortium blockchain, on the other hand, is run by an authorised group and is largely private, with efficient consensus time and maintenance expenses. Therefore, a car-sharing system was suggested using a consortium blockchain.

4.2] Sepolia testnet: One of the most well-known proof-of-stake (PoS) testnet for Ethereum is the Sepolia testnet. Since client developers currently maintain Sepolia, it is a safe and dependable test environment.
Sepolia-based transactions require gas, which is Sepolia testnet ETH. So you need tokens to do transactions on this testnet. Thankfully, a tap will grant you free Sepolia testnet ETH! To continue, you must first add your wallet to the Sepolia testnet network.

4.3] MetaMask: MetaMask is a software cryptocurrency wallet used to interact with the Ethereum blockchain. It enables users to utilize a browser extension or mobile app to access their Ethereum wallet, which can subsequently be used to connect with decentralized applications. With MetaMask, users may send and receive Ethereum-based

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 |

|| Volume 11, Issue 7, July 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1107020 |

cryptocurrencies and tokens, broadcast transactions, store and manage account keys, and securely connect to decentralized applications using a suitable web browser or the built-in browser of the mobile app.

A user's MetaMask wallet (and any other similar blockchain wallet browser extensions) can be connected to, authenticated, and/or integrated with other smart contract functionality by websites or other decentralized applications using JavaScript code. This enables the website to send action prompts, signature requests, or transaction requests to the user through MetaMask as an intermediary.

V. PROPOSED SYSTEM

Our suggested system has the capacity to identify users looking to travel to a common destination or a stopover. Therefore, in order to encourage the general public to use ride sharing, a system that carefully ensures ride fairness, payment fairness, user privacy, and Safety feature for rides must be established. The proposed solution aims to develop and put into use a peer-to-peer short-term car-sharing application based on blockchain and smart contracts. It also introduces a tracking feature for safety purposes; tracking of rides will be done if the user has enabled the feature after booking the ride. The ride will be tracked down by the user's point of contact.

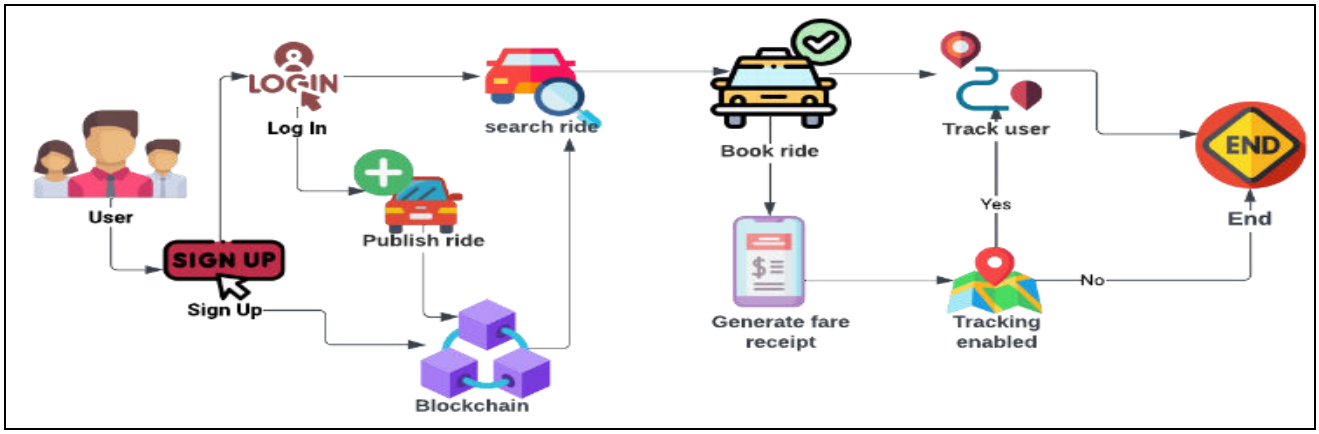

Fig.2. Proposed system architecture

The system is composed of three main components:
Sepolia(test network), ReactJS, and MetaMask. Hardhat is used to create a local blockchain, which generates 20 dummy accounts with private keys. These accounts are imported into MetaMask during account creation. MetaMask is a free, open-source blockchain wallet that is responsible for the login/signup process. Once logged in, users can fill out detailed information about their accounts, which will then be reflected on their profiles. For the carpooling project, users have two options: search/book a ride or publish a ride. When searching for a ride, users input their desired route and available rides will appear on the desktop. Users can then select a ride and book it. When publishing a ride, users create their own ride by selecting their route and setting the fare. These rides will appear for other users searching for the same route. All of these procedures take place on a
test network, which is powered by the local blockchain created by Sepolia. This is the overall process for carpooling on the system.

VI. ARCHITECTURE

The system consists of three main components: the front-end application, the Ethereum blockchain, and the IPFS storage network.

1. Front-end application: This component provides the interface through which car owners/driver and passenger interact with the system. The front-end application is responsible for managing user authentication through MetaMask, publishing rides, searching rides and tracking rides when tracking is enabled. The application is built using modern web technologies such as React.js, and communicates with the Ethereum blockchain using the Web3.js library.

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 |

|| Volume 11, Issue 7, July 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1107020 |

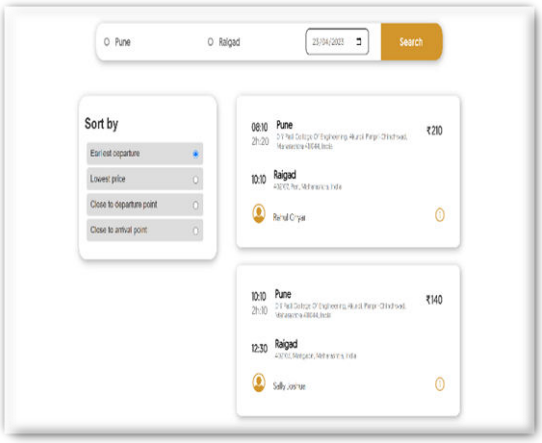

Fig.3. Carpool system

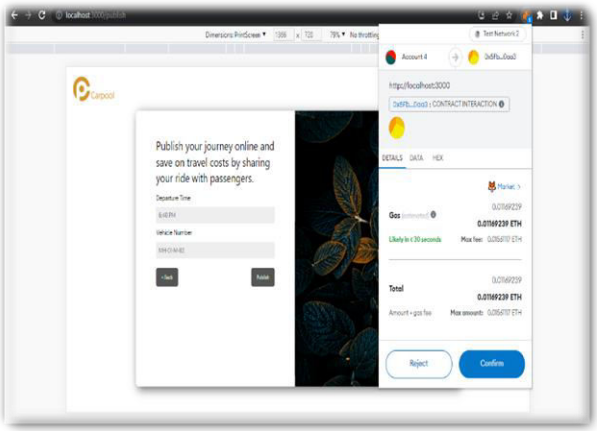

Fig.4 Publishing ride through metamask

2. MetaMask: This component allows user to Sign up and login using their MetaMask account. MetaMask is responsible for authentication of user. Users can sign up and log in to the ride-booking application using their MetaMask account. When signing up, the application may request permission to access the user's Ethereum address or other necessary information stored in their MetaMask wallet. This allows the application to associate the user's account with their MetaMask identity.
3. Backend using Blockchain: This component allows system to store the data. Blockchain technology is a decentralized and distributed ledger that records transactions across multiple computers or nodes. Each transaction is bundled together into a block, which contains a unique cryptographic hash that represents the data within the block. One of the fundamental features of blockchain is its immutability. Once a block is added to the blockchain, it becomes extremely difficult to alter or tamper with the data within it. The cryptographic hash serves as a unique identifier for the block, and any change made to the data would result in a different hash value. This makes it easy to detect any unauthorized modifications to the stored data. In a blockchain, data is stored in a decentralized manner across multiple nodes or computers participating in the network. Each node maintains a copy of the entire blockchain, ensuring redundancy and enhancing security. The distributed nature of blockchain makes it difficult for a single party or a third party to manipulate or corrupt the data, as it would require controlling a majority of the network's computing power.

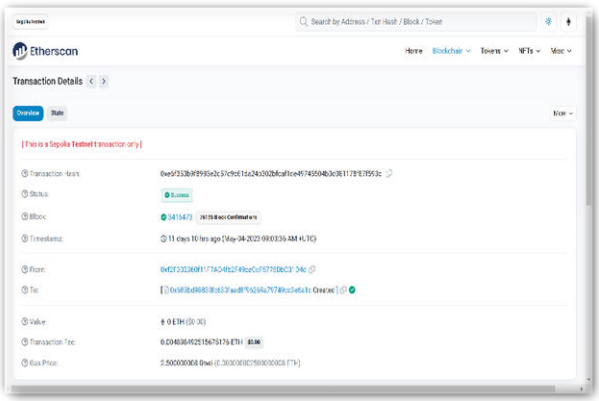

Fig.5. Etherscan - Deployed contract

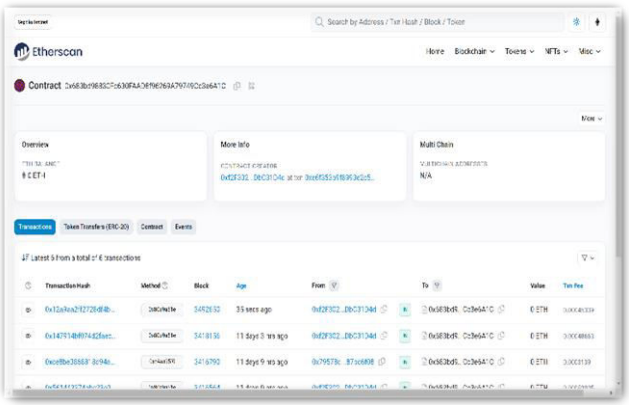

Fig.6. Deployed Contract Transaction Details

When the user first visits the website, the MetaMask is invoked to establish a connection with the network and the account of the user.

Once the MetaMask account is connected the user can click on the login option at the top right hand corner of the screen to fetch details of he's account from the blockchain if he is already registered, else the user is redirected to a new page to register himself on the blockchain. Within this registration the user can add he's first name, last name, phone number and enable tracking options.The connection with the contract is established using ethers.js library.

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 |

|| Volume 11, Issue 7, July 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1107020 |

The term "contract address" describes the location of a group of executable pieces of code on the Ethereum blockchain. When a transaction with related input data (a contract interaction) is made to a contract address, several functions are carried out. And a set of Fragments known as an Application Binary Interface (ABI) defines how to communicate with different Contract components. An interface aids in categorising Fragments and offers the functionality needed to encrypt, decrypt, and interact with each component. A Provider is an abstraction of a connection to the Ethereum network that offers a clear, standardised interface to the capabilities of a normal Ethereum node.

A contract object is created using the ethers library. This contract object acts as an API to interact with the blockchain. All the public elements of the contract can be accessed through this contract. One such function and one of the core functions is the searchRide() function, which is called when a user performs a search for a ride. The function is written in solidity and is accessed in React.js/JavaScript as: "contract.searchRide(finalKey);". Here we are calling the searchRide() function and passing it "finalKey" which is nothing but a string of departure city, destination city and date.

searchRide() function:

```
function searchRide(string memory _depDesCity) public view returns(Ride[] memory){
      uint256 rideLength = SearchRideList[_depDesCity].length;
      Ride[] memory _rides = new Ride[](rideLength);

      for(uint i = 0; i < rideLength; i++){
          _rides[i] = Rides[SearchRideList[_depDesCity][i]];
      }

      return _rides;
  }
```

The above function takes '_depDesCity' as a parameter. '_depDesCity' as mentioned before 'depDesCity' is nothing but "finalKey" which is a string variable that contains the departure city, destination city and departure date of the published ride.

The function returns an object that is a list of rides that travel from specified departure location to destination location and date. These three components are strings that are separated by a minus sign '–'. This can be understood with an example, following is an example of mapping key to search a ride from city 'Pune' to city 'Mumbai' on date June 24 2023:
"Pune-Mumbai-24/06/2024". This key is then used as a mapping key to find the ride ids from the SearchRideList.

SearchRideList is a mapping object in solidity. Mapping in Solidity acts like a hash table or dictionary in any other language. These are used to store the data in the form of key-value pairs, a key can be any of the built-in data types but reference types are not allowed while the value can be of any type. SearchRideList in our project is a mapping of string key to a list of IDs. These IDs are used to identify rides.

'Ride' is another key component of the project; it is a struct that holds all the necessary information related to a ride. Structs in Solidity allows use to create more complicated data types that have multiple properties. A mapping of these 'Ride' object is maintained as 'Rides' where the key of the mapping is the id of the ride.

The Ride struct is made up of fifteen variables one of which is an array of public key of passengers. Following is a list of these variables: uint256 id, uint256 rideHost, string depAddress, string desAddress, string depCity, string desCity, uint8 numberOfSeats, string depTime, uint32 fare, string rideHostName, uint64 rideHostPhone, string hostVehicleName, string hostVehicleNumber, string date, uint256[] passengers. Functions of each of these variables can be understood by their names. In solidity a uint data type is an unsigned integer and 'uint[]' is an array of unsigned integers.

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 |

|| Volume 11, Issue 7, July 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1107020 |

The "SearchRide()" function is a view function which means that it is used to view the blockchain, no transaction is invoked and no funds are required. This allows us to use heavy functionalities like for loops within the function as the processing is done on the user node i.e., User's machine.

The received list is then rendered as a list of cards that represent individual rides.

Once a user finds a ride to be booked, they can simply click on the ride card and a new page with additional details about the ride and a button to book the ride would open. When the user is done with verifying the details, they can book the ride by clicking the book ride button. On clicking the book ride button the bookRide() function of the contract is called and a transaction is invoked as we are performing changes to the state of the blockchain. If the user accepts the transaction a message conforming the booked ride is displayed along with the departure address and the destination address.

After successfully booking the ride, if the user is a minor or a lady, they can use the tracking feature by enabling it. This feature provides extra security to the user; it lets the user's point of contact track the user.

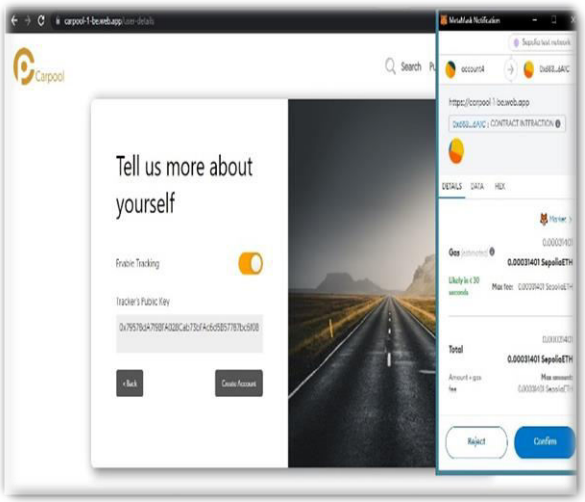

Fig.6.Enabling tracking

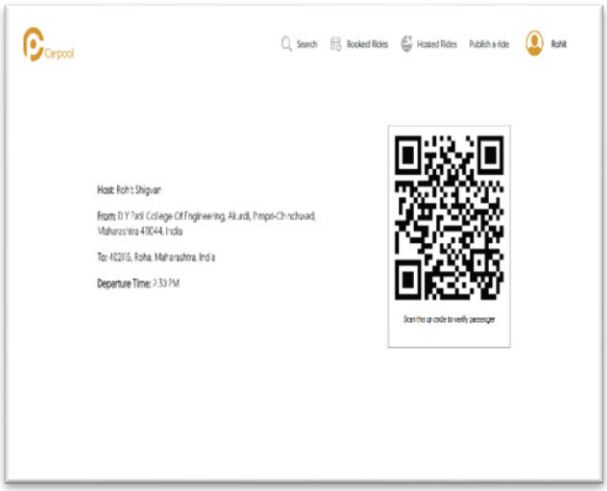

Fig.7.View QR code

If the user has booked a ride an option to view booked rides appears at the top right corner from where they can view all the booked rides. A QR code is generated for all the booked rides, which can be used for verification.
Similarly, a host can view all of their published rides through the 'Hosted Rides' option that appears after publishing their first ride. This also provides the host/publisher a feature to scan a QR code that is specifically created by the passenger of their rides. This way a passenger can be verified at the point of first meet up.

If a user has linked their account to another for tracking, they can view the name and public key of the user that they are tracking by clicking on their profile. They can also enable and disable tracking of the linked account. If the user enables tracking, an option to view the current location of the linked account is displayed as 'Tracking' at the top right position on screen. Once the user clicks on the option, they are taken to a new page where they can view the current location of the linked user. The location updates at an interval of five second.

VII. ADVANTAGES

Here are some potential advantages of our proposed Blockchain based peer to peer carpooling system:

1. Cut back on carbon emissions: Reducing carbon emissions is crucial for mitigating the impacts of climate change. Carpooling reduces carbon emissions as the number of cars will be reduced too.
2. Reduce cost of travel: Carpooling reduces the cost of travel as the fare gets distributed among all the passengers. And this makes carpooling pocket-friendly for middle-class people.

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 |

|| Volume 11, Issue 7, July 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1107020 |

3. Safe for use as it has tracking feature: Travelling alone for minors and women becomes safer and more secure due to the tracking feature, as the ride will be monitored until it reaches its destination.
4. Lessen the volume of traffic: Carpooling is an effective strategy to reduce traffic volume by encouraging multiple people to share a single vehicle for their commutes or trips. Carpooling allows multiple individuals travelling in the same direction to share a ride in one vehicle instead of using separate cars. This reduces the overall number of vehicles on the road, leading to decreased traffic congestion.

VIII. CONCLUSION

Our peer-to-peer carpooling system gives a promising solution to many transportation issues. By leveraging blockchain technology and MetaMask for login, we provide a secure and decentralized platform that enables reliable and affordable transportation. The live location tracking ensures safety and security, which is a crucial factor in ride-sharing. Additionally, the use of blockchain technology creates a tamper-proof and transparent record of all transactions, which promotes trust and transparency in the system. our system also has the potential to reduce the number of cars on the road, which would decrease carbon emissions and alleviate traffic congestion. The incentives for participation and user-friendly interface should encourage more people to use the platform, creating a more equitable and sustainable transportation ecosystem for everyone.

Overall, our peer-to-peer carpooling system has many benefits, and it could be a game-changer in the transportation industry. By combining the power of blockchain technology and MetaMask, we provide a secure, reliable, and affordable transportation solution that can benefit both the environment and users alike.

IX. FUTURE SCOPE

The future scope of a blockchain-based peer-to-peer carpooling system is quite promising. Here are some potential benefits and opportunities:
1. Enhanced security and trust: Blockchain technology can improve security and trust in carpooling programs. All transactional information and ride history are stored on a decentralized, immutable ledger, making it challenging for participants to modify or change the records. Users' trust can be increased and fraudulent activity can be decreased because to this openness.

2. Decentralization and autonomy: A blockchain-based carpooling system can be built to function in a decentralized fashion, enabling users to interact and transact with one another directly without depending on a central authority. Decentralization can promote autonomy, give users more control, and do away with the necessity for a middleman.

3. Enhanced data privacy: Sharing personal information in carpooling systems is frequently linked to privacy problems. Users can have more control over their data via blockchain. As the data is dispersed across the network and encrypted, it becomes more secure against unauthorized access. Users can choose to transmit only the information essential for ride-sharing reasons.

4. Integration with other services: A carpooling system based on blockchain can be easily connected with other mobility and transportation services. It might be connected to ride-hailing services, public transportation networks, or even smart city initiatives. Users may benefit from a full and practical mobility experience thanks to this integration.

5. Carpooling programs' natural goal is to lessen the number of automobiles on the road, which has a favorable effect on the environment. By streamlining routes, effectively connecting riders, and promoting a sharing economy mentality, blockchain technology can improve this even more. As a result, there will likely be less traffic congestion, fewer carbon emissions, and better air quality.

REFERENCES

1. Myeonghyun Kim, Joonyoung Lee, Kisung Park,Yohan Park, Kil Houm Park andYoungho Park,(Member,IEEE)“Design_of_Secure_Decentralized_Car-Sharing_System_Using_Blockchain” , March 29, 2021,
2. D. Rojas-Rueda, A. de Nazelle, O. Teixidó, and M. Nieuwenhuijsen, “Replacing car trips by increasing bike and public transport in the greater Barcelona metropolitan area: A health impact assessment study,” Environment International, vol. 49, pp. 100–109, nov 2012.

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 |

|| Volume 11, Issue 7, July 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1107020 |

3. Viktor Valaštín, Kristián Košt'ál, Rastislav Bencel, Ivan Kotuliak, "Blockchain based car-Sharing platform"
4. G. H. D. A. Correia, D. R. Jorge, and D. M. Antunes, ''The added value of accounting for users' flexibility and information on the potential of a station-based one-way car-sharing system: An application in Lisbon, Portugal,'' J. Intell. Transp. Syst., vol. 18, no. 3, pp. 299–308, Jul. 2014.
5. K. Münzel, L. Piscicelli, W. Boon, and K. Frenken, ''Different business models–different users? Uncovering the motives and characteristics of business-to-consumer and peer-to-peer carsharing adopters in The Netherlands,'' Transp. Res. D, Transp. Environ., vol. 73, pp. 276–306, Aug. 2019.
6. S. Shaheen, N. Chan, A. Bansal, and A. Cohen, ''Shared mobility: A sustainability & technologies workshop: Definitions, industry developments, and early understanding,'' Tech. Rep., 2015 https://www.apriorit.com/dev-blog/733-blockchain-implement-blockchain-in-car-sharing-service-using-the-cosmos-network
7. J. Jung and Y. Koo, ''Analyzing the effects of car sharing services on the reduction of greenhouse gas (GHG) emissions,'' Sustainability, vol. 10, no. 2, p. 539, Feb. 2018.
8. F. Ferrero, G. Perboli, M. Rosano, and A. Vesco, ''Car-sharing services: An annotated review,'' Sustain. Cities Soc., vol. 37, pp. 501–518, Feb. 2018.
9. P. W. Wadhwani and P. Saha, ''Car sharing market size by model (P2P, station-based, free-floating), by business model (round trip, one way), by application (business, private), industry analysis report, regional outlook, application potential, price trend, competitive market share & forecast, 2020–2026,'' Global Market Insights, Pune, India, Tech. Rep., Apr. 2020. [Online]. Available: https://www.gminsights.com/industryanalysis/carsharing-market
10. T. Donna Chen , Kara M. Kockelman,"Carsharing's life-cycle impacts on energy use and greenhouse gas emissions" Transp. Res. Part D Transp. Environ.(2016)
11. Getaround, "Getaround - Peer-to-peer car sharing and local car rental." Accessed: 2019-02-24.
12. Sarvesh Wadi, Mrunal Shidore, Malhar Surangalikar, Devarshi Talewar, Vedant Savalajkar
13. "P2P Ride-Sharing using Blockchain Technology", September 2022)
14. FFQuest, "FFQuest - Blockchain marketplace for Car rental, Ride-sharing and Parking." Accessed: 2019-04-1
15. K. Košt'ál, P. Helebrandt, M. Belluš, M. Ries, and I. Kotuliak, "Management and Monitoring of IoT Devices Using Blockchain," Sensors, vol. 19, p. 856, feb 2019. J.
16. . Z. Zheng, S. Xie, H. Dai, X. Chen, and H. Wang, ''An overview of blockchain technology: Architecture, consensus, and future trends,'' in Proc. IEEE Int. Congr. Big Data, Honolulu, HI, USA, Jun. 2017, pp. 557–564.
17. J. Xie, H. Tang, T. Huang, F. R. Yu, R. Xie, J. Liu, and Y. Liu, ''A survey of blockchain technology applied to smart cities: Research issues and challenges,'' IEEE Commun. Surveys Tuts., vol. 21, no. 3, pp. 2794–2830, 3rd Quart., 2019
18. S. Son, J. Lee, M. Kim, S. Yu, A. K. Das, and Y. Park, ''Design of secure authentication protocol for cloud-assisted telecare medical information system using blockchain,'' IEEE Access, vol. 8, pp. 192177–192191, Oct. 2020.

INNO SPACE
SJIF Scientific Journal Impact Factor

Impact Factor: 8.379

doi cross ref

ISSN INTERNATIONAL STANDARD SERIAL NUMBER INDIA

निस्केयर NISCAIR

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

9940 572 462 6381 907 438 ijircce@gmail.com

www.ijircce.com

Scan to save the contact details